Interactions between the Internal Dynamics of Organisations and their Operations in Markets

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Contents

Introduction

The past century saw five great merger waves—one at its beginning, and successive waves at the ends of the 1920s, 1960s, 1980s and 1990s. While much of the earlier merger activity was confined to North America and Great Britain, the most recent wave has engulfed all of the major industrial countries of the world. And, as suits a global economy, it has been composed of an increasing percentage of cross-border mergers.

Being such an important phenomenon in the economy, transforming industries and affecting the careers of millions, merger and industry dynamics are being very often discussed by policy makers and academics. But mergers are complex events for which we have incomplete understanding and of which we do not know all its consequences, in part because researchers tend to only look at partial explanations of them.

That is the aim of this thesis -broadening the reach of economic research on mergers and industry dynamics, pointing out that mergers are not only done because of firms' needs and do not only create effects in firms' markets. Indeed, dynamics are largely driven by managers and have their impact on employees. There is human life inside the black box. We have created some situations were internal functioning and external operating of firms interact.

The first chapter claims that if employees in a firm block law reforms that could hurt them, then intervening also in the way how firms should compete in their markets may create positive effects for employees, making them in the end to agree on reforms. Combining reforms creates positive externalites, which if well used can lower resisitance for necessary changes. In the second chapter we reconsider the market power-efficiency trade-off made by competition authorities and stress the importance of both strategic decision making of managers and internal organisation issues after mergers have taken place. The third chapter gives an explanation of merger failures based on uncertain synergy gains and post-merger integration problems.

In the first chapter, we want to identify the winners and losers from legal reforms in product and labour markets and analyse the conditions under which there will be sufficient support for having them. Reforming is fundamentally reducing and redistributing rents. Thus, even if a change in rules eventually proves beneficial, it is likely to come with redistribution effects and hence opposition from the loosing side. Firms enjoy often more market power than socially optimal. Influencing the political process of product market regulation is costly and only the firms do this effectively. Any reform that reduces the market power of the firms proves therefore difficult to implement. The main reason for frictions in labour markets is often said to be fierce opposition by the employed workers for any change that could decrease wages. A large body of empirical research has confirmed that labour market frictions, either directly, or in combination with macroeconomic and technological shocks, have played an important role in the unemployment problems of European labour markets.

But when the losses and gains of welfare enhancing reforms can be evenly distributed over employees and firms, they have considerably more chance to get approval. This is because reforms in the labour and product markets are complementary, and therefore the loosing side of one reform will be the winning side of the other reform. Also, reforms in both markets increase welfare more than a single reform and show thus synergy effects. Moreover, it offers a possible way out of the so called "sclerosis" effect. When frictions in markets are high, interest groups enjoy higher rents and oppose more reforms and thus the markets that need most a reform, are most stuck in a sclerosis. But combining reforms offers a solution. High frictions in one market make it easier to reform the other market and therefore the sclerosis in one market can cancel out the sclerosis in the other market.

The second chapter broadens the theory on horizontal mergers with efficiency gains in concentrated markets. Currently all discussions on mergers are limited to exogenous efficiencies while the outcomes and policy recommendations could be different when considering that becoming more efficient requires investment and is thus a strategic decision. The possibility that a merged firm may become more efficient does not mean that these gains will be actually realised as is now widely assumed in the economics literature.

The aim is to shed more light on how merger and investment decisions interact, and look how the internal organisation of firms has an influence on these interactions. A newly merged firm brings together different management teams, which can lead to distrust and conflict and therefore possibly less investment. Our approach facilitates the understanding of why some mergers may fail to become more efficient or even fail to happen. Moreover, it allows us to pin down some pitfalls for the regulator when taking into account efficiency gains in merger decisions.

For simplicity, we only consider two extreme cases. We start by analysing the situation where managers fully cooperate inside the firm. This is equivalent to saying that complete contracts can be written, or, managers trust each other and are willing to sacrifice their personal interests for the benefit of the firm. We find that if managers inside a firm cooperate, they have more incentives to do so in a merged firm because of potential synergies. However, they invest only when it is profitable and an executed merger becomes not necessarily more efficient. The second scenario considers a situation where the managers do not trust each other. As a result, investment decisions are done if it is beneficial for the manager personally -or for his team. The conflict of interests within the firm can dominate the possible synergies, making a larger merged firm invest less. This makes mergers to occur less often. But still managers merge and this resulting entity may be even less efficient than non-merged firms. Our model gives also a potential explanation for merger failures. If the managers underestimate the potential conflict, they may end up in an unprofitable merger.

The third chapter offers a formal explanation of why some mergers fail and others succeed. We achieve predictions by investigating the interaction between two important aspects of merging: post-merger integration difficulties and the pre-merger gathering of information about obtainable merger synergies. Cultural differences and poor integration efforts have often been cited in the business literature as the single most important factor in explaining a failure of synergy realisations. Organisation theorists argue that although better outcomes are associated with choosing a better partner, or expertly identifying and successfully sharing key strategic complementarities, the degree to which these events are likely to occur depends upon the process of implementing the merger. But to our knowledge, in the economics literature it is a novalty to explain merger failures from the explicit modelling of the post-merger process.

In the pre-merger stage, firms gather information about the synergies possible, and part of this information is kept private while part is shared among partners. On the base of this information, each makes a prediction of the profitability of the merger and of which integration actions the partner is likely to take. When the two firms decide to merge, there is the expectation to turn the merger into a successful entity -why would firms else want to merge? But in order to create a successful firm, partners need to do the right integration efforts to attain a workable common corporate culture. It may happen that it is optimal for a firm to merge and to do minimal integration efforts in the post-merger stage, expecting his partner to adapt most. This can lead to failures because of organisational problems if both partners take this course of actions.

Some of our results are intuitively clear as is the fact that less precise information leads to more failures. Less precise information makes it just easier to make judgement mistakes and to rely too much on the good news that your partner wants to merge with you. However, getting more precise information comes at a cost, both in terms of resources and time, so there is a trade-off. Second, the higher the potential synergy gains, the more probable these synergies are indeed realised through organisational integration, which is what some management case studies confirm. Our explanation why this exactly happens is new though; we say that higher expectations induce better actions. Third, when costs of merging are lower, more merger failures are encountered. For example, during stock market booms when it is easier to find funding for buying up other firms, considerably more failures are indeed encountered. One of our most interesting results finally is that when the punishment of not-integrating is higher, the possibility for failures is reduced. This might be an explanation of findings that cross-border mergers or mergers with very different management styles sometimes are found to be more successful: the cultural differences that could derail effective synergy realisation in domestic mergers are more carefully attended to in cross border combinations because of managers' heightened sensitivity.

Chapter 1

Interactions between Product and Labour Market Reforms

This chapter benefited from comments by Albert Banal Estañol, Samuel Bentolila, Maia Güell, Julius Moschitz, Inés Macho Stadler, Javier Ortega, Reinhilde Veugelers and participants of the Labour Seminar at Pompeu Fabra (Barcelona), the Micro Economics Worskhop at UAB (Barcelona), the ENTER Conference (Mannheim), the ZEW Workshop (Berlin), the EEA Conference (Venice), and the Conference of the Spanish Economic Association (Alicante).

1.1 Introduction

Product and labour market frictions are often blamed for the relatively poor European economic performance of the last 30 years, especially with respect to unemployment. Remove (many of) these frictions, the argument goes, and both employment and consumer welfare will increase. This is the theme of a number of studies by the OECD (e.g. The OECD Observer, December 1997-January 1998).

But why is it then that there remain so many frictions in both the labour and product markets?[1] Reforms are largely marginal, especially in the labour markets. Product market reforms are more widespread, but slow-moving and several sectors are still virtually served by (sometimes state owned) monopolies (Gonec et al. [28]).

[1] Boeri et al. [11] and Nicoletti et al. [59] develop a set of indicators of frictions in product and labour markets and find that in Europe frictions are high as compared to other OECD countries.

One possible explanation comes from a political point of view. Removing frictions is fundamentally reducing and redistributing rents. Thus, even if a reform eventually proves beneficial, it is likely to come with redistribution effects and hence opposition from the loosing side. In the product markets firms enjoy more market power than socially optimal. Influencing the political process of product market regulation is costly and only the firms do this effectively. Any reform that reduces the market power of the firms proves therefore difficult to implement (Faure-Grimaud and Martimort [22]; Kroszner and Strahan [47]; Li et al. [50]). The main reason for frictions in labour markets, says Saint-Paul [73], is that many reforms have proved difficult because they face fierce opposition by the employed workers when wages decrease. A large body of empirical research has confirmed that labour market frictions, either directly, or in combination with macroeconomic and technological shocks, have played an important role in the long depression of European labour markets (Blanchard and Wolfers [9]; Nickel and Ladyard [58]).

Of course, the labour and product markets are not functioning independently. An increasingly discussed hypothesis is that product market and entry regulations are other key factors in the slow rate of job creation in Europe. [2] However, there has been done virtually no research on the interaction between *reforms*. An OECD Study [61] says that it is important to take simultaneously and coordinated actions in all areas, because of synergies between different reforms. However, despite its potential importance, the theoretical argument has remained surprisingly loose.[3] The reasons *why* comprehensive reforms work better and seem to create synergies are not well understood.

In this paper we try to answer the question from a political economy point of view. That is, we want to identify the winners and losers from reforms in product and labour markets and analyse the conditions under which there will be sufficient support for having them. To our knowledge, this is a first attempt to model from a micro-economic point of view the interaction of reforms in the labour and product markets that takes explicitly into account the interests of the employed and un-

[2] A recent empirical study for the French retail industry by Bertrand and Kramarz [7] confirms this point. The relevance of a product market explanation for Europe$\mathcal{U}$b4s employment crisis has also been theoretically showed by for example Gersbach [27].

[3] An exception is Blanchard and Giavazzi [8], a macroeconomic paper in which it is shown that the negative employment effect of product market regulation gets reinforced when labour market regulation is also present.

employed workers, and firms. Firms contract workers where workers' effort is not observable and compete in an oligopolistic product market.[4] Our setup is closest to Saint-Paul [72] who assesses the support of employed workers for active labour market policies, but not taking into account firms and product markets.

In the context of European integration, we think of product market regulation as a measure of the intensity of direct competition between firms present in the market. A decrease in regulation reflects the elimination of tariff barriers, or standardisation measures making it easier to sell domestic products in other European countries. A greater product market integration leads then to more direct competition between firms, resulting in lower market power. There is a recent and growing literature dealing with the effects of international integration in imperfect competitive markets (e.g. Slaughter and Swagel [79]). But these models are either partial or are cast in a setting where there can be no unemployment, assuming a competitive fringe absorbing all "excess" labour.

Labour market regulation is modelled as the degree of employment protection. The idea is that firing costs are a source of market power for the incumbent workers vis-à-vis the unemployed. Employed workers use their power to exercise upward pressure on wages and create thereby unemployment. According to this view, the higher the firing costs, the higher the power of the employed workers and thus the higher the wage and consequently equilibrium unemployment (Diaz-Vázquez and Snower [16]). The main idea we want to capture is that there exist frictions in the labour market, increasing the rents for the employed workers at the expense of employment and total welfare. There are however different views among economists about how employment protection influences unemployment. But the implicit assumption of most theoretical models is that wages are exogenous and do not change in the presence of firing costs (see e.g. Bentolila and Bertola [6]; Garibaldi [26]). These models, as Galdón-Sánchez and G üell [29] point out, are very useful in understanding the effects of firing costs on the dynamic functioning of the labour market, but the effects on aggregate employment are ambiguous. Most recent empirical studies find a negative relationship between employment protection and equilibrium employment.[5]

[4]Nickell [57] and Weiss [86] prove that modelling imperfect competition is essential when looking at product and labour market interactions.

[5]With the major exception of a study by Nickell and Layard [58], all other recent empirical studies point to a reduction in equilibrium employment,or an increase in structural unemployment, in more generous employment protection regimes (see e.g. Heckman and Pages [36]; Nicoletta and

We agree that this model has a particular form of regulation in both the labour markets and product markets, and there is even possible controversy about whether excessive employment protection has a negative impact on equilibrium employment. However, the idea we want to capture is that *if* there is a direct relation between more regulation and higher power for firms and employed workers, *then* more regulation might mean a lower general welfare and at the same time reforms will prove to be more difficult. Our model is a first attempt to analyse this complicated issue.

We are looking at reforms that remove rigidities earlier imposed on an economy by its government and this in order to increase employment, competition and general welfare.[6] Reforms are approved when both the firms and employed workers agree, i.e. when they do not loose from a reform. We consider also of course how reforms affect the unemployed workers. But the unemployed workers are not as organised as the employed and are thus assumed not to have voting power. Moreover, we find that whenever employed workers agree on a reform, the reform is also supported by the unemployed workers, so an approved reform is never harmful for unemployed workers. It is clear that organised interests are more likely to agree with reforms when they perceive greater gains from making the system more effective. We suppose that groups have veto power, that is, each group can independently block a reform. Probably this is not true in reality. Reforms are a result of a decision process -or voting procedure- where interest groups have the power to influence decisions. However, in assuming veto power for each group, we establish a lower bound for the approval of reforms. Thus, when finding approval in our model, we can be sure that these reforms will also be agreed upon when applying a more elaborated voting procedure.

Our conclusions are encouraging. The main finding is that when the losses and gains of welfare enhancing reforms can be evenly distributed over employed workers and firms, they have considerably more chance to get approval. This is because reforms in the labour and product markets are complementary, and therefore the loosing side of one reform will be the winning side of the other reform. This means that higher employment and more product market competition can be more easily accomplished. Also, reforms in both markets increase welfare more than a single

Scarpetta [60]).

[6] We need to point out that this is not the whole picture. It has already been shown in the labour market context (Bentolila & Bertola [6]) that while changes can be welfare increasing in a first-best world, this is not necessarily the case in a second-best case.

reform and thus combined reforms show synergy effects. Moreover, this paper offers a possible way out of the so called "sclerosis" effect. When frictions in markets are high, interest groups enjoy higher rents and oppose more reforms and thus the markets that need most a reform, are most stuck in a sclerosis. But combining reforms offers a solution. The high frictions in the one market make it *easier* to reform the other market and therefore the sclerosis in the one market can cancel out the sclerosis in the other market. This implies also that it is better to reform in both markets at the same pace and can be therefore an explanation for the observations of Boeri et al. [11] and Nicoletti et al. [59] that when product markets are less regulated, labour markets tend to have less tight legislations.

In the next section, we characterise the equilibrium in the product and labour market in function of the labour and product market regulations. The model is built on two basic assumptions: competition à la Cournot in the product market and a labour supply derived from an efficiency wage model based on Shapiro and Stiglitz [78]. In section 1.3, we search for politically viable reforms to increase welfare. Section 1.4 concludes. All proofs are presented in the Appendix.

1.2 Equilibrium in the product and labour markets

The equilibrium in the product and labour markets depends both on the degree of competition in the product market and the level of employment protection in the labour market.

1.2.1 Firms

We model a product market where firms compete à la Cournot and where the degree of direct competition varies, depending on the product market regulation. Depending on the degree of product market competition, firms demand labour in function of the wage they have to pay. This allows us to analyse how product market reforms have an impact on the labour market and how labour and product market reforms interact. Moreover, firms are making positive profits which makes them active players in the political process.

A firm i decides how much labour it wants as a function of the wage it has to pay. We assume that when paying this wage a firm can influence effort decisions of workers, but is small relative to the size of the labour market and takes job flows as given. The firm's short-run production is $f_i(l_i) = l_i^\alpha$, with $0 < \alpha \leq 1$ and l_i is the demanded unskilled labour. We are assuming that the firm's other production factors (capital or skilled labour) are fixed and at full capacity. Total production in the product market is separable in individual productions, $F(l) = \sum f_i(l_i) = \sum l_i^\alpha$.

In order to allow for a change in direct competition through changes in regulation and at the same time having firms reacting strategically and enjoying rents in the long run, we cannot use a model of monopolistic competition. Instead, we model the product market as a replica economy where firms compete à la Cournot (see Vives [82] for a similar idea, but in a different set-up). Suppose that there are N firms present in labour and product markets. If markets are "zero-integrated", a firm faces no direct competition and can act as a monopoly, deciding on production independently of competitors. If total demand in the product market is equal to d, each firm i faces then an inverse demand $p = d - l_i^\alpha$. If however, each firm faces direct competition from exactly one other firm (firms are competing in a Cournot duopoly), they have to take into account this other firm when deciding on optimal production. Thus production decisions of firm i, $l_i^\alpha = d - p$ and production decisions of its direct competitor j, $l_j^\alpha = d - p$ are now taken interdependently. The price p is jointly determined by the productions of firms i and j, $l_i^\alpha + l_j^\alpha = 2(d-p)$ and therefore $p = d - \frac{l^\alpha + k^\alpha}{2}$. Generalising this reasoning for all degrees of competition, we can write the inverse demand as

$$p = d - \frac{\sum^m l_i^\alpha}{m},$$

where $m \in [1, \infty[$ indicates the degree of product market integration and therefore also of the degree of direct competition each firm faces in the product market. The competition firms face lies between the extreme $m = 1$, where a firms can behave as a monopoly in the product market (there is no integration) and the other extreme $m \to \infty$, where firms have no market power and face perfect competition (maximum possible integration). The profit of each firm is then

$$\pi_i = (d - \frac{\sum^m l_i^\alpha}{m})l_i^\alpha - w_i l_i,$$

where w_i is the wage firm i pays. Each firm maximises its profit w.r.t. production, paying a high enough wage to induce workers to put in effort: $w_i \geq w^{ns}$, where w^{ns} is the minimum wage where workers do not shirk.

$$\begin{aligned} &\max_{l_i} \;\; \pi_i \\ &s.t. \quad w_i \geq w^{ns}. \end{aligned}$$

Solving this problem gives us the labour demand and optimal wage of the firm,

$$w_i = (d - \frac{l_i^\alpha + \sum^m l_i^\alpha}{m})\alpha l_i^{\alpha-1} \text{ and } w_i = w^{ns}. \tag{1.1}$$

In order to sum up the demand for all N firms present, one needs a labour demand separable in l_i. Limiting ourselves to the case where $\alpha = 1$,[7] we can write the total labour demand as

$$w = (d - \frac{(m+1)\sum^N l_i}{mN}), \tag{1.2}$$

where $w = w^{ns}$ is the identical wage firms pay in the labour market.

1.2.2 Workers

The labour supply is a modified version of the shirking model of Shapiro and Stiglitz [78]. As such it is actually a wage setting curve and not a labour supply, but we will both use as synonyms throughout the paper. A worker's effort is not perfectly observable and there is a detection technology that catches shirking workers with some probability q (where $q < 1$). Each firm finds it optimal to fire shirkers, since the only other punishment, a wage reduction, would simply induce the disciplined worker to shirk again. Since q is associated with the monitoring technology, it can safely be assumed that firms do not want to fire people if they are not shirking. This is because other (exogenous) reasons of loosing a job are accounted by a variable b in the model. Hence, in Shapiro and Stiglitz [78] each firm fires the worker with probability

[7] While $\alpha = 1$ means constant returns to scale, it needs to be pointed out that when the price in the product market is not exogenous, we still have a downward sloping labour demand, $\frac{\partial w}{\partial l} < 0$. For a given price in the product market, this assumption would lead to a horizontal labour demand, $\frac{\partial w}{\partial l} = 0$, which means that constant returns to scale cannot be assumed in these models. Since we add a product market where price depends negatively on production, this assumption has no qualitative consequences.

1 when a worker is detected shirking. Our departure from the Shapiro and Stiglitz model is including employment protection legislation. Firing and job destruction in our model are no longer instantaneous, but can be costly and lengthy. The simplest and most widely used form of employment protection legislation is a fixed firing cost to be incurred by the firm when firing takes place (see e.g. Bentolila and Bertola [6]). But the multiple dimensions of employment protection are difficult to model in such a simple way. In most European countries, before firing can take place a discussion with a union representative is often necessary and, in extreme cases, a full agreement with government officials must be reached. From the firm's point of view, the existence of complicated procedures introduce uncertainty over the actual costs of firing and over the actual timing. For example, the existence of a "just clause" rule in most European legislation allows the worker to appeal against dismissal and can result in reinstatement of the dismissed worker (Galdón-Sánchez and Güell [29]). The traditional indicators fail to capture this uncertainty. As Garibaldi [26], we focus on a different form of job security provisions and consider a model where firing requires an exogenous firing permission. We do not explicitly model severance pay, but include a more general parameter that models the difficulties of firing a worker. Not all workers caught shirking can be dismissed, or, a dismissed worker must be reinstated when having won his case in court. More formally, we introduce a stochastic parameter $s \in [0, 1]$ that reflects the legal framework in the labour market. The parameter s encompasses the firing regulation. The higher s, the less restrictive is the employment protection. The probability of getting fired when caught shirking becomes now $sq \leq q$ because of legal restrictions.[8]

There exists a number of identical workers n and each worker is at any point of time either employed or unemployed. A worker is assumed to be risk neutral and his instantaneous utility function is separable in wage and effort: $U(y, Ef) = y - Ef$, where y is the payment a worker gets at each instant and Ef his effort. We suppose that an unemployed individual receives no unemployment benefit $y = 0$ and does not supply any effort ($Ef = 0$), which means that his instantaneous utility is $U_u(y, Ef) = 0$. An employed worker receives a wage $y = w$ and decides to shirk ($Ef = 0$) or to provide some fixed positive level of effort $Ef = e > 0$. A shirker has an instantaneous

[8] The effect of employment protecion on redundancies (variable b in our model) is neutral (this is a well known result proven by Lazear [49]), so nothing would change in the model if we allow s to affect economic dismissals.

utility $U_e^s(y, Ef) = w$ and a non-shirker has a utility $U_e^{ns}(y, Ef) = w - e$. The only choice an employed worker makes is the selection of effort. If the worker supplies effort for his job, only exogenous factors can cause a separation. This exogenous separation rate is due to relocation, recession, etc. and is a probability per unit of time $b \in [0, 1]$. If an employed worker shirks, there is again the possibility b that he will loose his job, but there has to be added a probability $sq \in [0, 1]$ per unit of time that he will be fired when discovered shirking, where q is the probability being caught and s the probability being fired when caught shirking. For $s = 1$, this gives us the original condition of Shapiro and Stiglitz [78].

The worker selects an effort level to maximise his discounted utility stream. This involves a comparison of the (expected) utility from shirking with the (expected) utility from not shirking, to which we now turn. We define E^s as the expected lifetime utility of an employed worker who shirks, E^{ns} the expected lifetime utility of an employed nonshirker and U as expected lifetime utility of an unemployed individual. The asset value equation for a nonshirker is given by

$$rE^{ns} = w - e + b(U_u - E^{ns}), \tag{1.3}$$

while for a shirker, it is

$$rE^s = w + (b + sq)(U_u - E^s). \tag{1.4}$$

Each of these two equations is of the form "interest rate r times asset value equals flow benefits".[9] The difference between the two valuations is that a non-shirker has a lower instantaneous utility $(w - e)$, because he supplies effort, but a shirker has a higher probability to loose his job $(b + sq)$. Hence, the risk of getting unemployed is proportional to the probability of getting caught q and to the regulation of the labour market s. If the labour market is more regulated, the lower will be s, and the less the cost of shirking.

The no-shirking condition is $E^{ns} \geq E^s$. The employer will pay the minimum allowable wage in order to meet the no-shirking condition, which means that in equilibrium $E^s = E^{ns} = E$. Substracting the asset value of the shirker (1.4) from the asset value of the non-shirker (1.3), and using that in equilibrium they will be the same yields:

$$E = U_u + \frac{e}{sq}. \tag{1.5}$$

[9] We only consider the steady state and do not take into account differences of E and U over time.

Using the relation between the value of the unemployed and employed workers (1.5), we find the asset value for an unemployed person:

$$\begin{aligned} U_u &= a(E - U_u) \\ &= a\frac{e}{sq}, \end{aligned} \tag{1.6}$$

where a is the endogenous probability of obtaining a job per unit of time.

Because in equilibrium the no-shirking condition will hold with equality and using the relation between the values for the employed workers and unemployed workers (1.5), we can rewrite the no-shirking wage w^{ns} as

$$w^{ns} = e + (r + b + a)\frac{e}{sq}. \tag{1.7}$$

The rate a itself can be related to more fundamental parameters of the model. The flow into the unemployment pool is bl, where l is aggregate employment and b the exogenous separation rate. The flow out of the unemployment pool is $a(n-l)$, where n is the total workforce. In the steady state, these must be equal , so $bl = a(n-l)$, or

$$a = \frac{bl}{n-l}. \tag{1.8}$$

Therefore the no-shirking condition (1.7) can be written as

$$\begin{aligned} w^{ns} &= e + (r + \frac{bn}{n-l})\frac{e}{sq} \\ &= rU + e + \frac{e}{sq}(r+b). \end{aligned} \tag{1.9}$$

If the firm pays this wage, workers will not shirk. In this wage equation, we can distinguish between the reservation wage $rU + e$ and the rent linked to the incentive problem $\frac{e}{sq}(r+b)$. It is easy to see that the higher the flexibility of the labour market s, the lower the efficiency wage. Hence, rents arise because of microeconomic frictions and are magnified by legal restrictions in the labour markets. Although it is true that workers in equilibrium do not shirk, the fact that they *could* shirk and that then the firm *could* have difficulties to fire them, gives higher power to the employed workers and thus a higher wage needs to be paid in order to have non shirking workers. Because of a higher wage, the equilibrium employment l^* decreases and therefore also the inflow into jobs, a.

Equation (1.9) is the curve for one firm. For N identical firms present in the labour market, and total labour force consisting of Nn workers (we replicate the labour market N times), we can write the wage setting curve as

$$w^{ns} = e + (r + \frac{bNn}{Nn - \sum^N l_i})\frac{e}{sq}, \tag{1.10}$$

where l_i is the number of workers employed by firm i and $\sum^N l_i$ is the total number of employed workers in the labour market.

1.2.3 Equilibrium in the markets

We are now able to characterise the equilibrium in the labour and product markets and analyse how it depends on the degree of competition in the product markets and on the level of employment protection in the labour markets. Since the labour demand is derived from profit maximisation in the product market, the equilibrium in the labour market determines at the same time the optimal production in the product market.

Lemma 1.1. ***(i)*** *When N identical firms are present in the markets and the total supply of workers is Nn, the equilibrium in the markets is unique and independent of N.*

(ii) *Equilibrium employment increases when direct competition in the product market is fiercer, $\frac{\partial l^*}{\partial m} \geq 0$, but the marginal effect decreases, $\frac{\partial^2 l^*}{\partial m^2} \leq 0$. Equilibrium wage increases when competition in the product market is fiercer, $\frac{\partial w^*}{\partial m} \geq 0$, but the marginal effect decreases, $\frac{\partial^2 w^*}{\partial m^2} \leq 0$.*

(iii) *Equilibrium employment increases when the labour market is more flexible, $\frac{\partial l^*}{\partial s} \geq 0$, but the marginal effect decreases, $\frac{\partial^2 l^*}{\partial s^2} \leq 0$. Equilibrium wage decreases when the labour market is more flexible, $\frac{\partial w^*}{\partial s} \leq 0$, but the marginal effect decreases, $\frac{\partial^2 w^*}{\partial s^2} \geq 0$.*

(iv) *The higher the direct competition in the product market, the lower the equilibrium price, $\frac{\partial p^*}{\partial m} \leq 0$. The more flexible the labour market, the lower the equilibrium price, $\frac{\partial p^*}{\partial s} \leq 0$.*

Part (i) of Lemma 1.1 shows that the equilibrium is unique and is independent of the number of firms N. Since we use replica economies, no matter how many firms present, it is as each firm faces an individual labour supply with n workers. This does not imply that there is immobility of workers across firms or sectors. The total labour force of workers Nn is free to move and supply labour to any firm. But since firms and workers are symmetric, in equilibrium each firm will hire the same number of workers and the equilibrium wage will be the same. This allows us as well to let $N \to \infty$, which justifies our assumption that firms take the aggregate job acquisition rate a as given.

When the direct competition in the product market increases through more integration, the demand for labour becomes more elastic. For a given labour supply, the equilibrium wage and employment will therefore increase. This is indeed the to be expected effect. While at the individual firm level, a decrease in market power for firms can lead to a decrease in wages, this does not carry over to economy-wide changes (Nickell [57]). While market power raises wages relative to the outside option, a universal rise in market power (fall in labour demand elasticity) also reduces labour demand by reducing the marginal revenue at any given output. This leads to a new equilibrium with lower employment, lower wages and higher firm profit. Thus, even if a fall in market power at the individual firm level can lower welfare of the employed workers in the firm, an overall fall is positive for them.

The slope of the labour demand is $-(\frac{m+1}{m})$. For a large m, this coefficient will not change much when competition increases, and thus the marginal effect of more integration on equilibrium wage and employment decreases.[10] When the labour market is made more flexible, the more elastic is the labour supply. For a given labour demand, the equilibrium employment increases and wages decrease. Again, the marginal effect of a higher flexibility s decreases and thus effects on equilibrium wages and employment are lower.

The price depends on the direct competition firms face and the equilibrium price

[10] If we change competition structure, the employment changes as well. More competition means higher equilibrium employment. But this would mean that we have different bases of comparison. So to allow us to use the same base of comparison, we need to impose that the initial equilibrium employment is the same for different degrees of competition. This means that the correct notation would be $\left.\frac{\partial^2 l^*}{\partial m^2}\right|_{l^*=\bar{l}^*}$, but we leave out the subscript $l^* = \bar{l}^*$. We keep l^* constant for all comparative statics throughout the paper.

is $p^* = d - \frac{\sum^m l^*}{m} = d - l^*$ since all firms are symmetric. This equilibrium price p^* decreases when the product markets are more integrated and when the labour market is more flexible, as shown in part (iv).[11]

In the case where firms compete in perfect competition in the product market, the firm is both a price taker in the product market and a wage taker in the labour market, leading to no power in both markets.

Corollary 1.2. *When firms face perfect competition in the product market, $m \to \infty$, and firms are wage takers in the labour market, the wage in the labour market is the same as the price in the product market: $w^* \to p^*$.*

Thus, if firms face perfect competition, both in the product market and in the labour market, they cannot make any profits, $\pi = 0$. The average revenue, which is the price of the product, equals the average cost, which is the wage of the employed workers. Consequently, all the gains from production will go to the employed workers.

1.3 Government policies and their support

We look at reforms in labour and products markets that increase employment and production. First we develop welfare measures for the interest groups and total welfare and show that higher employment and a higher production increase total welfare. Unemployment is costly for society in terms of unemployment benefits, forgoing of taxes, waste of talents and production factors etc. and is a serious problem in Europe. An inefficient level of production means that firms have too much market power and production factors, labour in our model, are not sufficiently used.[12]

We first assess the probability of approval for labour market reforms, dependent on the degree of competition in the product market. A labour market reform in our

[11] Remark that $\frac{\partial p^*}{\partial l^*}$ is not the slope of the inverse demand, but the way how the *equilibrium* price changes when the equilibrium production changes. The slope of the demand is $\frac{\partial p}{\partial l} = -\frac{1}{m}$. When the conditions in the labour market change, all firms will react in the same way: $\frac{\partial l_i^*}{\partial m} = \frac{\partial l_j^*}{\partial m}$ for all firms i, j because firms are symmetric. The change of the equilibrium price is then $\frac{\partial p^*}{\partial l^*} = \sum^m \frac{\partial p}{\partial l^*} = \sum^m -\frac{1}{m} = -1$.

[12] One should ideally also include capital and make a distinction between skilled and unskilled labour, since reforms will have a different impact on the utilisation of these factors, but this is beyond the scope of this paper.

model is defined as changing the regulation in the labour market through changes in the employment protection legislation. Likewise, dependent on the level of labour market flexibility, we determine how firms agree with product market reforms. Product market reforms are changes in product market regulation that increase direct competition through more product market integration. This gives us a first insight how the one market has an impact on reforms in the other market.

However, as can be seen from the current intents to change the competition and labour laws in Europe, reforms in one market are difficult to accomplish (Boeri et al. [11]). But both reforms also create positive externalities. Changing the competition and trade laws can create a higher demand for labour and hence higher wages, which benefits the employed workers. Reforms in the labour market create more labour supply and thus possibly lower wages and lower costs for the firms. Therefore, a combined reform that takes place in both labour and product markets makes use from these positive externalities and may open the way for approval from both interest groups separately. We analyse under which conditions governments can both increase employment and competition and receive approval from firms and employed workers.[13]

1.3.1 Welfare measures

We develop measures for welfare of firms, employed workers and total welfare. Unemployed workers always approve a policy that is designed to decrease unemployment and that is approved by the employed workers.

Employed

From equation (1.5), we know that the expected discount value of income for unemployed workers is

$$rE = rU + \frac{re}{sq} = (r + a)\frac{e}{sq}. \tag{1.11}$$

In comparison with unemployed workers, employed workers enjoy a rent because of the asymmetric information. This means that an increase in labour market flexibility

[13] We only analyse cross-steady states. By cross-steady state is meant the comparison of different steady states without taking into account the dynamics between two different steady states. Saint-Paul (1998) finds that transitional dynamics only account for a small fraction of the variation of each groups welfare, suggesting that the cross steady state comparison is a good approximation.

s will hurt them more which can lead to opposition for more labour market flexibility. Whether they approve a labour market reform depends on how this policy affects a. A product market reform increases the probability of obtaining a job per unit of time, a, and always increases the welfare of the employed.

Firms

The welfare per unit of time for firms is $\pi = (p - w)l$.[14] Using the results from Lemma 1, in equilibrium the profit can be written as

$$\pi = \frac{(l^*)^2}{m}. \tag{1.12}$$

Firms favour a labour market reform that increases the labour market flexibility s, since this increases equilibrium production l^*. More product market integration on the other hand increases the degree of competition in the product market m and is always opposed by the firms as will be shown below.

Total Welfare

A social planner maximises aggregate welfare per unit of time in equilibrium:

$$\begin{aligned} W &= N(\pi + rEl^* + rU(n - l^*)) \\ &= N((p^* - w^*)l^* + (a^* + r)\frac{e}{sq}l^* + a^*\frac{e}{sq}(n - l^*)), \end{aligned}$$

where $N\pi$ is the profit of the firms, $NrEl^*$ the welfare of employed workers, $NrU(n-l^*)$ the welfare of unemployed workers. This equation can be rewritten as

$$W = Nl^*(p^* - e). \tag{1.13}$$

In steady state, the inflows and outflows are such that maximising aggregate welfare across agents is equivalent to maximising the expected utility of a representative individual that gets all resources in the economy. That is, the total welfare is total

[14] It may seem strange that for the firms the interest rate does not play a role. However, if we write the flow equation for firms in discrete time, we have $\pi = (p - w)x - \frac{b}{1+r}\pi x + \frac{a}{1+r}\pi(n - x)$ and since $a = \frac{bx}{n-x}$, we see immediately that the profit per unit of time is $\pi = (p - w)x$. The same reasoning holds for continous time.

output multiplied by the social profit of production $(p^* - e)$. If the output price were constant, the social planner would always be concerned about more employment. Since in this model the output price is not taken as given, we need to check whether this still holds. When taking derivatives w.r.t. equilibrium employment, $\frac{\partial W}{\partial l^*} = N((p^* - e) + l^*(\frac{\partial p^*}{\partial l^*}))$. From Lemma 1, we know that $p^* = d - l^*$, and $\frac{\partial W}{\partial l^*} = N((d - 2l^* - e)$. If the competition structure is such that $m = 1$, the equilibrium wage will be $w^* = d - 2l^*$, and $\frac{\partial W}{\partial l^*} = w^* - e$. Since $w^* > e$,

$$\frac{\partial W}{\partial l^*} > 0.$$

If $m > 1$, the wage will be higher than $d - 2l^*$, so the inequality holds for all degrees of competition. Hence, even for non-constant product market prices, welfare is increased when employment or production increase.

We left out consumers for expositional ease. However, it is more logical that at least part of what an economy produces is consumed in the same economy. Including consumers in the welfare function leads us to

$$W' = N(\pi + rEl^* + rU(n - l^*) + \alpha(\int_0^{l^*} p(l)dl - p^*l^*),$$

where $\alpha \in [0, 1]$ is the share of the production that is consumed in the economy. For example, W' is the welfare of Europe and $(1 - \alpha)$ is the share of production which is exported outside Europe. As is shown in the Appendix, $\frac{\partial W'}{\partial l^*} > 0$, and therefore the results do not change when including a consumer part.

1.3.2 Labour market reforms, given a competition structure in the product market

Controlling for employment, we look at how the initial labour market flexibility and how the competition structure in the product market influence the support of the employed workers for a more flexible labour market. The employed workers will not oppose an increase in labour flexibility when $\frac{\partial (rE)}{\partial s} \geq 0$.

Lemma 1.3. ***(i)*** *The lower the initial labour market flexibility, the lower the probability that* $\frac{\partial (rE)}{\partial s} \geq 0$.

(ii) *The more competition in the product market, the higher the probability that* $\frac{\partial(rE)}{\partial s} \geq 0$.

(iii) *The lower the initial labour market flexibility, the higher the influence of the product market on labour market reforms:* $\frac{\partial^3(rE)}{\partial s \partial m \partial s} \leq 0$

The greater the initial rent (the less flexible the labour market), the more likely that changing employment protection legislation will be opposed by the employed workers. This is the so-called "European Sclerosis" effect. The less flexible the labour markets, the more difficult it is to get approval for reforms (Saint-Paul [73]).

A higher degree of competition in the product market leads to a more elastic labour demand. Therefore, an increase in labour market flexibility has a higher positive effect on employment and thus on a, the probability of obtaining a job per unit of time.[15]

In point (iii) of Lemma 1.3, we find that the influence of the product market of labour market reforms is higher when the labour market is less flexible. In other words, the less flexible the labour market, the more the conditions of the product market influence the labour market reforms.

1.3.3 Product market reforms, given the degree of employment protection in the product market

When controlling for production, we analyse the support of the firms for more competition in function of the initial product market competition and in function of the flexibility of the labour markets. The firms will not oppose an increase in product market competition when $\frac{\partial(\pi)}{\partial m} \geq 0$.

Lemma 1.4. ***(i)*** *For every initial product market competition* m*, the firms always oppose an increase in product market competition:* $\frac{\partial(\pi)}{\partial m} \leq 0$.

(ii) *A lower initial product market competition* m *makes this opposition even stronger:* $\frac{\partial^2(\pi)}{\partial m^2} \geq 0$ *for* $m \geq m'$*, where* $m' \in [1, 1+\sqrt{2}]$ *and for* $s \to 0$*,* $m' \to 1$.

[15] This result is similar to what Saint-Paul [72] finds. He states that an 'adverse policy selection' is more likely when the elasticity of labour demand is low. Our conclusion is the same, but in our model the elasticity of demand is determined by the degree of regulation in the product market and is not taken as given.

(iii) *The lower the initial product market competition, the higher the influence of the labour market on product market reforms:* $\frac{\partial^3(\pi)}{\partial m \partial s \partial m} \leq 0$.

Firms *always* block a product market reform in our model, since it reduces their market power and hence their profits. When initial market competition is low, a firm's market power is high and firms have more to loose from a product market reform. This is the product market side of the sclerosis effect as found for example in Duso [18] and Kroszner and Strahan [47]: the less competition between the firms, the more difficult to reform the product market.[16]

The influence of the labour market on the product market reforms is higher when there is less competition in the product market.

1.3.4 Product and labour market reforms combined

Since even in optimal conditions labour market reforms or product market reforms might be opposed by employed workers and firms respectively, especially when initial m and s are low, it is worth looking at the interaction of both reforms.

Proposition 1.5. ***(i)*** *(a) By combining labour and product market reforms, the possibilities to find support from employed workers is easier than when only a labour market reform is used:* $\frac{\partial(rE)}{\partial s} + \frac{\partial(rE)}{\partial m} \geq \frac{\partial(rE)}{\partial s}$, *since* $\frac{\partial(rE)}{\partial m} \geq 0$.

(b) A combination of a low initial labour market flexibility and high initial product market competition lowers the possibility for support from employed workers for combined reforms.

(ii) *(a) Support from firms for combined reforms is easier than for only product market reforms:* $\frac{\partial(\pi)}{\partial m} + \frac{\partial(\pi)}{\partial s} \geq \frac{\partial(\pi)}{\partial m}$, *since* $\frac{\partial(\pi)}{\partial s} \geq 0$.

(b) A combination of a low initial product market competition and high initial labour market flexibility lowers the possibility for support from firms for combined reforms.

[16] In the extreme case where equilibrium wages do not change for changes in labour demand (i.e. when the labour supply is horizontal), the maximum loss of a product market reform is not encountered for the smallest m ($m = 1$), but for $m \in [1, 1 + \sqrt{2}]$. We do not discuss this case any further.

(iii) *The stronger the negative correlation between the labour market flexibility and product market competition, the lower the likelihood to find overall support for a combined reform.*

Employed workers will more likely favour a combined reform than only a labour market reform. A product market reform is always favored by the employed workers because this increases their wages and thus the sum of the two reforms has more change to get approval. When employed workers are negatively affected by a labour market reform, which is when the initial flexibility of the labour market is low (the sclerosis effect), and when the competition in the product market is initially intense, it is possible that a combined reform might not find approval. In this case, a product market reform does not bring much change in wages and cannot compensate the employed workers for the negative impact of the labour market reform.

Firms will more agree upon a combined reform than only a product market reform. A labour market will always be favored by the firms since this decreases the labour costs and thus the sum of the two reforms has more chance to get approval. But when the initial market power is high, inducing more competition hurts the firms more, and when the labour market is already flexible, the possibility that firms will oppose a combined is highest. In this case, a labour market reform does not bring much change in labour costs and cannot compensate the firms for the negative impact of the product market reform.

The use of a combination of both welfare enhancing reforms opens thus the possibility to distribute the losses and gains for the employed workers and firms. Each reform creates positive and negative externalities, but for different interest groups. Only when initially the labour market is very flexible and initial direct competition very low, firms will not agree. Also, when initial direct competition between firms is high and labour market flexibility low, employed workers cannot be compensated enough and will block reforms. Thus the higher the negative correlation between the frictions in the markets, the higher the possibility that one of the two interest groups will block a combined reform. Therefore, the higher the negative correlation, the less chance for total approval.

This result has in our view a very important implication. When markets suffer from sclerosis, i.e. frictions are very high, it has been traditionally found in the literature that reforms will be hardest to be approved. But our analysis suggests that this is not necessarily the case when reforms are combined. If there exist sclerosis in both markets, it is *not* impossible to get approval from reforms. The high frictions in the one market make it *easier* to reform the other market and therefore the sclerosis in the one market can cancel out the sclerosis in the other market. The results also indicate that in order to implement reforms, one should combine both reforms at the same pace and gives a plausible explanation for the high positive correlation between product and labour market frictions (Boeri [11]).

In our model we did not take into account that workers can also be consumers, which is outside the scope of our model. In other words, we did not take into account the fact that the product market price has at least some influence on the welfare of the workers. We give here briefly the reasoning of what would happen when including the product market price in the welfare of the workers. An exogenous increase in the product market competition m leads to a decrease in the equilibrium product market price p^* as is shown in Lemma 1.1. This means that welfare of workers goes up more in this case than we found in our model. Of course, the higher purchasing power is then translated in a higher product demand, which has again implications for p^*, l^* and w^*, but these are endogenous changes and cannot superate the first effect that is induced by an exogenous increase in m. An exogenous increase in the labour market flexibility s leads to a decrease in the equilibrium product market price p^* as is shown in Lemma 1.1. Thus, the welfare of the workers goes down less than found in our model. Again, this has its consequences on the product demand and p^*, l^* and w^*, but these endogenous movements are smaller than the effect that is induced by an exogenous increase in s.

Taking into account that workers can also be consumers in the product markets should lead therefore to less resistance by workers for a labour market reform and even more approval for a combined reform than found in our model, but the qualitative results found in this paper should still hold in a more general equilibrium context.

1.4 Conclusion

Welfare increasing reforms in the product and labour market are difficult to implement. In both markets there exist well-organised interest groups that have the power to block any change. In the labour markets, employed workers enjoy higher rents because of frictions and will likely oppose a reform that tries to remove some of these rigidities to increase employment. In the product markets, firms enjoy higher rents when competition is low and will try to steer the political decision process towards a status quo. Thus, also product markets reforms that introduce more competition will have a high probability to be opposed by firms. Indeed, in Europe regulations are high and reforms are largely marginal, especially in the labour markets. The product market reforms are more widespread, but still slow-moving and several sectors are still virtually served by monopolies, e.g. in the European power markets.

These issues have received a lot of attention in the economics literature. However, there has been done almost no research on the interaction between reforms in the labour and product markets. In this paper, we make a first attempt to analyse interactions between both types of reforms. We find that there exist important complementarities between reforms in the product and labour markets: each reform creates positive and negative effects, but for different interest groups. The positive externalities that one reform creates on an interest group can then be used to offset the negative externalities of the other reform. In this way, approval from both firms and employed workers is always easier to accomplish than when trying to reform only one market. This result offers a possible explanation for the observation that when product markets are more open to competition, labour markets tend as well to have less tight legislations protecting the employed pool. Moreover, this paper offers a possible way out of the so called 'sclerosis' effect. When frictions in markets are high, interest groups enjoy higher rents and oppose more reforms which means that markets that need most reforms, are most stuck in a sclerosis. But combining reforms offers a solution. The high frictions in the one market make it *easier* to reform the other market and therefore the sclerosis in the one market can cancel out the sclerosis in the other market.

Further progress requires extending the model of this paper. We have not explicitly modelled the political process through which the private interests are materialised in particular policy descriptions. Essentially the supply side of regulation is taken as exogenous, while the regulators are also agents that create, shape and monitor the regulatory process. The model does not include capital as a factor of production and does not distinguish between long and short term unemployment. Moreover, we used particular ways of modelling reforms that we thought as relevant for Europe. In the product market, we modelled reforms as a higher product market integration that leads to more direct competition. The next reform that we need to look at is lowering entry barriers and allowing new firms to enter the market. Labour market reforms are focused on making the laws for laying off a worker more flexible, but other research in labour economics found that results can be different for other types of reforms. Also, workers are not consuming in the same economy, so our model is not one of complete general equilibrium.

However, we believe that the basic result is important and will hold for other assumptions. There exist interactions between product an labour markets that can make it easier to get approval for welfare increasing reforms.

Chapter 2

Mergers, Investment Decisions and Internal Organisation

Jointly written with Albert Banal Estañol and Inés Macho-Stadler.

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2.1 Introduction

Mergers are common practice in many markets and their dynamics, as well as their advantages and disadvantages, are often discussed. Especially the analysis of horizontal mergers and their possible efficiency gains have been important topics in recent years (European Commission Report [19]). Economic merger theory shows that a merger can reduce welfare by increasing market power but that it can also create efficiency gains in a variety of ways, thereby making the merger possibly welfare enhancing (see Röller et al. [69] for an overview).

This is the approach indicated by the Merger Guidelines released by the US department of Justice, which "...will not challenge a merger if efficiencies are sufficient to reverse the merger's potential to harm consumers in the relevant market, e.g. by preventing price increases in that market." (US Merger Guidelines, revised April 8, 1007, section 4). It is debatable whether the European Merger Regulation No. 4064/89 allows or not for an efficiency defence. However, in practice, the European Commission (EC) has so far never used efficiency gains arguments to clear a merger. But the EC is also thinking to include specific guidelines on efficiency gains (Röller et al. [70]).

This paper broadens the theory on horizontal mergers with efficiency gains in concentrated markets. Currently all discussions on mergers are limited to exogenous efficiencies while the outcomes and policy recommendations could be different when considering that becoming more efficient requires investment and is thus a strategic decision. In their study for the European Commission, Röller et al. [70] lament the lack of economic knowledge about the interaction of merger and investment decisions: "It is not clear how one should treat the endogenous scale economies that are an alienable aspect of concentrated industries". The possibility that a merged firm *may* become more efficient does not mean that these gains will be actually realised as is now widely assumed in the economics literature.

The aim is to shed more light on how merger and investment decisions interact, and look how the internal organisation of firms has an influence on these interactions. A newly merged firm brings together different management teams, which can lead to distrust and conflict and therefore possibly less investment.[1] Our approach facilitates the understanding of why some mergers may fail to become more efficient or even fail to happen. Moreover, it allows us to pin down some pitfalls for the regulator when taking into account efficiency gains.

There exist two different strands in the literature in modelling merger formation. In the *exogenous merger literature*, the modeler exogenously fixes a group of firms whose members compare the benefits of going together with the benefits of staying alone. Although these models help to study the private and social incentives to merge, they do not predict the resulting market structure. Other firms cannot react

[1] A recent example can be found in the creation of Corus in 1999. The Anglo-Dutch group became the third-biggest steel company in the world, but its value has dramatically come down. The Economist (March 15th 2003) argues that the error was that Corus "failed to construct a workable model for its internal management, choosing instead to paper over the differences between the English and the Dutch systems."

to the merger and more importantly, different groups of firms may find it profitable to merge. In the more recent *endogenous merger literature* models, all firms are allowed to choose whether to merge or not and how to react to a merger, providing a prediction of the final market structure. This proves to be crucial in making policy recommendations and in understanding market outcomes and it is the approach we take in this paper.[2]

Different approaches have been proposed to model mergers endogenously. Some papers rely on non-cooperative game theoretic solutions.[3] But the theory of dynamic process of merger formation relies on arbitrary assumptions concerning the rules and the timing of the game. The alternative way we follow is to not fully describe the merger process, but to check whether a particular market structure can be the outcome of a merger process because no firm wants to change the current configuration. An industry structure is called *stable* if no manager or group of managers has an incentive to deviate and form a different firm.[4] The backside of such a methodology is its complexity and we only allow for three managers or firms present in the market, this being the minimum number to allow for mergers with "insiders" and "outsiders". We believe however that the main effects present would not change in situations with more than three firms.

We construct thus a model of endogenous mergers with three managers, or equivalently with three management teams with aligned interests. We will use the terms "managers" and "management teams" as synonyms throughout the rest of the paper. Managers choose whom to form partnerships with while anticipating a share of the future revenues. In line with Rajan & Zingales [66], we think it is realistic to claim

[2] For example Motta and Vasconcelos [56] show that a shortsighted regulator -one that considers only one merger without anticipating future reactions of competitors- could make wrong decisions in considering only the present merger. Or, Stennek and Fridolfsson [24] show that if being an "insider" is better than being an "outsider," firms may merge to preempt their partner merging with a rival, even if this reduces profits with respect to the status quo.

[3] Take for example again Motta and Vasconcelos [56] who analyse a four-firm sequential merger formation game. First two firms decide upon merging and then the two remaining firms can react by going together as well. If both mergers go ahead, a monopoly market structure is considered. At each stage, a regulator can block the merger and stop the merger process.

[4] Other papers that also used concepts of stability in a merger framework are Barros [4] in a three-firm Cournot model for asymmetric firms and Horn and Persson [40] for any number of firms. Both papers however do not describe internal organisation issues and abstract from the sharing of the profits between merger partners.

that the manager and not the owner is in control of many decisions that affect a firm's efficiency.[5] Each manager controls some non-transferable resources, such as organisational or managerial capacities, that determine production costs. When managers are together, the resources of the new formed firm add up the resources that the participating managers control.[6] This allows us to take into account efficiency gains due to the close integration of specific hard-to-trade assets owned by the merging managers, "synergies" in the terminology of Farrell and Shapiro [21].[7]

A merged firm cannot enjoy these synergies if it fires a manager (or his team) since the fired manager would take his assets with him. If a merger is -at least partly- executed to lead to synergy gains by the bringing together of hard-to-trade assets, it is not possible to dismiss a manager (or his team).[8]

However, the possibility that a merger leads to efficiency gains does not mean that these gains will be actually realised. This is because of two related factors. Firstly, the right asset investment for the firm may imply a private cost for a manager: it may leave the manager to forego private benefits. In making the relation-specific investment which benefits the firm, he nay not be able to do a more market-oriented investment, increasing the value of his assets for outside use and thus more benefiting him privately.[9] This idea that managers' interests are not always perfectly aligned

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[5] Rajan & Zingales [66] say that the amount of surplus that a manager gets from the control of residual rights is often more contingent on him making the right specific investment than the surplus that comes from ownership. Hence, access to the resources of the firm can be a better mechanism to describe power than ownership.

[6] This argument is valid for all cases where the resources are complementary. The same idea is found in Bloch [10] and Goyal & Moraga-González [31], where efforts in R&D induce a higher spillover if firms are in a joint venture.

[7] A recent literature on endogenous coalition formation deals with efficiency gains (e.g. Belleflamme [5], Bloch [10] and Yi [87]), but also these authors model efficiency gains as exogenous.

[8] Suppose for example that there are two managers, each of them having specific computer knowledge. Both can independently decide to develop an information system, each leading to more efficiency in the firm. But if both the systems are developed, the interaction between the two can lead to a better functioning of the information flows of the firm, hereby creating synergies. If one manager leaves the company, he takes his knowledge with him and synergies cannot be created.

[9] This is most evident with bringing in human capital. Take again the manager (or a team of workers led by a manager) who brings in specific computer knowledge. It would be in the best interest of the firm if the manager learns and develops some information system A given the specific needs of the firm, but at the moment information system B is more "hot" in the market. Thus, learning and developing system A comes at a private cost for the manager.

with the interests of the firm as a whole is not a new one and is proposed by a number of authors in different forms.[10]

Secondly, forging a common corporate goal out of two or more disparate cultures can be difficult and can even lead to less efficient and less profitable firms. Surprisingly enough, concepts such as distrust and conflict within the firm are often forgotten in the economics literature when looking at merger decisions, despite evidence indicating that they play a major role (Seabright [80]). It is said that the motivation of managers to work together in the interest of the firm comes from team spirit and trust (Kandel & Lazear [44]). But, this is exactly what is lacking in a newly merged firm. If people do not trust each other, then parties' primary objective is ensuring their personal interests, rather than sacrificing those interests entirely to the benefit of the whole firm. This need establishes and reinforces the manager's preference over the firm's (Flynn [23]). Since it is not always possible to write complete contracts, the lack of trust may lead to a free riding problem within a merged firm. As pointed out by Mailath et al. [52], it is often intrinsically hard to describe and verify the "right" action in sufficient detail to distinguish it from many seemingly similar actions with quite different payoff consequences.

For simplicity, we only consider two extreme cases. We start by analysing the situation where managers fully cooperate inside the firm. This is equivalent to saying that complete contracts can be written, or, managers trust each other and are willing to sacrifice their personal interests for the benefit of the firm. This setup permits us to investigate what happens when investment is a decision variable and compare it with the case where managers do not cooperate within the firm. We find that if managers inside a firm cooperate, they have more incentives to do so in a merged firm because of potential synergies. However, since they invest *only* when it is profitable, a potential merger is not necessarily more efficient, even when there is no internal conflict. The second scenario considers a situation where the managers do not trust

[10] Fulghieri and Rodrick [25] model internal agency activities as entrenchment: to avoid personal costs, a divisional manager can reduce the probability of his division being divested by reducing its attractiveness to potential outside buyers. Hart and Holmstrom [33] present a model in which workers receive private benefits from firm policies, which may or may not be aligned with owners' benefits because a worker's job satisfaction may differ from what owners want them to do. Mailath et al. [52] posit that the value of a manager's human capital depends on the firm's business strategy. The resulting interaction between business strategy and managerial incentives affects then the organisation of business activities.

each other. As a result, investment decisions are done only if it is beneficial for the manager personally (or for his team). As argued before, these decisions are often not contractible while a firm's profit is verifiable and thus contractible.[11] Thus suboptimal investment decisions are likely to occur (Holmström [38]). We find that the conflict of interests within the firm can dominate the possible synergies, making a larger merged firm invest less. A merger can therefore even be a *less* efficient firm than non-merged firms.[12]

The equilibrium investment decisions have an impact on the stability of industry structures. When looking at which mergers will effectively materialise, we find for cooperating managers inside the firm a result in the spirit of Salant et al. [74]. If all managers simultaneously can choose to go to the monopoly industry structure, they will do so. This is possible with our merger stability concept in which managers can anticipate the reaction of the others. Thus, when managers cooperate at the investment-decision level, the only stable structure is the monopoly. This complete market concentration does not necessarily lead to a more efficient production. For non-cooperating managers, not only the monopoly structure but the duopoly and triopoly are also possible stable outcomes. Two conclusions follow. First, conflict within the firm can lead to less market concentration, even when modelling mergers as the potentially most efficient firms. Second, when there will indeed be mergers in equilibrium, these merged firms are sometimes to be found less efficient. This happens when -despite the internal conflict- it is optimal to merge, but -because of more internal conflict and aggressive investment of competitors- managers invest less in the larger merged firms.

Welfare analysis tells us three things. First, taking efficiency gains as exogenous

[11] One can think of a more rich model where at least part of the investment decision is contractable, but still some aspects stay impossible to verify. The results of such a model should be close the model we present here, but with a lower degree of moral hazard.

[12] The set-up of the model and sequence of events is in the same philosophy as Espinosa & Macho-Stadler [20], Rajan & Zingales [66] and Goyal & Moraga-González [31]. In Espinosa and Macho-Stadler [20], partners group into firms in a sequential way, and in the second stage firms compete à la Cournot with a moral hazard problem inside the firms when deciding upon production. In Rajan & Zingales [66], an asset owner chooses how many managers can have access to the assets. The managers who receive access choose their non-contractible investment. In Goyal & Moraga-González [31], firms decide to participate in R&D networks. Given a collaboration network, each firm chooses a non-contractible investment which defines the cost of production and all firms individually compete à la Cournot afterwards.

would lead to the approval of many mergers that are welfare reducing. Second, this approving of welfare reducing mergers is done more often and is more costly when managers do not cooperate internally. And third, when using total welfare as a welfare measure instead of consumer welfare, mistakes are also made more often. This calls for caution in allowing firms to defend a merger on the base of efficiency gains. Especially in situations where information about costs and gains of investing is difficult to verify, it is maybe better to not let firms use this argument. It must be mentioned that sometimes a merger is mistakenly prohibited when taking into account only consumers, but this mistake is intuitively less costly since firms maybe do not become more efficient, but gain neither in market power while in allowing by mistake a merger this does occur.

We give as well an explanation for merger failures. When firms decide to go together, the organisational difficulties that this creates are often underestimated. If managers do not correctly foresee the internal problems, the new firm may not be profitable and thus resulting in a failure.

The paper is structured as follows. Section 2.2 describes the model. Sections 2.3, 2.4 and 2.5 present the solution of the different stages of the model. Section 2.6 and section 2.7 discuss respectively welfare issues and a possible explanation of merger failures. Finally, section 2.8 presents some extensions of the model. All proofs are presented in the Appendix.

2.2 Model

We consider a situation where three managers have to decide on their productive organisation. In a first stage, managers choose whether to set up their own firm or join forces with other managers, determining the industry structure (Ω). Three market structures can arise: monopoly, duopoly or triopoly. These industry structures are denoted, respectively, $\Omega_M = \{m\}$, $\Omega_D = \{i, o\}$ and $\Omega_T = \{t_1, t_2, t_3\}$, where m stands for a monopoly firm, i for a two-manager firm in the duopoly (set up by the two "insiders"), o for a single-manager firm in the duopoly (managed by the "outsider") and t for triopolist. In the second stage, production costs are determined. Each manager decides to which extent he makes a costly investment to reduce production costs. In the third stage the formed firms compete à la Cournot.

In the *first stage*, the merger stage, each manager decides whether to form a firm alone or together with other managers. We explain how firms merge and how merging partners share profits. Remember that we are using the concept of a stable industry structure. The benefits of a formed firm depend on the organisation of the other managers. Hence, in evaluating a possible deviation, managers must make a prediction of what the other managers will do. Several ad-hoc assumptions have been followed by the literature.[13] We adopt the -novel to our notice- view that the most reasonable prediction when deciding upon a deviation is that the remaining managers will choose their best strategy.

Definition 2.1. *An industry structure Ω is stable if there is no profitable deviation by a group of managers to form another firm, considering that the remaining managers would choose to form firms to maximise their payoff.*

When all three managers consider to deviate from the current market structure and form a monopoly, we only need to check if this is profitable since there are no managers left. When two managers deviate to form a two-manager firm, the remaining manager can only stay alone. More interestingly, when only one manager deviates, the remaining two optimally choose either to go together or to split apart.

For simplicity, we present throughout the paper the case where the *sharing of a firm's profits is exogenously set to giving all managers an equal part*. But as argued in detail in Section 2.8, our results remain qualitatively unchanged when optimal contracts are used within a firm. The optimal contract maximises firm's profits, taking into account the incentives provided by this agreement in the investment stage. When the equal sharing does not give the adequate incentives in a multi-manager firm, better investment incentives can be obtained by increasing the percentage of the profits to some managers and compensate the others via a fixed fee.

Once firms are formed and the market structure is set, production costs are determined in a *second stage*. Following Perry and Porter [64], we allow the possibility that the merged firm is larger than any of the forming firms, i.e. that it produces at lower marginal cost. We model this by assuming that each manager has a limited amount of resources or assets which, if adequately employed, lower the production

[13] Mainly two assumptions are made in the literature. A first approach is to assume that all managers not involved in the deviation will split apart towards stand-alone firms (e.g. Barros [4]). The second way is to assume that the other managers do not react at all, which is how Horn and Persson [40] model stability.

cost of the firm. Hence, more managers in the firm increases the possibilities to lower the marginal cost of production. These assets also have an alternative use outside the firm and making the right asset investment for the firm implies a private cost for the manager. Hence, in contrast to Perry and Porter [64], insiders do not always devote their resources to reduce the marginal costs of the merged firm. Consequently, if insiders do not invest in cost reducing activities, merged firms might not be more efficient than either of the merging firms. This allows us to differentiate between potential and realised efficiency gains.

To accommodate this additional decision, we assume that the magnitude of the investment by the managers are substracted from the common marginal cost, S (instead of divided as in Perry and Porter's model). Accordingly, the constant marginal cost of firm ω in a given market structure is given by

$$s_{\omega} = S - \sum_{j \in \omega} I_j, \tag{2.1}$$

where I_j, $I_j \in \{0, k\}$, represents the magnitude that investment by manager j brings in lowering the production costs of firm ω.[14] The cost of an investment I_j is $C_j(I_j)$, where $C_j(0) = 0$ and $C_j(k) = c$. As explained above, c represents the private benefits lost by making the relation-specific investment I_j, which lowers the marginal costs by k units.[15] If managers' assets do not have any outside value, $c = 0$, then all the managers in all possible market structures devote resources to reduce the marginal cost and our model leads to the same qualitative results as in Perry and Porter's model [64].

Managers simultaneously choose whether to make this relation-specific investment. As a benchmark case, in a first scenario the managers in each firm cooperatively decide which investments to make. Indeed, if there is no internal conflict within a firm, managers behave in the interest of the firm to which they belong.[16] In the

[14] We assume that in equilibrium all firms in all industry structures produce a non-negative quantity and therefore $k \in [0, \frac{a-S}{2}]$.

[15] Note that an alternative approach is to assume that the investment belongs to an interval $[0, k]$. Given the linearity of the model, this would be equivalent to the assumption $I \in \{0, k\}$ since the optimal decision on investment is always a corner solution. To consider convex cost functions for investment makes the model untractable when managers decide upon investment levels.

[16] Equivalently, managers unilaterely decide to which extent to invest and these decisions are contractible and verifiable.

second case, each manager does what is best for him individually because of a lack of trust.

In the *third stage* of the game, firms simultaneously decide their production level. We consider a homogeneous market with a linear demand, $P(Q) = a - Q$, where a is a positive constant measuring the size of the market and $Q = \sum_{\omega \in \Omega} q_\omega$ is the total production, with q_ω the production of firm w.[17]

We solve the game by backward induction. For each scenario and for each market structure, managers take investment decisions, anticipating production decisions. Multiple Nash equilibria in investment may exist in a particular market structure. If this happens, at the merger stage managers need to make a prediction about which would be the investment outcome at that market structure. As other authors, we adopt the view that managers are *optimistic*: when considering a deviation leading to that structure, a manager or a group of managers predict that the resulting investment equilibrium will be the one which benefits him or them the most.[18] Although this view may induce many deviations and no stable industry structure, it allows us to concentrate on the 'very' stable ones.[19]

2.3 Product market competition (3rd Stage)

Assume that an industry structure Ω with r firms has been formed at stage 1 and the investments made in stage 2 imply costs s_υ, for all $\upsilon \in \Omega$. Then each firm $w \in \Omega$

[17] It is in the interest of all the managers in the same firm to cooperate in the product market. This is because we do not assume that there is an individual cost attached to producing. For a partnership formation model where production is costly for each manager, see Espinosa & Macho-Stadler [20].

[18] Diamantoudi [17] analyses the endogenous formation of coalitions using the concept of 'binding agreements' when there are multiple Nash equilibria and considers different behavioral assumptions, among others the optimistic approach. A similar concept for matching markets has been defined by Demange & Gale [15]. Our assumption of managers being optimistic reduces the set of stable market structures, making in some cases the set empty. If managers were pessimistic and hence less willing to deviate, while the set of empty structures may be smaller, we might have situations with multiple stable structures.

[19] In our model with three managers, stability is reached for almost all parameter combinations. Non-existence of stable outcomes is something wich unfortunately happens often when using stability concepts as in for example Horn and Persson [40].

maximizes its profits:

$$\max_{q_\omega}\left\{\left[a-\sum_{\upsilon\in\Omega}q_\upsilon\right]q_\omega-s_\omega q_\omega\right\}.$$

The Nash equilibrium of the Cournot game leads firm $\omega\in\Omega$ to produce

$$q_\omega=\frac{a+\sum\limits_{\upsilon\in\Omega,\upsilon\neq\omega}s_\upsilon-rs_\omega}{r+1}=\frac{a-S-\sum\limits_{\upsilon\in\Omega,\upsilon\neq\omega}I_\upsilon+rI_\omega}{r+1}. \tag{2.2}$$

Without loss of generality we assume $a-S=1$. The equilibrium (gross) profit for firm ω is

$$\Pi_\omega=\frac{\left(1-\sum\limits_{\upsilon\in\Omega,\upsilon\neq\omega}I_\upsilon+rI_\omega\right)^2}{(r+1)^2}. \tag{2.3}$$

2.4 Endogenous Investment (2nd stage)

A manager brings in hard-to-trade assets to the firm which if adequately employed lead to lower marginal costs. When managers merge, the resulting firm might become more efficient. We say that there are *efficiency gains* when a merged firm produces at a lower marginal cost than would separate entities do. This lowering in marginal costs is not due to simple scale economies, but to the close integration of specific hard-to-trade assets owned by the merging managers, possibilities of "synergies" in the terminology of Farrell and Shapiro [21]. But the bringing together of these assets alone is not enough to realise synergies. It must be that managers *use* these assets in a productive way.

Definition 2.2. *A merger implies* ***efficiency gains*** *when the merged firm produces at a lower marginal cost than would separate entities do. These lower production costs result from (1) the close integration of specific hard-to-trade assets AND (2) managers invest in the brought in assets.*

For organisational structure to have any effect on decisions, it must be the case that the investment decisions (or at least part of them) cannot be contracted on. This assumption is motivated by the observation that, in many circumstances, it is intrinsically hard to describe the "right" action in sufficient detail to distinguish it from many seemingly similar actions with quite different payoff consequences. Contracting to induce that action may be impossible even after the state of the world is realised. For simplicity we assume that *no* contract can be written about the managers's investment decisions. On the other hand, the monetary benefits of the firm are contractible because they are easily verifiable.

We look at two extreme cases of internal organisation. First, we discuss the scenario where managers cooperate fully within the firm, i.e. all decisions are contractible. This results in the best possible situation for the managers (first best). Second, the situation as described above where profits are verifiable but investment is uncontractible, the "internal conflict" case, is looked at. Of course, other organisational set-ups are possible (see e.g. in Gal-Or [30] where different forms of integration are compared), but less adequate to describe an organisational integration where synergies can arise.

2.4.1 No Internal Conflict

If investment is a cooperative decision within the firm, the profit for a manager j in firm $\omega \in \Omega$ with $|\omega|$ managers is

$$\pi_{\omega}^{j} = \frac{1}{|\omega|}\Pi_{\omega} - \frac{1}{|\omega|}\sum_{l \in \omega} C_l \ . \tag{2.4}$$

Note that maximizing (2.4) is equivalent to maximizing the (net) profits of the firm. Investment of different firms must form a Nash equilibrium.

It is intuitive enough that costs c and gains k of investment play a major role in what happens in equilibrium and our analysis is done in function of these two parameters. But apart from costs and gains, the amount in which firms will decide to reduce production costs depends (i) on the size of the firms, i.e. the number of managers in the firm, and (ii), on the competition level. First, the larger a firm is, the more incentives to invest. Since managers in the same firm are cooperating, they will be able to exploit the synergies. Second, a firm may want to invest for strategic reasons. Investment activities are strategic substitutes across firms and more investment implies later on a better position in the production phase vis à vis the competitors. Therefore, the more competitors in the market, the more incentives a manager has to invest. This means that the scale effect and strategic effect go in *opposite* directions.[20] Proposition 1 states the previous intuition as a function of the parameters of the model. Remark that we state the efficiency gains in the conditional state. At this stage we do not know yet which mergers are going to take place, if any.

Proposition 2.3. *When managers cooperate, for costs w.r.t. gains of investment going from low to high, we can distinguish four regions:*
(A) All managers invest. Any merger would imply efficiency gains.
(B) Managers in the monopoly and insiders in a duopoly invest, but single-manager firms may not. Any merger would imply efficiency gains.
(C) Managers that set up a firm alone do not invest. Either the monopolists or the insiders invest. There exist therefore always a merger that would lead to efficiency gains, but not any merger would lead to an efficiency gain.
(D) Nobody invests. No merger would imply efficiency gains.

The regions defined in Proposition 2.3 are stated formally in the Appendix and are depicted in Figure 1.[21] When the investment is free (i.e., $c = 0$) or its costs is very low, any firm will invest in reducing production costs (region A). On the contrary, when the investment is extremely expensive as compared to the cost-production savings, the optimal decision will be not to invest (region D). For intermediate ranges of costs w.r.t. gains of investment, the synergy and strategic issues determine who invests. Region B shows that the first managers to give up investing are the one-manager firms, because the synergy event is strongest: the smallest firms loose first their incentives. In region C, both effects can dominate. In region C1, only monopolists invest because the synergy effect dominates. In region C2, the strategic motive is more important and the insiders in the duopoly invest whereas the monopolists do not. Note that *within* the duopoly the insiders have more incentives to invest than the outsider because of the scale effect. In our model the strategic effects are almost always inferior to the

[20]This is of course an immediate consequence of our model. The number of managers in the market is fixed, so if there are more managers inside the firm -i.e. the firm is larger- there are less managers outside the firm -ie. there are less competitors. However, it seems natural to assume that, *given* a certain industry, larger firms and a more concentrated market go together, even if there would be free entry.

[21]Note that the normalisation $a - S = 1$ implies that $k \in [0, 1/2]$ in order to have all firms producing in equilibrium. Without the normalisation, the axes in Figure 1 would have been: $\frac{k}{a-S}$ and $\frac{c}{a-S}$. Comparative statics with respect to $(a - S)$ would simply expand or contract the Figure.

scale effects when there is no internal conflict.

[Place Figure 1 approximately here]

Multiple investment equilibria may exist. The optimal decision for a monopoly and duopoly is always unique. In the triopoly the *type* of equilibrium is unique but it is not always clear which manager invests in equilibrium. There are three equilibria of the type $((k)(k)(0))$ where two managers invest, $I = k$, and the third does not. In another region of the parameters there exist three Nash equilibria where the investment decisions take the form $((k)(0)(0))$. This is because managers are ex-ante symmetric and we cannot say who invests and who not. This is not important in the investment stage, but the identity of the managers that invest or does not may be important at the merger stage.

2.4.2 Internal Conflict

We now solve the situation where managers within the firm do not cooperate when taking investment decisions. Managers choose again their investment as a function of the gains this investment implies for the profits of the firm to which they belong. But the cost of investing is not shared by the whole firm, the managers *individually* bear this cost and a free riding problem might arise. The profit for a manager j in firm $\omega \in \Omega$ with $|\omega|$ managers is

$$\pi_\omega^j = \frac{1}{|\omega|}\Pi_\omega - C_j. \tag{2.5}$$

As in the first best case, the amount in which firms decide to reduce production costs depends (i) on the size of the firms and (ii), on the competition structure. However, the issues are not as clear cut anymore. If a firm is larger, there are still more chances to exploit the synergies. But also the possibility for internal conflict grows. In a larger firm each manager receives a smaller share of the gross profits induced by his individually costly investment. The effect of the size of a firm on the incentives to invest can go both ways. Whereas for low costs with respect to gains of investment synergies dominates, conflict becomes rapidly more important as costs w.r.t. gains rise. Thus, managers in larger firms loose much faster their incentives to invest than in the case without conflict. The strategic event still induces managers in a less concentrated market to invest more. It is therefore easy to understand that both the conflict and strategic effect go in the same direction. When conflict is strong, managers in smaller firms -and therefore also facing more competitors- have more incentives to invest. Proposition 2.4 states the previous intuition as a function of the parameters of the model.

Proposition 2.4. *When managers do not cooperate inside the firm, for costs w.r.t. gains of investment going from low to high, we can distinguish four regions:*
(E) Managers in a monopoly and insiders invest. Any merger would imply efficiency gains.
(F) Managers in a monopoly never invest and there is always an equilibrium in which insiders invest. In the equilibrium where insiders invest, a merger towards duopoly would imply efficiency gains. A merger towards monopoly would mean an efficiency loss.
(G) Managers in the monopoly and insiders never invest, but there exists always a single-manager firm that does. Any merger would imply efficiency losses.
(H) Nobody invests. No merger leads to efficiency gains or efficiency losses.

The regions defined in Proposition 2.4 are stated formally in the Appendix and are depicted in Figure 2. In region E where the investment is close to free, any firm invests. Within this region conflict is not important, and the synergy effect dominates, implying that the largest firms in the market have most incentives to invest. When costs rise relatively, the conflict issue, reinforced by the strategic effect, starts interfering with scale and managers in the monopoly stop investing (region F1). Further on, the conflict situation becomes more and more important, making either the insiders or the outsider in duopoly invest (region F2). The conflict effect becomes finally always dominant and insiders never invest anymore (region G). Finally, when the investment is extremely expensive as compared to the cost-production savings, the optimal decision for all managers will be not to invest (region H).

[Place Figure 2 approximately here]

What does this imply for the efficiency gains? As long as the monopolist invests, any merger leads to a more efficient firm. From the moment that managers in the monopoly do not invest and other managers still do, a merger towards monopoly leads to efficiency *losses*. When also the insiders stop investing and the one-manager firm still does, *any* merger leads to efficiency losses. Finally, when nobody invests, a merger does not lead to any efficiency changes.

Summarising the results obtained for both scenarios, some mergers may induce efficiency gains but for this to be true a necessary condition is that the cost of the investment compared to the gains are low enough. When the internal conflict is important, a merger may even imply efficiency losses.

2.5 Stable market structures (1st stage)

Managers decide in the first stage to stay alone or go together with other managers, anticipating the investment decisions and competition in the market. We analyse the stable industry structures. We consider first the situation with no internal conflict.

2.5.1 No Internal Conflict

When managers cooperate within the firms, larger firms tend to invest more and tend to be more profitable. This makes it naturally more interesting for managers to merge. The next proposition confirms this intuition.

Proposition 2.5. *When there is no internal conflict within firms, the monopoly is the only stable structure.*

The results stated in Proposition 2.5 are represented in Figure 3. Two different processes lead the monopoly to be the only stable outcome. The first takes place because managers are able to avoid the classical outsider-problem. If a managers tries to free-ride on the others by deviating, the other two *optimally* split apart, making the deviation unprofitable.[22] The other process leads managers very naturally towards the monopoly outcome, because *any* merger is profitable for all managers.

When the cost of investment is high with respect to its gains (region D in the corresponding Figure 1), managers do not invest and the only motive for merging is having more market power. Managers reach thus the monopoly through the first process. However, when the cost of investment is low with respect to its gains (region A), managers always prefer to invest because of synergies. Merged entities have

[22] The outsider-problem occurs when it is beneficial for all to merge towards monopoly, but it is even better to be the outsider in duopoly. This is the situation in Salant et al. [74]. In their model, where there are no synergies, merging is beneficial if the number of outsiders is low and the merging firms represent at least 80% of the total market. In our three-firm case this threshold implies the merger towards monopoly.

therefore lower production costs, leading in general to more incentives to merge than when nobody invests. This situation is similar to the situation described in Perry & Porter [64], where the merged firm has lower production costs than either of the forming firms.[23] In regions B and C, either the first or the second process makes the monopoly the only stable outcome.

[Place Figure 3 approximately here]

2.5.2 Internal Conflict

We present the stable mergers when conflict within firms happens. For the sake of presentation, we show the results separately for the four regions identified in Proposition 2.4. Consider first the case corresponding to Proposition 2.4(E) where the cost of investment is low with respect to its gains, making monopolists and insiders always invest.

Proposition 2.6. *When there is internal conflict within firms and investment costs w.r.t. gains are low (monopolists and insiders always invest), the monopoly is the only stable structure.*

When managers always prefer to invest, entities merge towards monopoly for exactly the same reasons as when managers always invest in the no-conflict situation. These results are depicted in the lower part of Figure 4 (equivalent to region E of Figure 2).

[Place Figure 4 approximately here]

The case corresponding to Proposition 2.4(F) is where the conflict effect starts interfering with the synergy effect, making the monopoly never investing and there is always an equilibrium in which insiders invest.

[23] To be complete, we have to distinguish three different cases when all managers invest. First, for a high enough efficiency gain (a high enough k), the monopoly naturally arises. For intermediate gains, managers still prefer to be an outsider over being in a monopoly, but now the other two will prefer to stay together over being alone. There will be therefore continuously a duopoly, but the formed firms are *not stable*. When gains are low, only the merger towards monopoly is profitable and the reasoning is the same as in the case of no investment.

Proposition 2.7. *When there is internal conflict within firms and costs w.r.t. gains of investment are intermediate (monopolists never invest and insiders might invest),*
(a) If in equilibrium the insiders always invest, the duopoly or monopoly can be the unique stable industry structure.
(b) If in equilibrium either insiders or the outsider invest, the duopoly is the only stable structure.

Whenever the gains are high, the duopoly in which the insiders invest is the stable industry structure. The conflict effect induces the monopoly not to invest, but it is still not dominating in the two-player firm, making the insiders in the duopoly the best off (see intermediate part of Figure 4, corresponding to region F1 and F2 of Figure 2). In addition, insiders do not have incentives to split apart: the gains are high enough to prevent them to deviate to triopoly. Hence, duopoly is the stable market structure.[24] Insiders obtain here a higher profit than monopolists. This is an important effect that appears with conflict. When there is no internal conflict, monopoly is always superior to being an insider in duopoly.

When gains are lower and costs of investment higher, the stability arguments are again the same as the situation where all managers invest in no-conflict (its three cases also appear here, see footnote 14), but there is an important difference. Here the monopoly does *not* invest. However, even if in this region the monopoly does not invest, the reduction in competition and the lower benefits from investment make the monopoly substantially more beneficial and makes it the only stable industry structure (see region F1 and F2 of Figure 2). A merger to monopoly induces here efficiency losses.

When costs are high with respect to gains, we are in Proposition 2.4(G) and 2.4(H). The conflict effect becomes always dominant and neither monopolists nor insiders invest. When the investment is extremely expensive as compared to the cost-production savings, the optimal decision for *all* managers will be not to invest.

[24] In case (b), the investment Nash equilibrium in duopoly is not unique. There is an equilibrium where only the insiders invest and a second where only the outsider invests. When two managers deviate, they are optimistic and expect that in the duopoly structure the Nash equilibrium will be such that they will invest and the outsider will not. They obtain more under this market structure than under triopoly and hence the triopoly is not stable. When deviating from monopoly, the outsider being optimistic, assumes that the final equilibrium is the one in which he invests. However, when the outsider invests, the insiders prefer to break up and to deviate towards triopoly and we have no stability. For the same reason, the outsider-investing duopoly is not stable.

Proposition 2.8. *When there is internal conflict within firms and costs w.r.t. gains of investment are high (only single-manager firms might invest).*
(a) If only one triopolist invests, the triopoly or monopoly can be the unique stable industry structure.
(b) Otherwise, only the monopoly can be a stable industry structure.

When only one triopolist invests and gains from investment are high enough, it is clear that the triopoly will be the only stable industry structure.[25] In the other cases, monopoly is stable for the same reasons as in region D in Proposition 2.5.

When managers do not trust each other in a newly merged firm, they are less willing to invest, making in turn a merger sometimes unprofitable. Thus, internal conflict generates less mergers. This indicates that even when numerous factors would lead to monopolisation, managers might decide not to merge because of a lack of trust. Mergers however still occur because of the monopolisation factors. The monopolisation factors are twofold in our model: possible synergies and having more market power. But the lack of trust makes managers often not investing and mergers lead in this case to efficiency losses.

2.6 Merger Regulation

The regulator should try and estimate whether the higher power enjoyed by mergers are likely or not to be compensated by efficiency gains. We assume for most of this section that the regulator maximises *consumer welfare.* This is consistent with the current standards used both in the US and the EU to assess mergers.[26] By assuming that the regulator assesses mergers according to a consumer surplus standard, we do

[25] This triopolist does not want to merge with other managers because of the reinforcing conflict and strategic effects. The other two triopolists do not want to go together either. In a duopoly, the non-investing insiders are in a disadvantage with respect to the investing outsider and moreover, they have to share profits.

[26] In the US, the "substantial lessening of competition" test (SLC) has been interpreted that a merger is unlawful if it is likely that it will lead to an increase in price (that is, to a decrease in consumer surplus). In the EU, it is curently debated whether to switch to the SLC test or keep the current dominace test. It is less clear whether this test is closer to a consumer welfare or total welfare standard, but the wording of article 1.1.(b) of the Merger Regulation states that the Commission shall should take into account above all the interests of the consumers.

not want to imply that this *should* be the right standard.[27] We adopt this assumption because it describes best current practice and has the an advantage that it allows us to keep the analysis simple. Consumer welfare in our model is defined as:

$$W_C = \frac{Q^2}{2}. \tag{2.6}$$

The best solution for consumers is where total industry production is highest, inducing to a lowest market price for consumers. Total production is increasing in the level of competition and in firms' efficiency. We will now look at both scenarios separately.

First, suppose that managers are cooperating inside firms. From the previous section we know that managers always want to merge towards monopoly. A regulator needs thus to check when he wants to prohibit a monopoly. Figure 5 presents the consumer optimum for internal cooperation. If a regulator takes efficiency gains for granted -we call him a *naive regulator*- he assumes the investment cost to be zero, $c = 0$. Whenever investment gains are high enough, a naive regulator approves a merger towards monopoly (see bottom of Figure 5). However, we believe reality is more complex and investment costs are not negligible, $c > 0$. From Proposition 2.3 we know that there are many combinations of costs w.r.t. gains of investing where a merger does not lead to efficiency gains (see regions C and D of Figure 1). Taking this into account makes relatively a lot more monopolies bad for consumers since market power gains of firms are not going to be compensated with efficiency gains. For costs w.r.t. gains reasonably high, a merger towards monopoly might be approved by a naive regulator while it is not accompanied with efficiency gains and the merger should then *not* be allowed.

[Place Figure 5 approximately here]

Sometimes the opposite may also happen. Imagine the situation where investment costs are zero, $c = 0$, and efficiency gains k are high enough such that managers in all firm structures would invest, but these gains are not so high to have a monopoly or duopoly gain enough in efficiencies to offset gains in market power. A naive regulator says then no to any merger proposal. But maybe investment costs c are such that triopolists do not want to invest. Then it can occur that it is actually better to allow a merger towards monopoly since relative efficiency gains of the merger are

[27] But see Lyons [51] for arguments in favour of the consumer surplus standard.

high enough. Thus, sometimes a merger is erroneously blocked by naive merger authorities. This type of mistake is intuitively less costly since there might be some efficiency gains foregone, but firms gain not in market power. This leads us to the following proposition:

Proposition 2.9. *For managers cooperating internally, if antitrust authorities take efficiency gains of mergers for granted, they may erroneously allow both too few or too many mergers from a consumer welfare point of view.*

What happens if managers do not cooperate inside the firm? Managers in larger firms may invest less than if they would do in smaller firms as we explained in the previous section. Despite investing less, managers will still mostly want to merge towards monopoly (see Figure 4). As before, a naive regulator allows too many mergers when the potential efficiency gains are high (see the bottom of Figure 6).

[Place Figure 6 approximately here]

But in this situation he makes this mistake more often because of the internal conflict problem that becomes more serious for higher investment costs c. Moreover, when managers do not cooperate internally, *this mistake is more costly*, since a merger might lead to *less* efficient firms as compared to the stand-alone firms as we discussed in the previous section. The other mistake -prohibiting a merger that is welfare enhancing for consumers- is still made, but less often than before; managers in larger firms invest less, making efficiency gains seldom high enough to offset higher market power. Thus:

Proposition 2.10. *For managers not cooperating internally, if antitrust authorities take efficiency gains of mergers for granted, they allow more often by mistake mergers as compared with the situation where managers cooperate internally, but prohibit less often by mistake mergers.*

Since allowing by mistake a merger is more costly than prohibiting one by mistake, as explained above, a shortsighted regulator does more harm when there exists internal conflict.

Let us now have a quick look at total welfare. If the regulator were to take also firm profits into account, one could employ the standard sum of consumer and producer surplus,

$$W_T = \frac{Q^2}{2} + \sum_{w \in \Omega} \pi^w.$$

If this measure of welfare is used, then a naive regulator makes considerably more mistakes than when using consumer welfare. If there is no internal conflict, while the intended mergers towards monopoly should be now almost always accepted if efficiency gains are taken for granted (see the bottom part of Figure 7), they should be forbidden for a wide range of combinations of costs and gains. The reason is that firms gain relatively a lot more when all invest -and a naive regulator allows then more often mergers- but this investment very often does not materialise. The second type of mistakes -prohibiting a welfare enhancing merger- is not made when using total welfare.

[Place Figures 7 and 8 approximately here]

We can derive three main conclusions from the welfare analysis. First, taking efficiency gains as exogenous would lead to the approval of many mergers that are welfare reducing. Second, these approved mergers by mistake are made more often and are more costly when managers do not cooperate internally. Third, when using total welfare as a welfare measure instead of consumer welfare, mistakes are also made more often. This calls for caution in allowing firms to defend a merger on the base of efficiency gains. Especially in situations where information about costs and gains of investing is difficult to verify, it is maybe better to not let firms use this argument. It must be mentioned that sometimes a merger is mistakenly prohibited when taking into account only consumers, but this mistake is intuitively less costly since firms maybe do not become more efficient, but gain neither in market power.

2.7 Merger Failures

Our model can also provide some explanation for common phenomenon of merger failures. Until know managers were assumed to know the exact situation within the firm. If managers cannot perfectly foresee whether there will be internal conflict within the merged firm, it is possible that wrong merger decisions are taken. Suppose that ex-ante managers merge because they expect a priori that there will be no internal conflict, but conflict does arise later on. This misjudgments might lead to a merger failure (less profits in merger than in no-merger). We have indeed found cases where the monopoly is stable under no conflict but where in a conflict situation, profits are higher with a lower market concentration, meaning that because of not foreseeing this conflict, managers have erroneously merged.

A similar argument applies when managers are rational but there exists uncertainty about the possibility of internal conflict. Let us assume that ex post -in the investment stage- we are in one of our two extreme cases (no conflict at all or total conflict), but ex ante -in the merger stage- managers cannot perfectly foresee what is going to happen. Thus, managers decide upon merging given their expectations:

$$\begin{aligned} \Pr(Conflict) &= \alpha \\ \Pr(NoConflict) &= 1 - \alpha. \end{aligned}$$

Once mergers have occurred, managers realise in which case they are and investment decisions are as described in Section 2.4. We omit the derivation of the stable structures, but the procedure is similar to the two cases presented before.[28] The stable market structures are obtained by calculating with expected profits and are defined by the investment gains (k), investment costs (c) and expectations (α). For illustrating purposes, we depict in Figure 9 the stability results for the case $k = 1/2$.

[Place Figure 9 approximately here]

When managers merge to monopoly because they expect the merger to be profitable because the risk of internal conflict is sufficiently low, but there arises a conflict later, there are cases where triopoly or duopoly would have been better choices.[29]

It is worth noting that a complementary approach is to consider that uncertainty may affect the incentives to merge (see e.g. Banal-Estañol [2]). In addition, uncertainty over the ability of the merging firms to achieve efficiency gains may affect the behaviour of the outsiders. Amir et al. [1] model the post-merger situation as a Cournot oligopoly wherein the outsiders face uncertainty about the merged entity's final cost. In an exogenous model they consider the incentive for firms to merge and

[28] Calculations are available upon request.

[29] The opposite can also be true. If managers have a priori pessimistic expectations about the degree of internal conflict and choose not to merge, it may well be ex post that a merger would have been profitable.

they show that bilateral mergers are profitable provided that the non-merged firms believe that the merger will achieve large enough efficiency gains, even if these gains do not materialise ex-post.

2.8 Endogenous sharing rules

Throughout the paper we considered the *sharing rule as exogenous*. In this section we want to highlight that our results qualitatively remain unchanged in a model where the managers optimally decide upon the sharing of the profits when the firm is formed.

It seems natural to assume that when managers are ex ante identical, all have to receive ex-post the same payoff when being in the same firm. This is indeed true when there is no conflict because the sharing rule has no incentive effects (or when there is conflict but the investment cost $c = 0$). Each share is then determined by the managers' bargaining power and since identical managers have the same bargaining power, they share profits equally.[30] However, in a situation of internal conflict, the form of the sharing scheme -whether the managers receive their payoff via a fixed fee and/or as a percentage of the joint profit- determines the incentives to invest. Managers determine the terms of the contract in order to maximise the firm's profits while taking into account the incentives that this agreement provides. We state the optimal contracts for monopoly.

Lemma 2.11. *For given gains from investment, the optimal sharing scheme that managers in a monopoly will agree is:*
(a) For very low costs of investment, the optimal sharing is the equal division of profits. Investment will reach a level $3k$.
(b) For higher costs, one third of the monopoly profits does not provide enough incentives to invest. An agreement stating that one manager will receive a fixed fee and two managers will equally share the monopoly profits (minus the fixed part for the first) leads still two managers to invest. Since the third manager receives a fixed fee, he has no incentives to invest. Investment in will be $2k$.
(c) For still higher cost, half of the profits in monopoly is not enough anymore to pro-

[30] Ray & Vohra [68] proved that in a sequential coalition formation game where players are identical and they decide on the coalition they form and on nthe sharing rule, equal sharing is optimal.

vide incentives to invest. Only when a manager is the residual claimant of the firm, he may want to invest. The other two managers will receive a fixed fee. Investment will be k*.*
(d) For very high costs of investment no manager will invest, and any sharing scheme, including the equal sharing of profits, will be optimal. Investment is equal to zero.

Thus, when the parameter combinations are such that agreeing on an equal sharing of the profits induces the same investment decision as in the non-conflict case, this sharing rule is optimal. When the equal sharing does not give the right incentives in a multi-manager firm, better investment incentives can be obtained by increasing the percentage of the profits to some managers and compensate the others via a fixed fee. However, in this case the potential synergies will be smaller since the managers receiving a fix payoff will not invest.

The firm formed by two managers under duopoly has a similar payment scheme: for low costs equal sharing of duopoly profits is optimal. For higher costs, a manager receives a fixed fee, the other behaving as residual claimant will be the only one to invest, and for higher cost no manager will invest and equal sharing is again optimal.

When managers set up the optimal payment scheme within firms, the differences between the conflict and no conflict case change more gradually because in conflict the investment levels decrease now more gradually. However, our results do not change qualitatively by letting multi-manager firms sign optimal contracts. We have chosen to present the exogenous sharing rule case because this reduces drastically the number of cases to consider. While having considerably more cases, the analysis of the stable structures with endogenous sharing agreements is very similar to Propositions 2.6, 2.7 and 2.8.

2.9 Conclusion

The purpose of this paper is to broaden the theory on horizontal mergers with efficiency gains in concentrated markets, including investment as a strategic variable and allowing for a lack of trust within the firm. This approach facilitates the understanding of why some mergers may fail to become more efficient or even fail to happen. Other merger models take investment to be exogenous and treat the firm as a black box, but as Holmström [39] points out, "we cannot claim to fully understand either the internal organisation of firms or the operation in markets by studying them in isolation".

We construct an endogenous merger formation model with three managers simultaneously taking merger decisions. Internal problems may arise on the moment where managers decide on investing. The lack of trust and inability to identify individual contributions may result in free-riding problems and suboptimal decisions.

We find indeed that even when allowing a merger to be potentially more efficient -i.e., a larger firm can produce at a lower cost when having taken the necessary investment decisions- managers in a merged firm do not necessarily want this to happen. People in a larger firm have effectively more incentives to invest because of synergies, but only do so when this is profitable. The problems due to a lack of trust -becoming bigger in a larger firm- can even offset the possible synergies thereby making a merged firm *less* efficient. In a model of strategic R&D networks with Cournot competition in later stage, Goyal & Moraga-González [31] also find that when R&D is unilaterally chosen, the level of R&D is decreasing in the size of the R&D network.

When managers cooperate internally, we find a complete market concentration to be the only stable outcome. Managers can simultaneously decide together and are able to reach what is for them the best possible industry structure (this is a result similar in the spirit of Salant et al. [74]). With internal conflict, not only monopoly but also less concentrated market structures and even a completely defragmented industry is possible in equilibrium.

Therefore, when managers in the same firm cooperate, all merge, but this merged firm is not necessarily more efficient than a smaller firm would be. When managers do not cooperate internally, they may decide not to merge because of a too high conflict. If they still decide to merge, they may invest less than would do smaller firms.

Welfare analysis tells us that taking efficiency gains as exogenous lead to the approval of too many mergers that are welfare reducing. These approved mergers by mistake are made more often and are more costly when managers do not cooperate internally. And, when using total welfare as a welfare measure instead of consumer welfare, mistakes are also made more often. It must be mentioned that sometimes a merger is mistakenly prohibited when taking into account consumer welfare, but this mistake is intuitively less costly since firms maybe do not become more efficient, but gain neither in market power.

With our results, we want to point out that the recent documents on the "efficiency defence of mergers" (see European Commission Report [19]) are forgetting some essential elements. A regulator should not assume that possible efficiency gains of a merger will be realised, which could change the decision for approval of this merger. This calls for caution in allowing firms to defend a merger on the base of efficiency gains. Especially in situations where information about costs and gains of investing is difficult to verify, it is maybe better to not let firms use this argument. Finally, our model also gives an explanation for merger failures. When firms decide to go together, the organisational difficulties that this creates are often underestimated. If managers do not correctly foresee internal problems, they merge while this new entity is not profitable and resulting thus in a failure.

2.10 Figures

Figure 1: Investment Nash Equilibria when there is no internal conflict.

Figure 2: Investment Nash Equilibria when there is internal conflict.

Figure 3: Stable market structures when there is no internal conflict.

Figure 4: Stable market structures when there is internal conflict.

Figure 5: Consumer optimal market structures when there is no internal conflict.

Figure 6: Consumer optimal market structures when there is internal conflict.

Figure 7: Socially optimal market structures when there is no internal conflict.

Figure 8: Socially optimal market structures when there is internal conflict.

Figure 9: Stable market structures when there is a possibility of internal conflict ($k = 1/2$).

Chapter 3

Merger Failures

Jointly written with Albert Banal Estañol.

This chapter benefited from valuable discussions and comments by Miguel Angel Cestona, Inés Macho-Stadler and David Pérez-Castrillo. We have also benefited from the comments of seminar participants at the Universitat Autònoma de Barcelona, the University of Guelph, the Universidad del Pais Vasco and the Wissenschaftszentrum Berlin.

3.1 Introduction

On May 7, 1998, the CEO's of Daimler-Benz AG and Chrysler publicly announced their merger. The combined company was a colossus, with $132 billion in annual revenues and the largest industrial merger the world had ever seen. In the short term, synergies of $1.4 billion were expected, and more than the double in the medium term (DaimlerChrysler Proxy statement, p.59). However, after a $1 billion loss in the second quarter of 2003, DaimlerChrysler may end 2003 with losses. That wipes out the gains of 2002 and follows the $5.8 billion loss in 2001, the biggest loss in German business history. The total value of DaimlerChrysler shares at merger time was $47 billion; now it's $38 billion. Many say that the merger between Daimler and Chrysler was a failure (Business Week, 29/9/2003).

The DaimlerChrysler case is no exception. A majority of mergers and acquisitions (M&A's) fail. Failure occurs, on average, in every sense: acquiring firm stock prices tend to fall after the merger; many acquired companies are later sold off; profitability is lower after the merger.[1]

This paper offers a novel formal explanation of why some mergers fail and others succeed. We achieve predictions by investigating the interaction between two important aspects of merging: post-merger integration difficulties and the pre-merger gathering of information about obtainable merger synergies. In the pre-merger stage, firms gather information about the synergies possible, and part of this information is kept private while part is shared among partners. On the base of this information, each makes a prediction of the profitability of the merger and of which integration actions the partner is likely to take. When the two firms decide to merge, there is the expectation to turn the merger into a successful entity -why would firms else want to merge? But in order to create a successful firm, partners need to do the right integration efforts to attain a workable common corporate culture. It may happen that it is ex-ante optimal for a firm to merge and to do minimal integration efforts in the post-merger stage, expecting his partner to adapt most. This can lead to failures if both partners take this course of actions. We call thus a "merger failure" the non-realisation of synergies after the merger agreement because of organisational problems, leading to not enough extra benefits for each partner to offset the merger costs and therefore into a loss of total benefits relative to not merging.[2]

Our story tries to capture the necessity to integrate different corporate cultures into a common one in order to enjoy synergies, as was also one of the main issues in the Daimler-Chrysler merger:

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[1] Porter [65] revealed in his famous study of the M&A activity of 33 US companies over a long period that 50% of M&A's had divested: in other words, were failures. Also conclusive evidence comes from Ravenscraft and Scherer [67]. They find that operating income as a percentage of assets is lower by 0.03 for the merged business. This is a substantial (and statistically significant) drop, since their pre-merger operating income/assets ration averaged 0.115. Gugler et al. [32] analyze the effects of mergers around the world over the past15 years and find that those mergers that suffered a decrease in profits account for 43% of all investigated mergers. Of course, it is not clear at which point in time we can say that a merger is definitively a failure, because what is a merger failure after one year might become a success after five years. Gugler et al. [32] find however that the share of mergers that gained positive net benefits relative to non-merging stayed constant from year one to five after the merger, indicating that on average a failure stays a failure.

[2] It may be that a merger is a success only on the ground of market power gains or a merger might also be considered a failure when no agreement is reached (Hviid and Prendergast [41]). Our model includes both situations and other explanations of merger failures as explained below, but we focus on the story of failures on the ground of post-merger issues.

> "...Although the management of Chrysler and Daimler-Benz expect the transactions will produce substantial synergies, the integration of two large companies, incorporated in different countries and with different business cultures, presents significant management challenges. There can be no assurance that this integration, and the synergies expected to result from that integration, will be achieved rapidly or to the extend currently anticipated." (DaimlerChrysler Proxy statement, p.24)

Few economic studies have touched on post-merger issues and even on merger failures. Researchers have mainly focused on the incentives of merging. The net success of a merger is then the trade-off between the expected gains and the problems of managing a higher internal agency conflict.[3] These two factors are treated as having well-understood, independent effects on firm-value. Standard intuition suggests that, on the one hand the gains from merging increase monotonically with expected synergies; on the other hand, increasing organisational complexity is presumed to increase agency conflicts. But if a merger is the independent sum of expected synergy gains and costs, a merger failure thus only occurs because of bad luck.

Failure can occur because managers are "empire-builders". Managers may be not maximising benefits or share prices, but their own utility. Since their utility is typically correlated with the size of the firm to which they belong, managers merge only to belong to a larger firm. Gugler et al. [32] find that this explains roughly one third of the found failures in terms of lower benefits. But this is a "desired" failure by the managers.

A more explicit explanation of failure exists; managers overestimate the future performance of the merged entity because they are over-optimistic about synergy gains or simply do not foresee post-merger problems. Managers can make errors of overvaluation or undervaluation, because when merging they evaluate the merger in expected terms, but when the observed error is truncated towards the right, they are too optimistic (this is called managerial "hubris"). This explanation has been the

[3] Benefits arise because of expected synergies in scale and scope, an increase in market power or lower transaction costs (see Röller, Stennek and Verboven [69] for an overview). Internal conflicts may emerge from the more hierarchical structure of an organisation (Meyer, Milgrom and Roberts [53]), from divisional rent seeking (Sharfstein and Stein [75]), or simply from more coordination problems because of facing a more complex organisation (Weber, Camerer, Rottenstreich and Knez [85]).

theme of some recent studies that address explicitly the problem of merger failures.[4] In a study closest to our set-up, Fulghieri and Hodrick [25] link synergies with agency problems. When synergies and internal conflicts interact in more complex ways, optimal decision rules for a division of a merged firm depend on the decisions of managers of other divisions. This creates coordination problems and different merger outcomes are possible, dependent on the actions of the merger partners in the post-merger stage. If managers foresee that all will take the necessary actions to attain a workable merger, but end up in a situation where nobody does an effort, a merger failure occurs. However, why managers think that the good outcome will surely prevail and why the bad situation is the final outcome is not explained by Fulghieri and Hodrick [25] and the whole decision process remains thus a "black box".[5] This is annoying from an economic point of view, since one cannot predict the occurrence of merger failures in function of underlying parameters.

We think that a merger process can be modelled more realistically in such a way that managers make rational choices about which merger and integration actions to take. By considering uncertainty and information gathering about synergy gains in the pre-merger stage and adding a post-merger integration process, we can identify unique actions taken by managers and a unique outcome in function of the underlying parameters. Our model succeeds in explaining why optimal actions may still lead to a merger failure. Our emphasis on post-merger issues is not meant to suggest, of course, that the other potential causes of merger failure are not important. But Gugler et

[4] Banal-Estañol, Macho-Stadler, and Seldeslachts [3] give a theoretical explanation of failure where managers underestimate internal conflict. Weber and Camerer [83] show in an experimental study that following the merger of two firms, performance decreases because of conflicting organisational cultures while subjects did not foresee this. It must also be mentioned that Borek et al. [12] talk about merger failures. In a merger model with two-sided asymmetric information about firms' types, it may be that two "bad" firms merge towards a bad entity. However, this is not exactly a merger failure as we define it since the two firms were *before* the merger already in trouble.

[5] As Morrison and Shin [55] point out, the apparency of coordination problems in models can be seen as a consequence of two modelling assumptions introduced. First, the synergy gains are assumed to be common knowledge; and second, merger partners are assumed to be certain about others' behaviour in equilibrium. Both assumptions are made for the sake of tractability, but they do much more besides. If a firm expects its merger partner to do efforts in the post-merger stage, then it is in his best interest to do effort as well. But if a firm expects the other *not* to do any effort, he also wants to refrain from adapting towards the other's culture. In both cases, the beliefs are logically coherent and we have an indeterminacy because of "self-fulfilling beliefs".

al. [32] find that a fourth of all mergers and two thirds of all merger failures suffer a decrease in profits and sales; bad luck or hubris surely can't be the only reasons.

Cultural differences and poor integration efforts have often been cited in the business literature as the single most important factor in explaining a failure of synergy realisations (e.g. Larsson and Finkelstein [48]). Organisation theorists argue that although better outcomes are associated with choosing a better partner, or expertly identifying and successfully sharing key strategic complementarities, the degree to which these events are likely to occur depends upon the process of implementing the merger (e.g. Haspeslagh and Jemison [35] and Pablo [62]). But to our knowledge, the explicit modelling of the post-merger process in explaining merger failures is a novelty in the economics literature.

We allow managers in the pre-merger stage to gather information about the uncertain obtainable synergy gains. For example, firms often contract investment banks to acquire information about the possible synergy gains (Servaes and Zenner [77]). These gains remain inherently uncertain until a certain degree. Reaction of competitors after the merger, economic fundamentals etc. make that it is impossible to get absolute certainty. This obtained information is only going to be partly shared with the merger partner. In mergers, the only situation in which it is in the interests of both partners to have all knowledge shared is a genuine merger between peers. Such mergers are rare.

After the gathering of information, a firm can decide to propose the merger to the other firm, who in turn can accept or reject. When the two joined firms differ in their conventions, this can create a source of conflict and misunderstanding that prevents the merged firm from realising economic efficiency. Therefore, a merger can only fully function when a truly common corporate culture is developed. We come back later in a separate section on what is exactly a "corporate culture" and why it is needed for a good functioning of the merger. But the adaption process comes at a cost for each. Employees in each of the two firms may have reasons to prefer maintaining the "old way of doing things" – possibly because of learning costs, inertia, etc. – and may therefore intentionally resist adopting towards the other firms' practices. We model the post-merger process as a unilateral and costly decision of each partner to adapt towards the other in reaching a common corporate culture.

It is an important issue in explaining merger failures whether the managers change behaviour at an interim stage to take more desirable integration actions when actions of the merger partner are observed. We claim that such changes are not made -and hence the integration efforts should be modelled as simultaneous- since actions are difficult to verify, which implies also that it is neither ex ante nor ex post contractible. As in Mailath, Nocke and Postlewaite [52], we motivate this assumption by the observation that in many circumstances it is intrinsically hard to describe the desired actions in sufficient detail to distinguish it from seemingly similar actions with quite different consequences. Concrete discussions and actions during the integration fase are likely to be plagued by confusion and misunderstandings, reinforcing ambiguity about what each unit is doing (Vaara [81]). Moreover, firms often prefer to speed up the integration process in order not to loose momentum, but creating even more confusion.

We find that it may be optimal for firms to merge and to do not much integration efforts in the post-merger stage, leading to a failure. This happens when three conditions are fulfilled. First, costs of merging and stand-alone profits must not be too high, making the opportunity costs of merging low enough such that firms easily merge. Second, the punishment of not operating in a fully integrated entity cannot be too low, which lowers adaption incentives. And third, synergy expectations for a firm must be intermediate after the information gathering process. If expectations are high, firms are best of by integrating while for low expectations, firms do not want to merge anyway. For intermediate gains the firm prefers to take the merger step, but counts on the partner to do the adapting process, because it gives a high enough probability to the other doing the right actions. If now *both* partners gathered information saying that synergies could be intermediate, both will merge, but do nothing afterwards to let the merger succeed, a sure failure. The probabilities to encounter these failures rise when information becomes less precise and when merger opportunity costs are lower. Firms become more optimistic and merge more, but they also become more risk-loving.

Some of our results are intuitively clear as is the fact that less precise information leads to more failures. Less precise information makes it just easier to make judgement mistakes and to rely too much on the good news that your partner wants to merge with you. However, getting more precise information comes at a cost, both in terms of resources and time, so there is a trade-off. An obvious extension of this paper is including a cost for gathering more precise information. Second, the higher the potential synergy gains, the more probable these synergies are indeed realised through organisational integration, which is what Larsson and Finkelstein [48] confirm in their study of 61 merger case studies. Our explanation why this exactly happens is new though; we say that higher expectations induce better actions. Third, when costs of merging are lower, more merger failures are encountered. Gugler et al. [32] find that during stock market booms, when it is easier to find funding for buying up other firms, considerably more failures are encountered.[6]

One of the most interesting results of this paper, we believe, is that when the punishment of not-integrating is higher, the possibility for failures is reduced. This might be an explanation of findings that cross-border mergers or mergers with very different management styles sometimes are found to be more successful: the cultural differences that could derail effective synergy realisation in domestic mergers are more carefully attended to in cross border combinations because of managers' heightened sensitivity to such an apparently important consideration when combining firms in different countries (e.g. Morosini et al. [54]). As a result, though certainly not without significant challenge, cross border mergers or mergers between firms with very different management cultures may actually not represent such dangers as they are sometimes made out to be in the popular press.

The remainder of the paper is organised as follows. Section 3.2 explains in more detail what is organisational culture and how it is linked with failures. Section 3.3 presents the model. Section 3.4 analyses the model with all information about synergy gains shared. Section 3.5 presents the situation where information is kept private and discusses shortly the case of both public and private information. Section 3.6 concludes. All proofs are in the Appendix if not presented in the text.

3.2 Organisational Culture and Merger Failures

There are many organisational studies that link cultural differences and integration issues with merger problems (Haspeslagh and Jemison [35], and Pablo [62]). However, we still need to explain what is a "corporate culture" and why a lack of it leads often to inefficient organisations. We do not model any explicit process proving that having a common corporate culture leads to a well-functioning merger. This is beyond the scope of this paper. Instead, based on the literature, we explain that it leads to a

[6] This can of course also partly be due to managers becoming more optimistic at these times, which would lead to a failure because of more managerial "hubris" as the authors say.

more efficient firm and link this with merger failures. While agreement on a precise definition of the concept has proven difficult, there are a few important elements shared among organisational studies. Having a common culture is usually thought of as a general shared social understanding, resulting in commonly held assumptions and views of the world among organisational members. It is useful because it allows an organisation's members to coordinate activity tacitly without having to reach agreement explicitly in every instance. It usually comes about through shared experience or a process of socialization (Schein [76]). However, despite agreement that culture is important, it is difficult to measure and study precisely. Perhaps because of this difficulty of measurement and the lack of a concrete theoretical framework, culture has received considerably less attention from economists. Kreps [46] argues that culture presents organisations with a solution to problems in which there may be uncertainty about the appropriate behavior – cultural rules are "focal principles" that point to a solution, limiting the need for explicit communication. Hermalin [37] presents a formal model where culture is an efficiency-improving asset in which firms can invest. A shared understanding is extremely helpful because it allows members of a firm to coordinate activity successfully. Carrillo and Gromb [14] model corporate culture as production technologies for which employees can make specific investments. Weber and Camerer [83] finally present experimental results that bear on the phenomenon culture. They let pairs of people ('firms') develop a homemade language for solving problems, which they interpret as the firm's culture. They then merge groups and show that their performance often declines after the merger because their firms do not sufficiently adapt towards each other. Culture in their sense has again an obvious performance advantage.

Based on these studies on organisational culture, we assume that a common organisational culture leads to a better functioning of the merger. In order to reach this culture, merged partners need to adapt towards each other -or "invest" in a common culture in the terminology of the mentioned papers above- to achieve synergies. We assume then further from organisation theory (see Larsson and Finkelstein [48] for an overview) that if none of the partners does this investment, then *no* synergies are realised and a failure is in the making if market power gains are not enough to offset merger opportunity costs. We now turn to the model.

3.3 Model

Two symmetric firms consider the possibility to merge as equals. Modelling only mergers of equals is of course a simplification. It allows us to abstract from bargaining problems of how the benefits of the merger are going to be shared. A completely symmetric merger may be rare in reality, but at the time of the merger agreement between Daimler-Benz AG and Chrysler, both firms were similar in size, profitability and in the relative success of their portfolios. The whole process was continuously referred to as a "merger of equals".

By merging, firms have the possibility to obtain synergy gains.[7] These gains are uncertain but prior to the merger firms can collect information about synergies. To which extent these gains are realised depends on the post-integration process. More gains can be achieved when more integration efforts are made.

The two units or divisions of the new firm decide unilaterally and simultaneously whether to do an integration effort. We claim that interim changes are not made -and hence the integration efforts should be modelled as simultaneous- since actions are difficult to verify. Concrete discussions and actions during the integration fase are also likely to be plagued by confusion and misunderstandings, reinforcing ambiguity about what each unit is doing. An American DaimlerChrysler executive observed in 2001:

> "...In particularly Germany, the expectation was that if you tell them what it is you want, then they'll act that way. It was completely different from what we were doing at Chrysler. We had a much more in-depth way of communicating with employees. But we did not realise until it was too late, that we could not communicate the same thing across the world and that everybody would receive it the same way."

Moreover, firms often prefer to speed up the integration process in order not to loose momentum, resulting in even more confusion. During merger negotiations in

[7] Following the definition of Larsson and Finkelstein [48], synergies include (1) operational synergies in production, marketing, R&D and administration achieved through economies of scale, vertical economies and economies of scope, (2) collusive synergies from purchasing power (3) managerial synergies from applying complementary competencies, and (4) financial synergies from risk diversification and coinsurance. The various sources of synergies define a combination's potential.

April 1998, both Daimler-Benz and Chrysler executives decided they would move immediately and as fast as possible to integrate the two companies. Their executives recognised that a more gradual approach to integration could have been possible, but decided against it at the outset:

> "...A gradual integration process can help to reassure both sides that no decisions will be taken hastily and you give each other time to know the other side better. But it can be dangerous to wait. You may loose momentum and a real opportunity to make radical transformations in both companies."

The structure and timing of the model is thus as follows.

1. Pre-merger stage: Both firms gather information about the uncertain synergy gains of merging. Information can be shared or kept private.

2. Merger Stage: Managers of both firms decide unilaterally (and sequentially) whether to merge. Only when both firms agree to merge there is a post-merger stage.

3. Post-Merger Stage: The two units of the new firm decide unilaterally and simultaneously whether to do an integration effort.

3.3.1 Pre-Merger Stage: Gathering of Information

The potential synergies of merging θ for each partner i ($i = 1, 2$) are uncertain. Before gathering information, merger gains are completely uncertain and therefore θ is a priori randomly drawn from the real line, with each realisation equally likely.[8] We consider three possible ways of gathering information. Firstly, if at the pre-merger stage, firms only would engage in jointly information gathering, then both receive a "public signal", which we assume is

[8] The assumption that θ is uniformly distributed on the real line is non-standard but presents no technical difficulties. Such "improper priors" with infinite mass are well behaved as long as we are concerned only with conditional beliefs. See Hartigan [34] for a discussion on improper beliefs. An improper belief is the same as assuming that the prior distribution of θ becomes diffuse.

$$y = \theta + \upsilon, \tag{3.1}$$

where $\upsilon \sim U(-l, l)$ and υ and θ are independent. Both firms believe then that θ is uniformly distributed with

$$\theta \mid y \sim U[y - l, y + l].$$

Secondly, if on the other hand firms only would privately collect information, then from the independent gathering of information, each firm receives a signal that is not observed by the other firm, a "private signal" x_i (where $i = 1, 2$), which we assume is

$$x_i = \theta + \varepsilon_i, \tag{3.2}$$

where ε_i are i.i.d. with $\varepsilon_i \sim U(-l, l)$ and ε_i and θ, ε_i and υ are independent. Then expectations of synergy gains are different for each firm. Firm i thinks θ is uniformly distributed with

$$\theta \mid x_i \sim U[x_i - l, x_i + l]. \tag{3.3}$$

Each firm now also needs to predict the behaviour of the other firm. Given the information it has, needs to form a belief about the signal of the other. For firm i, the signal of the other firm x_j is distributed according to a sum of uniforms with density function

$$f(x_j \mid x_i) = \left\{ \begin{array}{ll} \frac{x_j - (x_i - 2l)}{(2l)^2} & \text{if } x_j \in [x_i - 2l, x_i] \\ \frac{x_i + 2l - x_j}{(2l)^2} & \text{if } x_j \in [x_i, x_i + 2l] \end{array} \right\}. \tag{3.4}$$

Thirdly, if now firms engage in a double information collection process, one in which firms work together and another which firms undertake separately, then both firms receive a public signal y and a private signal x_i as described in equations (3.1) and (3.2). If we assume for simplicity that the two signals are equally precise, it can be shown (see Appendix Synergy Gains) that firm i believes θ is uniformly distributed with

$$\theta \mid y, x_i \sim U[\max\{y, x_i\} - l, \min\{y, x_i\} + l].$$

Firms use now also both signals collected to update their beliefs about the signal of the other. For firm i, the signal of the other firm x_j is distributed according to a sum of uniforms, with density function (see Appendix Synergy Gains):

$$f(x_j \mid y, x_i) = \left\{ \begin{array}{lr} \frac{x_j - (\max\{y, x_i\} - 2l)}{2l(2l - (\max\{y, x_i\} - \min\{y, x_i\}))} & \text{if } x_j \in [\max\{y, x_i\} - 2l, \min\{y, x_i\}] \\ \frac{1}{2l} & \text{if } x_j \in [\min\{y, x_i\}, \max\{y, x_i\}] \\ \frac{\min\{y, x_i\} + 2l - x_j}{2l(2l - (\max\{y, x_i\} - \min\{y, x_i\}))} & \text{if } x_j \in [\max\{y, x_i\}, \min\{y, x_i\} + 2l] \end{array} \right\}.$$

After the pre-merger gathering of information, firms take a merger decision.

3.3.2 Merger decision

Based on the information previously collected, firms decide in a sequential way whether to merge. Denoting the firm that decides first as 1, firm 2 takes a decision only when firm 1 has accepted. Each firm i estimates, with the information I_i^m available at the merger stage, its profits from merging $E_i(u \mid I_i^m)$ as described below.[9] The information available depends on how the information in the pre-merger stage was collected. If all information is shared,

$$\begin{aligned} I_1^m &= \{y\}. \\ I_2^m &= \{y, \text{firm 1 agrees to merge}\}. \end{aligned}$$

With only independent collection of information

$$\begin{aligned} I_1^m &= \{x_1\}. \\ I_2^m &= \{x_2, \text{firm 1 agrees to merge}\}, \end{aligned}$$

whereas for the double information collection process

$$\begin{aligned} I_1^m &= \{x_1, y\}. \\ I_2^m &= \{x_2, y, \text{firm 1 agreed to merge}\}. \end{aligned}$$

Merging has costs K for each partner. If at least one firm decides not to merge, both firms obtain stand-alone profits Π, competing as independent firms. Thus, firm i decides to merge whenever

$$E_i(u \mid I_i^m) - K \geq \Pi. \tag{3.5}$$

[9] Remark that the expectation is player-dependent, $E_i()$, because each firm knows which action it is going to take in the post-merger stage.

3.3.3 Post-Merger Stage: The Integration Process

When both firms agree to become partners of a single firm, the integration process starts. The cultures of partner 1 and 2 before the merger, C_1^B and C_2^B, can be represented on the real line. Partners adapt their cultures in the post-merger stage towards C_1^A and C_2^A respectively. The obtained synergy gains are then

$$\frac{\theta}{d(C_1^B, C_2^B, C_1^A, C_2^A)},$$

where $d(C_1^B, C_2^B, C_1^A, C_2^A) \geq 1$ is the "discount function" when full integration is not achieved ($d(.) = 1$ is full integration). This perspective suggests that the content of the merger decision forms an upper bound on the degree of success that a merger can achieve, whereas the process affects the degree to which the potential is realised. The discount function can be defined as

$$d(C_1^B, C_2^B, C_1^A, C_2^A) = \left(\frac{dist(C_1^B, C_2^B)}{dist(C_1^B, C_2^B) - dist(C_1^A, C_2^A)} \right)^p,$$

where $dist(C_1^B, C_2^B)$ and $dist(C_1^A, C_2^A)$ represent the distance between firm 1 and firm 2's culture before and after the post-merger process respectively, and $p > 0$ is the degree of punishment. When both partners adapt fully towards each other in the post-merger stage, $dist(C_1^A, C_2^A) = 0$ an thus $d(C_1^B, C_2^B, C_1^A, C_2^A) = 1$ and synergy gains are not discounted. The modelled integration process is thus a metaphor for "coming towards each other", borrowed from the DaimlerChrysler Case:

> "...The debate about corporate culture seemed to center around: "German engineering versus American cowboy independence". In the end DaimlerChrysler managers decided that if the cultural differences are so far apart, they would pick a spot in the middle." (Herbert Paul, Fachhochschule Mainz).

We further model the integration process as a binary choice, i.e. a partner can choose to adapt its culture towards the other at an adoption cost t, or do nothing at all. Since partners are symmetric, there are three possible situations:

- When both partners adapt fully towards each other, $d(.) = 1$ and synergy gains are not discounted.

- If only one partner does an integration effort, $d(.) > 1$, since $dist(C_1^A, C_2^A) > 0$.[10] The higher the punishment p, the higher d.
- When none of them does an integration effort, the punishment is assumed to be extremely high, $d(C_1^B, C_2^B, C_1^A, C_2^A) = \infty$ and zero synergy gains are obtained.

Since we postulated above that the integration process should be modelled as a simultaneous decision, we can summarize the integration stage in a normal game form:[11]

	Integrate	Not Integrate
Integrate	$\theta - t, \theta - t$	$\frac{\theta}{d} - t, \frac{\theta}{d}$
Not Integrate	$\frac{\theta}{d}, \frac{\theta}{d} - t$	$0, 0$

When partners decide upon integration, potential synergy gains are still uncertain and each estimates θ using all the available information $E(\theta \mid I_i^p)$, where

$$I_i^p = \{I_i^m, \text{partner } j \text{ agreed to merge}\},$$

since both partners agreed to go ahead with the merger. Let us for now simplify the game by letting the integration cost $t = 1$. The simplified integration game can then be summarized as

	Integrate	Not Integrate
Integrate	$\theta - 1, \theta - 1$	$\frac{\theta}{d} - 1, \frac{\theta}{d}$
Not Integrate	$\frac{\theta}{d}, \frac{\theta}{d} - 1$	$0, 0$

(3.6)

The payoff structure of the post-merger stage is rich enough to capture two different settings that can occur when considering an integration process:

- If $d > 2$, integration efforts are *strategic complements*. For a given expectation of the synergy gains θ, a firm has more incentives to integrate when it knows its partner will integrate (or when it assigns a higher probability that its partner will integrate).

[10] We assume thus that one partner never wants to go as far as to adapt comnpletely towards the other's culture: $C_i^A \neq C_j^B$. This would not be realistic, even in the case of a take-over. We believe that both partners must do each *some* adaption effort to have a fully workable merger.

[11] Remark that we have to deduct in each post-merger situation the opportunity costs $K + \Pi$ that has been incurred because of the merger decision. In order to isolate the analysis of both stages, we do not write this cost here.

- When $d \in (1, 2]$, the actions of integrating are *strategic substitutes*. In this case, a firm has *less* incentives to integrate when it knows that its partner integrates (or when it assigns a higher probability that its partner will integrate).

Integration efforts are thus strategic substitutes or complements, depending on the magnitude of the discount factor d. If the discount factor is low, a firm prefers to not incur the integration costs when it beliefs that the partner integrates. While still enjoying important synergy benefits, no adaption cost has been paid. We believe that both situations are realistic when thinking about organisational integration processes. We now turn to the explanation of merging and integration decisions when all information is shared between the firms.

3.4 Merging and integrating decisions when all information is shared

Firms collect all information jointly and thus only receive the public signal y about the uncertain synergy gains θ. There is uncertainty, but everything is public information,[12]

$$I_i^m = I_j^m = I_i^p = I_j^p = y.$$

We can solve the model by backward induction, first solving the post-merger integration stage and then the merger decision. We distinguish between integration actions being strategic complements or substitutes.

3.4.1 Integration actions are strategic complements

Simple analysis of the integration process leads to the following equilibria. If $d > 2$ then actions are strategic complements and the equilibrium is such that

- If $y > d$, each player has a dominant strategy to integrate. (I, I) is the unique Nash Equilibrium, where I is short hand for integrating.
- If $y \in [\frac{d}{d-1}, d]$, there are two pure strategy NE: (I, I) and (NI, NI), where NI is short hand for not integrating.

[12] This is equivalent to the case in which θ is uncertain but known to both players from the very begining. We should then replace y for θ.

- If $y < \frac{d}{d-1}$, each player has a dominant strategy not to integrate: (NI, NI) is the unique NE.

This means that for $y > d$, a firm wants to merge whenever $E_i(u \mid I_i^m) - (K + \Pi) = y - 1 - (K + \Pi) \geq 0$, or whenever the public signal is higher than the sum of the merger and integration costs, $y \geq 1 + (K + \Pi)$. When $y < \frac{d}{d-1}$, the expected synergy gains are 0 and a firm never would like to merge when $(K + \Pi) > 0$. However, when $y \in [\frac{d}{d-1}, d]$, synergy gains are intermediate and there are multiple equilibria. It is not clear how one should compute the expected profits from merging. Because of self-fulfilling beliefs, firms cannot be sure in which integration stage equilibrium they are going to coordinate, (I, I) or (NI, NI). This is how other papers explain merger failures: ex ante, firms expect to coordinate in (I, I) and they decide to merge. However, for some reason, they coordinate ex post in (NI, NI) and should not have merged. A merger failure happens thus when firms pick ex-ante the "good" equilibrium, but coordinate ex-post into the "bad" equilibrium and firms are therefore bounded rational. One can of course never exclude the realisation of a θ that is much lower than predicted which would turn the merger into a failure, whatever action taken. It can thus also be that a merger turns out to be unprofitable when both firms coordinate well, but the synergy gains are lower than expected, just bad luck. This proofs the following Lemma.

Lemma 3.1. *: When all information about uncertain synergy gains is shared among merger partners and organisational integration actions are strategic complements, a merger failure can only occur because of irrationalities or bad luck.*

We now turn to the case where integration actions are strategic substitutes.

3.4.2 Integration actions are strategic substitutes

If $d \in (1, 2]$, then integration actions are strategic substitutes and the equilibrium is such that

- If $y > \frac{d}{d-1}$, each player has a dominant strategy to Integrate. (I, I) is the unique Nash Equilibrium.

- If $y \in [d, \frac{d}{d-1}]$, there are two pure strategy NE: (I, NI) and (NI, I).

- If $y < d$, each player has a dominant strategy not to integrate: (NI, NI) is the unique NE.

For $y > \frac{d}{d-1}$, a firm wants to merge whenever $E_i(u \mid I_i^m) - (K+\Pi) = y-1-K \geq 0$, or whenever the public signal is higher than the sum of the merger and integration costs, $y \geq 1 + (K + \Pi)$. When $y < d$, the expected synergy gains are 0 and a firm never would like to merge when $K + \Pi > 0$. Again, when synergy gains are intermediate, $y \in [d, \frac{d}{d-1}]$, there are multiple equilibria. But when integration actions are strategic substitutes, the situation (NI, NI), a clear case of merger failures for $(K + \Pi) > 0$, is never an equilibrium. Since firms are symmetric, both (NI, I) and (I, NI) lead to mergers when the integrating firm has expected benefits $\frac{y}{d} - 1$ higher than $(K+\Pi)$, or when $y \geq d(1+(K+\Pi))$. For the non-integrating firm, it must hold that $y \geq d(K + \Pi)$. Since both firms are symmetric and all information is public, a merger occurs thus when the most stringent condition is satisfied: it must be that $y \geq d(1 + (K + \Pi))$. If now firms had predicted the equilibrium (I, NI), but end up in (NI, I), the condition for merging is still satisfied for both firms because of symmetry. This means that merger failures only occur when the realisation θ is lower than expected. The following Lemma states our reasoning formally.

Lemma 3.2. *: When all information about uncertain synergy gains is shared among symmetric merger partners and organisational integration actions are strategic substitutes, a merger failure can only occur because of bad luck.*

Thus, when integration actions are strategic substitutes, there exists no "bad" equilibrium where both partners do nothing, which means that a failure only can occur if synergy gains are much lower than expected such that the merger turns out to be unprofitable.

A part of merger failures can indeed be explained by bad luck or irrationalities, but we believe that another explanation is possible. In what follows we introduce private information about synergy gains and we will be concerned in obtaining a unique equilibrium in the integration process so that firms will be rationally choosing actions. We assume the integration efforts to be strategic complements (and hence $d > 2$).[13] In a first step, we consider the case where firms only can collect privately

[13] The methodology to solve for unique equilibrium is different and more difficult when looking at strategic substitutes because action monotonicty does not hold anymore . We are currently working on solving the model for strategic substitutes.

information.

3.5 Merging and integrating decisions when all information is kept private

If the collection of information is done independently and not shared, then a firm only receives a private signal. To explain the methodology of equilibrium selection, we first suppose firms are "forced" into a merger. Thus firms only have to decide upon integrating. In the subsection thereafter, we will assume that firms also decide upon merging.

3.5.1 A forced Merger

When firms are forced into a merger, then the merging decision is not a deliberate one and does therefore not yield any extra information. All information received and used is the private signal x_i :

$$I_i^m = I_j^m = I_i^p = I_j^p = x_i.$$

Firm i can now not exactly foresee what signal firm j has received and thus what integration action partner j will take. We define now formally an integration strategy.

Definition 3.3. *: A strategy is a function specifying an action for each possible private signal,*

$$s_i : \mathbb{R} \rightarrow Int_i = \{Integrate, Not\ Integrate\}.$$

A natural type of strategy we might consider is one where a firm decides to integrate only if it observes a private signal above a cutoff point, $\widetilde{\widetilde{x}}_i$. We will refer to this strategy as the switching strategy around $\widetilde{\widetilde{x}}_i$.

Definition 3.4. *: An integration switching strategy for firm i around cutoff $\widetilde{\widetilde{x}}_i$ is*

$$s_i(x_i) = \left\{ \begin{array}{cc} Integrate & if\ x_i > \widetilde{\widetilde{x}}_i \\ Not\ Integrate & if\ x_i \leq \widetilde{\widetilde{x}}_i \end{array} \right\}.$$

Firm i will take a positive integration decision when

$$E_i(\text{Firm } i \text{ integrate}) \geq E_i(\text{Firm } i \text{ not integrate}). \tag{3.7}$$

From the integration payoffs (3.6) we can calculate the expected extra benefits of integrating over not integrating and using switching strategies, we can rewrite the integration decision of firm i (equation 3.7) as:

$$[E(\theta \mid x_i) - 1] \Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid x_i) + [E(\frac{\theta}{d} \mid x_i) - 1] \Pr ob(x_j < \widetilde{\widetilde{x}}_j \mid x_i) \geq [E(\frac{\theta}{d} \mid x_i)] \Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid x_i).$$

Rearranging terms and defining a function $g(x_i, \widetilde{\widetilde{x}}_j)$, firm i says yes when the expected synergy gains and the probability that its partner integrates are high enough such that

$$g(x_i, \widetilde{\widetilde{x}}_j) = E(\theta \mid x_i)[1 + (d-2) \Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid x_i)] - d \geq 0. \tag{3.8}$$

We now want to find the signal x_i such that firm i is indifferent between integrating and not integrating, i.e. where $g(x_i, \widetilde{\widetilde{x}}_j) = 0$. This is the signal which defines exactly the cutoff $\widetilde{\widetilde{x}}_i$ that firm i uses in its switching strategy, $g(\widetilde{\widetilde{x}}_i, \widetilde{\widetilde{x}}_j) = 0$. If both firms use the same cutoff, $\widetilde{\widetilde{x}}_j = \widetilde{\widetilde{x}}_j = \widetilde{\widetilde{x}}$, then the *symmetric* switching strategy for both firms can be found by letting

$$g(\widetilde{\widetilde{x}}, \widetilde{\widetilde{x}}) = [E(\theta \mid \widetilde{\widetilde{x}})][1 + (d-2) \Pr ob(x_j \geq \widetilde{\widetilde{x}} \mid \widetilde{\widetilde{x}})] - d = 0.$$

From the expectation of synergy gains (3.3) and the beliefs about the other's signal (3.4), we find the equilibrium[14] in which both firms use a switching strategy around cutoff

$$\widetilde{\widetilde{x}} = 2.$$

We see thus that having private information makes the firms take a particular action for each signal received and the zone of indeterminacy has disappeared. In fact, it is already proven by Carlsson and van Damme [13] and Morris and Shin [55] that in similar games with strategic complements each firm using this switching strategy

[14] An *equilibrium* is a profile of strategies -one for each firm- such that a firm´s strategy maximises his expected payoff conditional on the information available, when the other firm is following the strategies in the profile.

around a cutoff $\widetilde{\widetilde{x}}$ is not only the unique Bayesian Nash equilibrium but that it is also the unique strategy profile surviving iterated deletion of strictly (interim) dominated strategies.

Lemma 3.5. *: An integration switching strategy for each firm i*

$$s_i(x_i) = \begin{Bmatrix} \textit{Integrate} & \textit{if } x_i > 2 \\ \textit{Not Integrate} & \textit{if } x_i \leq 2 \end{Bmatrix}.$$

is the unique Nash equilibrium and survives iterated deletion of strictly dominated strategies.

Proof. See Morris and Shin [55] pp. 20–23 for the formal proof. □

We state here the reasoning for this result. The found cutoff lies between the cutoffs for the two dominant strategies in the public information case:

$$\frac{d}{d-1} \leq \widetilde{\widetilde{x}} = 2 \leq d, \tag{3.9}$$

where a partner never integrates when the public expected synergy gains are lower than $\frac{d}{d-1}$ and always integrates when the expected gains are larger than d. Both firms possess some noisy private information concerning the realisation of the synergy gains. If a firm receives a "very high" private signal ($x_i > d$), it will of course always integrate, since it believes that the merger looks that good that integrating is always profitable - independent of the integration actions undertaken by the other firm. This is the same as in the public information case. Consider now a firm that possesses a "high" but not a "very high" signal. If it expects the other not to integrate, then it would rather refrain from integrating. It knows, however, that a partner with a very high signal integrates. Given its own signal, it is equally likely that its partner has received a higher or lower signal than its own. Therefore, in equilibrium, it cannot expect that the other player does not integrate. As his signal is "high," its knowledge that partners with a very high signal integrate is then maybe enough to induce him to integrate as well, not having a "very high", but only a "high" signal. This will, in turn, convince the other firm possessing a signal a little less favorable then his to also. integrate, etc... This process of iterative elimination of dominated strategies stops at the point where a partner, who believes that someone with a lower signal than himself does not integrate, is indifferent between integrating and not integrating. Similar, because it is a dominant strategy not to integrate for firms with "very low" signals ($x_i < \frac{d}{d-1}$), firms with low signals refrain from integrating. Iteratively eliminating players for whom it is a dominant strategy not to integrate, there is a critical signal for which a merger partner is indifferent between integrating and not integrating if he believes that the other with a higher signal than himself integrates. With a uniform prior, the two iterative processes stop at the same point and, hence, there is a unique equilibrium.

Having explained the case where firms only can decide upon integrating, we now turn to the more realistic case where firms also can take merger decisions.

3.5.2 Firms use all available information

We define as above the switching strategies, both in the merger and integration stage.

Definition 3.6. *: A merger switching strategy with cutoff $\widetilde{x}_i$ for firm i can be described as*

$$s_i(x_i) = \begin{Bmatrix} Merge & \text{if } x_i > \widetilde{x}_i \\ Not\ Merge & \text{if } x_i \leq \widetilde{x}_i \end{Bmatrix}.$$

The integration switching strategy with cutoff $\widetilde{\widetilde{x}}_i$ is defined as above in definition 2. When managers use in the post-merger stage the extra information that comes from the positive merger decision of its partner, the cutoffs for merging and integrating become interdependent. Before finding these cutoffs, we proof in the following lemma that, although firm 1 who decides first upon merging does not know yet what firm 2 is going to decide, it can take decisions *as if* it knew that firm 2 is going to agree. Suppose that firm 2 plays a switching strategy around $\widetilde{x}_2$ in the merger stage, then:

Lemma 3.7. *: When taking a merger decision, first-mover firm 1 decides as if it knew that firm 2 is going to agree to merge, i.e.*

$$I_1^m = I_1^p = \{x_1, x_2 \geq \widetilde{x}_2\} = I_1.$$

The first-mover in the merger decisions can thus already use in the merger stage all information that will be available to him in the post-merger stage, $I_1^m = I_1^p$. This result is due to the fact that in the case where one of the two firms says no to the merger, stand-alone profits are assumed to be a constant Π. We believe that this is a realistic assumption. When the merger does not start, firms continue to be as profitable as before, i.e. the gathering of information about possible synergy gains in the pre-merger stage has not changed the profitability and the way of working of the two separate firms.[15] The consequences of this feature are important. When deciding upon merging, the first firm can use exactly the reasoning as the second firm and is thus not in a first-mover advantage or disadvantage. It also has as consequence that the extra information that is obtained because of the merger decision of the other can be used throughout the whole decision process.

We look now at the same time at merger and integration decisions. Both stages are treated simultaneously because of their interrelation.

From (3.6), we know that firm i integrates whenever:

$$g(x_i, \widetilde{x}_j, \widetilde{\widetilde{x}}_j) = E(\theta \mid I_i)[1 + (d-2)\Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i)] - d \geq 0. \tag{3.10}$$

This is of course the same decision as above in equation (3.8), where firms were also deciding upon integrating. There is an important difference however. With a forced merger, $g(.)$ depended only on the private signal x_i and the integration cutoff of the partner, $\widetilde{\widetilde{x}}_j$. Now also the merger cutoff of the partner, $\widetilde{x}_j$, will influence the integration decision of firm i, since the merger decision of the other reveals information, $I_i = \{x_i, x_j \geq \widetilde{x}_j\}$. This extra information in its turn influences the expected benefits, $E(\theta \mid I_i)$, and beliefs of the partner integrating, $\Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i)$, and has therefore its impact on the integration decisions of firm i.

From equation (3.5), the merger is wanted by firm i when $E_i(u \mid I_i) - K \geq \Pi$. There is in practice no information added between the merger and the integration stage, which means that when firms study the possibility to merge, they already know whether they want to integrate in the post-merger stage. Suppose first that firm i knows that it is going to integrate. Then from table (3.6), its expected benefits from merging $E_i(u \mid I_i)$ would be

$$E_i(u \mid I_i) = [E(\theta \mid I_i) - 1] * \Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i) + [\frac{E(\theta \mid I_i)}{d} - 1] * \Pr ob(x_j < \widetilde{\widetilde{x}}_j \mid I_i).$$

[15] There are situations one can think of where this is not completely true. Hvidd and Prendergast [41] illustrate how a failed merger bid reveals positive information about the target firm, i.e. the target firm is more worth than the bidder thought. However, in our model the only uncertainty comes from the synergies of the *merger,* not from benefits of the seperate entities. It would be an interesting extension to have a different Π_i for each different situation that results in a no-merger.

Rearranging terms and defining a function $h(.)$, given that it would *integrate in the post-merger stage*, a firm i merges whenever

$$h(x_i, \widetilde{x}_j, \widetilde{\widetilde{x}}_j) = E(\theta \mid I_i)[1 + (d-1)\Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i)] - d(1 + K + \Pi) \geq 0. \quad (3.11)$$

If now firm i knows that it will not integrate later on, we can again from the integration table (3.6) see that then

$$E_i(u \mid I_i) = [\frac{E(\theta \mid I_i)}{d}] * \Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i) + 0 * \Pr ob(x_j < \widetilde{\widetilde{x}}_j \mid I_i).$$

Defining a function $m(.)$ and rearranging terms, we can write the merger decision of firm i, given that it would *NOT integrate in the post-merger stage* as

$$m(x_i,\widetilde{x}_j,\widetilde{\widetilde{x}}_j) = E(\theta \mid I_i)\Pr ob(x_j \geq \widetilde{\widetilde{x}}_j \mid I_i) - d(K + \Pi) \geq 0. \quad (3.12)$$

It is important to note that also the merger decision depend on the cutoffs of the two stages. The merger functions $h(.)$ and $m(.)$ are a function of the private signal x_i, the merger cutoff of the other $\widetilde{x}_j$ *and* the integration cutoff of the other firm .$\widetilde{\widetilde{x}}_j$.

In finding and characterising the equilibrium, we proceed in three steps. In a first step, we characterise the potential equilibria in symmetric switching strategies and state the relative position of the cutoffs of integrating and merging. In a second step, it is shown that there exists an equilibrium and that it is unique for information gathered that has still some "noise", i.e. when information is not too precise. In a last step, we show how this unique equilibrium can be characterised in function of the exogenous parameters.

We show in a first step the characterisation of the equilibrium in both stages in symmetric switching strategies, i.e. we look for strategies of partners i and j around the same cutoffs in merging and integrating, $\widetilde{x}_i = \widetilde{x}_j = \widetilde{x}$ and $\widetilde{\widetilde{x}}_i = \widetilde{\widetilde{x}}_j = \widetilde{\widetilde{x}}$.

Lemma 3.8. *:* CHARACTERISATION OF THE EQUILIBRIUM.

A pair of cutoffs $(\widetilde{x}, \widetilde{\widetilde{x}})$ is a symmetric equilibrium in switching strategies iff

$$\text{a) } g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0, h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0 \text{ and } \widetilde{\widetilde{x}} \leq \widetilde{x} \text{ or}$$
$$\text{b) } g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0, m(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0 \text{ and } \widetilde{\widetilde{x}} \geq \widetilde{x}.$$

The equilibrium characterisation says two things. First, an equilibrium in both stages is found by the intersection of the integration decision function $g(.) = 0$ and *either* the

"I-will-later-integrate" merger decision function $h(.) = 0$ *or* the "I-will-later-NOT-integrate" merger decision function $m(.) = 0$. This is as much as saying that you can't integrate and not integrate at the same time, and therefore must only use one of the two merger decision equations. Second, if the equilibrium is found by the intersection of the integration function $g(.) = 0$ and the "I-will-later-integrate" merger decision function $h(.) = 0$, then it must necessarily be that $\widetilde{\widetilde{x}} \leq \widetilde{x}$. The reasoning is simple: if firm i would like to integrate in the post-merger stage, it is sure that its private signal will be higher than the integration cutoff, $x_i \geq \widetilde{\widetilde{x}}$. A merger cutoff $\widetilde{x}$ lower than $\widetilde{\widetilde{x}}$ makes then no sense, because then firm i would always merge, $x_i > \widetilde{x}$ for sure. Thus, it must necessarily be that $\widetilde{\widetilde{x}} \leq \widetilde{x}$ when the equilibrium is found by the intersection of $g(.) = 0$ and $m(.) = 0$. The same reasoning holds for the other intersection. The next step in the characterisation of the equilibrium is showing that it is exists and is unique for low enough values of l, with l being the standard deviation of the private signal x_i.

Proposition 3.9. *:* EXISTENCE AND UNIQUENESS OF THE EQUILIBRIUM.
If $l \geq l^* = \frac{3d(d-2)}{2(d-2)^2}$, *there is a unique symmetric equilibrium in switching strategies* $(\widetilde{\widetilde{x}}, \widetilde{x})$.

To have a unique equilibrium, we need thus that firms who gather privately information, are not able to find out exactly what synergy gains are going to be. In other words, after having received the private information, firms are still sufficiently doubting about the real value of the synergies. Why do we need to have a minimum of "noise" in order to have a unique solution? The merger decision of both firms makes that part of the private information becomes public. Public information has a "multiplier effect" on all actions, because both firms know its partner received the same information and public signals play a role in coordinating outcomes that exceeds the information content. If the public information is relatively precise, then firms start again to coordinate on actions, as happened in our case where firms only worked together in the information gathering. Thus the problem of self-fulfilling beliefs shows up again until a certain degree. However, if public information is relatively "noisy", firms cannot coordinate anymore and this problem vanishes when part of the information stays private. This is a feature that keeps on returning in the literature that uses this equilibrium refinement technique (see e.g. Morris and Shin [55]). The particular -and nice, we believe- feature here however is that it is the *private* signal that becomes partly public through the merger decision. Thus, in order to have unicity, we need to have some "noise" on the private signal. We are now able to characterise this unique equilibrium in function of the parameters of our model.

Proposition 3.10. : CHARACTERISATION OF THE EQUILIBRIUM IN FUNCTION OF THE OPPORTUNITY COSTS OF MERGING AND THE DISCOUNT FACTOR OF NOT FULLY INTEGRATING.

Define a cutoff $x^* = \frac{d}{d-1} - \frac{l}{3}$. *Then the symmetric switching equilibrium* $(\widetilde{x}, \widetilde{\widetilde{x}})$ *is as follows:*

a) if $(K + \Pi) = \frac{1}{d-1}$ then $\widetilde{\widetilde{x}} = \widetilde{x} = x^*$.
b) if $(K + \Pi) > \frac{1}{d-1}$ then $\widetilde{\widetilde{x}} \leq x^* \leq \widetilde{x}$
c) if $(K + \Pi) < \frac{1}{d-1}$ then $\widetilde{x} \leq x^* \leq \widetilde{\widetilde{x}}$

This is the central proposition of this section. We give here the more technical explanation of the proposition, the economic intuition is given in the following corollaries. To find the condition in (a) for which both the merger and integration cutoffs are the same, $\widetilde{\widetilde{x}} = \widetilde{x} = x^*$, it must of course be that the "I-will-later-integrate" merger decision function $h(.)$ and the "I-will-later-NOT-integrate" merger decision function $m(.)$ hold at the same time: $h(x^*, x^*, x^*) = 0$ and $m(x^*, x^*, x^*) = 0$ (see Lemma 3.8). At the same time, $\Pr ob(x_j \geq x_j^* \mid I_i) = 1$; given that firm i knows that his partner has merged, $x_j \geq x_j^*$, when cutoffs are the same it knows for sure that firm j also will integrate. From the two merger decision equations (3.11) and (3.12), it is straightforward that $\widetilde{\widetilde{x}} = \widetilde{x} = x^*$ only holds for $(K + \Pi) = \frac{1}{d-1}$ and $x^* = \frac{d}{d-1} - \frac{l}{3}$. There exists therefore a unique combination of the parameters for which the merger and integration decisions are exactly the same.

When the cost of merging K and the stand-alone benefits Π are high enough and the discount factor of not fully integrating d is low enough such that $(K + \Pi) > \frac{1}{d-1}$, then the equilibrium pair of cutoffs $(\widetilde{x}, \widetilde{\widetilde{x}})$ is found by the intersection of the integration decision function $g(.) = 0$ and "I-will-later-integrate" merger decision function $h(.) = 0$, which by part (a) of Lemma (3.8) leads to $\widetilde{\widetilde{x}} \leq \widetilde{x}$. We need to use the "I-will-later-integrate" merger decision function $h(.) = 0$ in this case because merging has become relatively more expensive and integrating relatively cheaper, which means that a firm will more easily integrate than merge, and thus the most tough decision becomes now the merging one. This also has as consequence that equilibrium cutoffs move in a way that $\widetilde{\widetilde{x}} \leq x^* \leq \widetilde{x}$.

On the other hand, when parameters are such that $(K+\Pi) < \frac{1}{d-1}$, the intersection of the integration decision function $g(.) = 0$ and "I-will-later-NOT-integrate" merger decision function $m(.) = 0$, which by part (a) of Lemma (3.8) leads to $\widetilde{x} \leq \widetilde{\widetilde{x}}$. The reasoning is similar as explained above for part (b) of this proposition.

We are ready to explain rational merger failures and to do comparative statics, explaining the economic intuition of this proposition.

Corollary 3.11. *:* RATIONAL MERGER FAILURES.

When integration actions are strategic complements and collected information is kept private, merger failures can occur because of rational decisions when

a) $(K + \Pi) < \frac{1}{d-1}$, *and*

b) $\widetilde{x} < x_i, x_j < \widetilde{\widetilde{x}}$.

Proof. Follows directly from Proposition 3.10. □

A rational merger failure can only occur when both firms choose to merge, but to not integrate. For this to happen, the necessary condition for the equilibrium strategies to hold is $\widetilde{x} < \widetilde{\widetilde{x}}$, i.e. the merger decision is taken more easily than the integration decision. This occurs when $(K + \Pi) < \frac{1}{d-1}$ (see Proposition 3.10). The reason is intuitive: when the opportunity costs of merging are low enough ($(K + \Pi)$ low), firms will more easily merge. If at the same time the cost of operating in a not fully integrated firm is not too high (d low), firms may not want to integrate if the expected benefits are not high. Moreover, the fact that the merger is less costly has as consequence that the information of the other having merged, is less valuable. This may lead to even less incentives to integrate in equilibrium. In order to have then a *de facto* failure, it must be that the private signals received by both partners are intermediate, i.e. $\widetilde{x} < x_i, x_j < \widetilde{\widetilde{x}}$. Both firms have gathered information about the synergies, good enough to merge, but not good enough to integrate. Thus both merge and both don't integrate and we end up in the (NI, NI) outcome, for sure a merger failure. Remark that if $(K + \Pi) \geq \frac{1}{d-1}$, then $\widetilde{x} \geq \widetilde{\widetilde{x}}$ and a rational merger failure cannot occur, since firms will always integrate if they merge. The higher merger opportunity costs make firms less risky! Of course a merger failure because of bad luck stays always a possibility. We now turn to the comparative statics.

Corollary 3.12. *:* LOWER OPPORTUNITY COSTS OF MERGING.

Lower merger costs (K lower) or lower status-quo non-merger benefits (Π) lead to more mergers ($\widetilde{x}$ lower) and less integration ($\widetilde{\widetilde{x}}$ greater) and therefore to more rational failures ($\widetilde{\widetilde{x}} - \widetilde{x}$ greater).

A lower opportunity cost of merging (lower Π or K) makes a merger less costly, and firms will more easily merge. This makes that when the other firm has decided to merge, easier than before, this also yields *less* valuable information about the information gathered by him. Thus, expected synergies and the possibility of the partner integrating are less good now and a firm will be more careful in his integration decision. This leads in equilibrium to a lower $\widetilde{x}$ and a higher $\widetilde{\widetilde{x}}$. In other words, firms more easily merge, but are less prone on integrating. This makes the distance $\widetilde{\widetilde{x}} - \widetilde{x}$ greater, and thus the possibility for a rational failure becomes larger.

Corollary 3.13. *: A* Higher discount factor of not fully integrating.

More punishment (d greater) leads to more mergers ($\widetilde{x}$ lower) and more integration ($\widetilde{\widetilde{x}}$ lower), but less rational failures ($\widetilde{\widetilde{x}} - \widetilde{x}$ lower).

A higher discount factor when being in a not fully integrated firm punishes more non-integration. Thus, *if* firms merge, they are going to more easily integrate. This has as consequence that a firm i gives a higher probability that its partner will also integrate in the post-merger stage and increases incentives to merge! Thus in equilibrium both $\widetilde{x}$ and $\widetilde{\widetilde{x}}$ will be lower for a lower discount factor d. However, the cutoff $\widetilde{x}$ diminishes more, which makes that the failure zone $\widetilde{\widetilde{x}} - \widetilde{x}$ becomes smaller. Thus, a higher punishment of not being fully integrated leads to less failures. We show this in an example:

$l = 2$ and $k = 0.01$	$\widetilde{x}$	$\widetilde{\widetilde{x}}$	$\widetilde{\widetilde{x}} - \widetilde{x}$
$d = 3$	0.581	1.203	0.621
$d = 4$	0.531	0.974	0.443
$d = 10$	0.414	0.564	0.149

We now turn to the last corollary which treats the effects of having less precise information. This is an important aspect of mergers, since firms often speed up the information gathering process, which can lead to less precise information. Alternatively, if info gathering is costly, it would be interesting to know what the influence of the precision of information has on possible failures.

Corollary 3.14. *:* LESS PRECISE INFORMATION.

Less precise information (l greater) leads to more mergers ($\widetilde{x}$ lower) and more integration ($\widetilde{\widetilde{x}}$ lower), but more failures ($\widetilde{\widetilde{x}} - \widetilde{x}$ greater).

A less precise private signal makes each partner to rely more on the positive signal of the other having merged when taking integration decisions. This increases the beliefs of a post-merger integration of the partner. Consequently, partners integrate more and, anticipating this, firms merge more. However, since their decisions are based on less information, they carry more risk and therefore there are more mistakes and more failures. We show this in an example:

$d = 3$ and $k = \frac{1}{4}(< \frac{1}{2})$	$\widetilde{x}$	$\widetilde{\widetilde{x}}$	$\widetilde{\widetilde{x}} - \widetilde{x}$
$l = 2$	0.722	1.035	0.312
$l = 3$	0.347	0.683	0.335
$l = 10$	-2.052	-1.687	0.365

Thus, less precise information makes firms more optimistic, but also more risk-taking!

The introduction of a public signal y along with the private signals (x_i and x_j) does not alter significantly the results of this section. The Lemmas and Propositions (and the proofs) can be stated in terms of the two types of information, public and private. The unicity condition however is somewhat more complex and depends on the realisation of the private signal. Nevertheless, noisy enough signals are again sufficient to ensure unicity of equilibrium.

3.6 Conclusion

A majority of M&A's fail. Managers blame mainly poor integration efforts and cultural differences. Researchers have come not further than formally explaining a failure because of bad luck or firms being irrationally over-optimistic. We propose a new formal "rational" explanation of merger failures, based on post-merger integration issues and uncertainty about obtainable synergy gains.

Merger partners need to adapt their initial organisational cultures into a new one in order to fully benefit from the synergy gains. However, how much integration effort the other partner actually puts in the new company is not easy to verify. The integration process needs often to be done fast and the habits and communication methods of the new partner are at the beginning not easy to interpret.

At the same time, it is uncertain how high potential merger synergies can be. The more information is gathered in a pre-merger stage, the better managers can form an idea, but reaction of competitors after the merger, economic fundamentals and different organisational cultures of the partners make it impossible to get certainty about the obtainable gains. This gathering of information can be shared with the partner or kept private. In mergers, the only situation in which it is in the interest to share all the knowledge is a genuine merger between peers, but such mergers are rare.

The interaction between the gathering of information in a pre-merger stage and potential post-merger coordination problems make merger failures sometimes "rational". It may be that it is ex-ante optimal for a firm to merge and to do not much integration efforts in the post-merger stage. This happens when three conditions are fulfilled. First, costs of merging and stand-alone profits must not be too high, making the opportunity costs of merging low enough such that firms easily merge. Second, the punishment of not operating in a fully integrated entity is not too low, which lowers adaption incentives. And third, synergy expectations for a firm must be intermediate after the information gathering process. If expectations are high, firms are best of by integrating while for low expectations, firms do not want to merge anyway. For intermediate gains the firm prefers to take the merger step, but counts on the partner to the adapting process, because he gives a high enough possibility to the other doing the right thing. If now *both* partners gathered information saying that synergies could be intermediate, both will want to merge, but do nothing afterwards to let the merger succeed, a sure failure.

The probabilities to encounter rational failures rise when information becomes less precise and when merger opportunity costs are lower. Firms become more optimistic and merger more, but they also become more risk-loving.

How to interpret some of our results? Less precise information makes it easier to make judgement mistakes and to rely too much on the good news that your partner wants to merge with you, possibly leading to more failures. However, getting more precise information comes at a cost, both in terms of resources and time, so there is a trade-off. Also, the higher the potential synergy gains, the more probable these synergies are indeed realised through organisational integration, which is confirmed by Larsson and Finkelstein [48]. Our explanation why this exactly happens is new though for post-merger issues; higher expectations induce better integration actions. Third, when costs of merging are lower, more merger failures are encountered. During stock market booms, when it is easier to find funding for buying up other firms, considerably more failures are indeed encountered. Maybe one of the nicest results of this paper is that when the punishment of not-integrating is higher, the possibility for failures is reduced. This might be an explanation of findings that cross-border mergers or mergers with very different management styles sometimes are found to be more successful: the small differences that derail effective synergy realisation in domestic mergers are more carefully attended to in cross border combinations because of managers' heightened sensitivity.

Our analysis is a first attempt -admittedly very rudimentary- to open the black box of the post-merger process in indicating how managers may take integration decisions. Many process issues remain unclear. What is the influence of strong or weak leaders in the merger process? Is the integration actually negatively influenced by misinterpretations, and does the adaptation process speed up once the right direction is taken? How do differences in size and power of the partners influence mergers? Our goal is to further analyse these issues, bringing together the approaches of organisational science and economics of organisations, showing how simple formal models can be used to represent different problems of organisational interdependence and how theoretic solutions to coordination problems are related to organisational solutions.

Appendix

Appendix to Chapter 1

Proof of Lemma 1.1

(i) Since firms demanding labour pay optimally the no-shirking wage (see wage equations (1.1)), we can equate the wage setting curve (1.10) and total labour demand (1.2) to find the equilibrium:

$$(d - \frac{(m+1)\sum^N l_i}{mN}) = e + (r + \frac{bNn}{Nn - \sum^N l_i})\frac{e}{sq}.$$

Assuming that all firms are identical, $l_i = l$, the equilibrium can be rewritten as $(d - \frac{(m+1)Nl}{mN}) = e + (r + \frac{bNn}{Nn-Nl})\frac{e}{sq}$, and N cancels out. Let $G \equiv (d - (e + (r+b)\frac{e}{sq})$ and $B \equiv \frac{be}{sq}$ and the equilibrium is

$$G - \frac{Bn}{n-l} - \frac{(m+1)}{m}l = 0. \tag{1.13}$$

This equation can be rearranged as $(G - \frac{(m+1)}{m}l)(n-l) = Bn$. Solving for equilibrium employment l^*, the equation gives us two possible candidate solutions. But one solution is larger than n, which is impossible since this would result in a total employment Nl larger than Nn, the total labour supply.

(ii) The derivative of implicit function (1.13) w.r.t. the parameter of direct competition m is $\frac{\partial l^*}{\partial m} = \frac{\frac{l^*}{m^2}}{\frac{m+1}{m} + \frac{Bn}{(n-l^*)^2}} \geq 0$, since total labour supply is higher than equilibrium labour demand, $Nn > Nl^*$. In order to have the same base for comparison, we have to assume the same equilibrium employment l^* for different degrees of competition as Saint-Paul [72] showed. We do this for all the comparative statics in this paper. The second derivative is thus $\frac{\partial^2 l^*}{\partial m^2}\Big|_{l^*=\bar{l}^*} = \frac{-\frac{l^*}{m^3}(\frac{1}{2m}+1+\frac{Bn}{(n-l^*)^2})}{(\frac{m+1}{m}+\frac{Bn}{(n-l^*)^2})^2} \leq 0$.

The equilibrium found in part (i) of Lemma 1.1 can also be rewritten as a system of two equations:

$$\begin{cases} w^* - d + \frac{m+1}{m} l^* = 0 \\ w^* - e - \frac{re}{sq} - \frac{Bn}{n-l^*} = 0. \end{cases}$$

This system allows us to take derivatives of the wage w^* with respect to the degree of competition m and given the found signs for $\frac{\partial l^*}{\partial m}$ and $\frac{\partial^2 l^*}{\partial m^2}$, we find $\frac{\partial w^*}{\partial m} = \frac{\frac{Bn}{(n-l^*)^2}\frac{l^*}{m^2}}{\frac{m+1}{m}+\frac{Bn}{(n-l^*)^2}} = \frac{Bn}{(n-l^*)^2}\frac{\partial l^*}{\partial m} \geq 0$ and $\frac{\partial^2 w^*}{\partial m^2}\Big|_{l^*=\bar{l}^*} = \frac{Bn}{(n-l^*)^2}\frac{\partial^2 l^*}{\partial m^2} \leq 0$.

(iii) Using equation (1.13), the derivative of equilibrium employment l^* w.r.t. s, $\frac{\partial l^*}{\partial s} = \frac{(r+\frac{bn}{(n-l^*)})\frac{e}{qs^2}}{\frac{m+1}{m}+\frac{Bn}{(n-l^*)^2}} \geq 0$, since $Nn > Nl^*$ and $\frac{\partial^2 l^*}{\partial s^2}\Big|_{l^*=\bar{l}^*} = \frac{-(r+\frac{bn}{(n-l^*)^2})(\frac{e}{qs^3})}{(\frac{m+1}{m}+\frac{Bn}{(n-l^*)^2})^2} \leq 0$. In the same way as we found $\frac{\partial w^*}{\partial m}$, we find that $\frac{\partial w^*}{\partial s} = -\frac{(\frac{m+1}{m})(r+\frac{bn}{(n-l^*)})\frac{e}{qs^2}}{\frac{m+1}{m}+\frac{Bn}{(n-l^*)^2}} = -\frac{m+1}{m}\frac{\partial l^*}{\partial s} \leq 0$ and $\frac{\partial^2 w^*}{\partial s^2}\Big|_{l^*=\bar{l}^*} = -\frac{m+1}{m}\frac{\partial^2 l^*}{\partial s^2} \geq 0$.

(iv) The inverse demand in the product markets is $p = d - \frac{\sum^m l_i}{m}$. Since firms are symmetric, in equilibrium $p^* = d - \frac{\sum^m l_i^*}{m} = d - \frac{\sum^m l^*}{m} = d - \frac{ml^*}{m} = d - l^*$. Therefore, $\frac{\partial p^*}{\partial m} = \frac{\partial p^*}{\partial l^*}\frac{\partial l^*}{\partial m} = -\frac{\partial l^*}{\partial m} \leq 0$ and $\frac{\partial p^*}{\partial s} = \frac{\partial p^*}{\partial l^*}\frac{\partial l^*}{\partial s} = -\frac{\partial l^*}{\partial s} \leq 0$.

Proof of $\frac{\partial W'}{\partial l^*} > 0$

The derivative of welfare with consumers W' w.r.t. equilibrium employment $l^* = \bar{l}^*$ is $\frac{\partial W'}{\partial l^*} = \frac{\partial W}{\partial l^*} + \frac{\partial[\alpha(\int_0^{l^*} p(l)dl - p^* l^*)]}{\partial l^*}$, where W is the welfare without consumers. It is already proven in the text that $\frac{\partial W}{\partial l^*} > 0$, and we prove here that the second part of the derivative is also positive. We know that $p(l) = d - \frac{\sum^m l}{m}$, so $\int_0^{l^*} p(l)dl = dl^* - \frac{(m-1)l^{*2}}{m} - \frac{l^{*2}}{2m}$ and $\frac{\partial(\int_0^{l^*} p(l)dl)}{\partial l^*} = d - 2l^* + \frac{l^*}{m}$. On the other hand, $p^* l^* = (d - l^*)l^*$ and $\frac{\partial(p^* l^*)}{\partial l^*} = d - 2l^*$. Therefore $\frac{\partial(\int_0^{l^*} p(l)dl)}{\partial l^*} \geq \frac{\partial(p^* l^*)}{\partial l^*}$ and thus $\frac{\partial[\alpha(\int_0^{l^*} p(l)dl - p^* l^*)]}{\partial l^*} \geq 0$.

Proof of Lemma 1.3

(i) The welfare per unit of time for employed workers in equilibrium is $rE = (r+a^*)\frac{e}{sq}$ and thus $\frac{\partial(rE)}{\partial s} = \frac{e}{sq}(\frac{\partial a^*}{\partial l^*}\frac{\partial l^*}{\partial s} - (r+a^*)\frac{1}{s})$. Then $\frac{\partial(rE)}{\partial s} \geq 0$ when $s\frac{\partial a^*}{\partial l^*}\frac{\partial l^*}{\partial s} \geq (r+a^*)$. This expression can be rewritten as $\frac{\partial a^*}{\partial l^*}\frac{\frac{e}{q}(r+b+a)}{\frac{m+1}{m}+\frac{ben}{s(n-l^*)^2}} \geq (r+a^*)$. For a given equilibrium employment level $l^* = \bar{l}^*$, the higher s, the higher the left hand side of the inequality while the right hand side does not change for changes in s. Thus, the higher s, the higher the probability that $\frac{\partial(rE)}{\partial s} \geq 0$.

(ii) Using the results of Lemma 1.1, we find $\left.\frac{\partial^2 l^*}{\partial s \partial m}\right|_{l^*=\bar{l}^*} = \frac{\frac{1}{m^2}(r+\frac{bn}{(n-l^*)})(\frac{e}{qs^2})}{(\frac{m+1}{m}+\frac{Bn}{(n-l^*)^2})^2} \geq 0$ and therefore $\left.\frac{\partial^2(rE)^*}{\partial s \partial m}\right|_{l^*=\bar{l}^*} \geq 0$, because $\frac{\partial a^*}{\partial l^*} = \frac{bn}{(n-l^*)^2} \geq 0$. Hence the probability that $\frac{\partial(rE)}{\partial s} \geq 0$ increases for m larger.

(iii) Given the equilibrium employment $l^* = \bar{l}^*$, the influence of the product market on a labour market reform is $\left.\frac{\partial^3(rE)^*}{\partial s \partial m \partial s}\right|_{l^*=\bar{l}^*} = \frac{e}{sq}\frac{\partial a^*}{\partial l^*}\frac{\partial^3 l^*}{\partial s \partial m \partial s} \leq 0$, since $\left.\frac{\partial^3 l^*}{\partial s \partial m \partial s}\right|_{l^*=\bar{l}^*} \leq 0$ (this follows easily from the derivation of $\left.\frac{\partial^2 l^*}{\partial s \partial m}\right|_{l^*=\bar{l}^*}$ in part (ii) of Lemma 1.3). Thus, the lower s, the higher the influence of m on $\frac{\partial(rE)^*}{\partial s}$.

Proof of Lemma 1.4

(i) The welfare per unit of time for firms in equilibrium is $\pi = \frac{l^{*2}}{m}$ (equation (1.12)). Thus, $\frac{\partial(\pi)}{\partial m} = 2l^*\frac{\partial l^*}{\partial m}\frac{1}{m} - \frac{l^{*2}}{m^2}$ and $\frac{\partial(\pi)}{\partial m} \geq 0$ when $\frac{2l^*}{m}(\frac{\partial l^*}{\partial m} - \frac{l^*}{m^2}) \geq 0$. From Lemma 1.1, we know that $\frac{\partial l^*}{\partial m} = \frac{\frac{l^*}{m^2}}{\frac{m+1}{m}+\frac{Bn}{(n-l^*)^2}}$, so $\frac{\partial l^*}{\partial m} \leq \frac{l^*}{m^2}$ and $\frac{\partial(\pi)}{\partial m} \leq 0$ for every m.

(ii) The minimum of $\frac{\partial(\pi)}{\partial m}$ is reached for $m = m'$where $m\prime = \frac{(1+\sqrt{2})}{(1+\frac{Bn}{(n-l)^2})}$. Hence, $\frac{\partial(\pi)}{\partial m}$ does not behave monotonously. But $m' \in [1, 1+\sqrt{2}]$ and for $s \to 0$, $m' \to 1$. Since $m \in [1, \infty[$ and $s \in [0,1]$, the theoretical probability that $m < m'$ is very small. For $m \geq m'$ $\left.\frac{\partial^2(\pi)}{\partial m^2}\right|_{l^*=\bar{l}^*} \geq 0$ and thus for $m \geq m'$, a higher m lowers the opposition of the firms for a product market reform.

(iii) Given the equilibrium employment $l^* = \bar{l}^*$, the influence of the labour market on a product market reform is $\left.\frac{\partial^2(\pi)}{\partial m \partial s}\right|_{l^*=\bar{l}^*} = \frac{2l^*}{m}\frac{\partial^2 l^*}{\partial m \partial s}$. We can derive that $\left.\frac{\partial^3(\pi)^*}{\partial m \partial s \partial s}\right|_{l^*=\bar{l}^*} = \frac{e}{sq}\frac{\partial a^*}{\partial l^*}\frac{\partial^3 l^*}{\partial s \partial m \partial s} \leq 0$, since $\frac{\partial^3 l^*}{\partial s \partial m \partial s} \leq 0$. Thus, the lower s, the higher the influence of m on $\frac{\partial(\pi)}{\partial s}$.

Proof of Proposition 1.5

(i) (a) The change in welfare per unit of time for employed workers w.r.t. m is $\frac{\partial(rE)}{\partial m} = \frac{e}{sq}\frac{\partial a^*}{\partial l^*}\frac{\partial l^*}{\partial m} \geq 0$ because $\frac{\partial l^*}{\partial m} \geq 0$ (Lemma 1.1) and $\frac{\partial a^*}{\partial l^*} \geq 0$ (Lemma 1.3). Here out logically follows $\frac{\partial(rE)}{\partial s} + \frac{\partial(rE)}{\partial m} \geq \frac{\partial(rE)}{\partial s}$.

(i) (b) We need to check the effects of s and m on both $\frac{\partial(rE)}{\partial s}$ and $\frac{\partial(rE)}{\partial m}$. From point (i) of Lemma 1.3, we know that $\frac{\partial(rE)}{\partial s}$ has a lower probability to be positive for a lower s. Also, we know from point (ii) of Lemma 1.1 that $\left.\frac{\partial^2 l^*}{\partial m^2}\right|_{l^*=\bar{l}^*} \leq 0$ and therefore $\left.\frac{\partial^2(rE)^*}{\partial m^2}\right|_{l^*=\bar{l}^*} = \frac{e}{sq}\frac{\partial a^*}{\partial l^*}\frac{\partial^2 l^*}{\partial m^2} \leq 0$. Hence the direct effects of a low s and high m are clearly negative. We now check the cross effects. The derivative $\frac{\partial(rE)}{\partial m}$ also diminishes for a lower s as we can see from point (i) (a) when substituting $\frac{\partial l^*}{\partial m}$ and a lower s is thus worse for both reforms. But we know from point (ii) of Lemma 1.3 that the higher m, the higher the probability that $\frac{\partial(rE)}{\partial s}$ will be positive. However, the ratio $\frac{\left.\frac{\partial^2(rE)^*}{\partial m^2}\right|_{l^*=\bar{l}^*}}{\left.\frac{\partial^2(rE)^*}{\partial s\partial m}\right|_{l^*=\bar{l}^*}} = \frac{\frac{l}{m}(\frac{1}{m}-2(r+\frac{Bn}{(n-l)^2}))}{\frac{e}{s^2q}(r+b+a)}$ and a higher m leads to a lower ratio with $\lim_{m\to\infty}\left(\frac{\left.\frac{\partial^2(rE)^*}{\partial m^2}\right|_{l^*=\bar{l}^*}}{\left.\frac{\partial^2(rE)^*}{\partial s\partial m}\right|_{l^*=\bar{l}^*}}\right) = 0$. This means that $\frac{\partial(rE)}{\partial m}$ lowers faster than $\frac{\partial(rE)}{\partial s}$ rises for m large and thus for a large m the probability of approval of employed workers for a combined policy diminishes the higher m and the lower s.

(ii) (a) The change in welfare per unit of time for firms w.r.t. s is $\frac{\partial(\pi)}{\partial s} = \frac{2l^*}{m}\frac{\partial l^*}{\partial s} \geq 0$ because $\frac{\partial l^*}{\partial s} \geq 0$ (Lemma 1.1). Hereout logically follows $\frac{\partial(\pi)}{\partial s} + \frac{\partial(\pi)}{\partial m} \geq \frac{\partial(\pi)}{\partial m}$.

(ii) (b) We need to check the effects of a s and m on both $\frac{\partial(\pi)}{\partial s}$ and $\frac{\partial(\pi)}{\partial m}$. From point (ii) of Lemma 1.4, we know that $\left.\frac{\partial^2(\pi)}{\partial m^2}\right|_{l^*=\bar{l}^*} \geq 0$ for $m \geq m'$ where $m' \in [1, 1+\sqrt{2}]$. Thus a low m generates a more negative $\frac{\partial(\pi)}{\partial m}$. Also, we know from point (iii) of Lemma 1.1 that $\left.\frac{\partial^2 l^*}{\partial s^2}\right|_{l^*=\bar{l}^*} \leq 0$ and therefore $\left.\frac{\partial^2(\pi)}{\partial s^2}\right|_{l^*=\bar{l}^*} = \frac{2l^*}{m}\frac{\partial^2 l^*}{\partial s^2} \leq 0$ and a high s generates a low $\frac{\partial(\pi)}{\partial s}$. Hence the direct effects of a high s and low m are clearly negative. We now check the cross effects. The ratio $\frac{\left.\frac{\partial^2(\pi)^*}{\partial s\partial m}\right|_{l^*=\bar{l}^*}}{\left.\frac{\partial^2(\pi)^*}{\partial m^2}\right|_{l^*=\bar{l}^*}} = \frac{(r+\frac{bn}{(n-l^*)^2})(\frac{e}{s^2q})}{-l^{*2}(\frac{1}{2m}+l^*+\frac{Bn}{(n-l^*)^2})}$ and goes down for a lower m. This means that the negative effect of a low m on $\frac{\partial(\pi)}{\partial m}$ dominates the positive effect of a low m on $\frac{\partial(\pi)}{\partial s}$ and thus for a low m the probability of approval of firms for a combined policy diminishes. Also, the ratio $\frac{\left.\frac{\partial^2(\pi)^*}{\partial s^2}\right|_{l^*=\bar{l}^*}}{\left.\frac{\partial^2(\pi)^*}{\partial s \partial m}\right|_{l^*=\bar{l}^*}} = \frac{-(r+\frac{bn}{(n-l)^2})\frac{e}{s}}{(r+\frac{bn}{(n-l)^2})\frac{1}{m}}$ goes down for a higher s. This means that $\frac{\partial(\pi)}{\partial s}$ lowers faster than $\frac{\partial(\pi)}{\partial m}$ rises for a bigger s and thus for a larger s and lower m the probability of approval of firms for a combined policy diminishes.

(iii) This follows indirectly from points (i) and (ii) of the proposition. From point (i) we know that a high m and a low s is the worst for employed workers. Then, an increase in s increases for sure the possibility of approval for the employed workers. This at the same time worsens the possibility for approval from the firms, but still not reaches the lowest possible approval from the firms, which is when m is low and s is high. Thus, a high m and a high s are leading to higher approval chances than a high m and a low s. At the same time, a low s and low m lead to more approval from the employed workers than a high m and a low s, since a lower m is better for the employed workers. Again, this is worse for the firms, but still better than its worst case, which is a low m and high s. The same reasoning can be made starting from the worst case for the firms and it is easy to see that instead of a high initial m and low initial s, it is better for the firms to have a high s and m, or a low m and s, while these two parameter combinations still do not induce the highest disapproval from the employed workers. Thus, the stronger the negative correlation between the two parameters, the less probability to find support from both interest groups.

Appendix to Chapter 2

In this section we present the explicit expressions for the different cases in the propositions and their proofs. The proofs are given following a series of lemmas. We denote for simplicity Π_j^m the (gross) profits for each manager in monopoly when j managers invest; $\Pi_{j,l}^i$ and $\Pi_{l,j}^o$ the (gross) profits for each insider and outsider manager, respectively, when j insiders and l outsiders invests; and $\Pi_{1,j}^t$ and $\Pi_{0,j}^t$ the (gross) profits for each triopolist when he invests and when he does not, respectively, in the case the other j triopolists invest ($j = 0, 1, 2$). Similarly we denote π^m, π^i, $\pi^o$and π^t the 'net' profits for each monopolist, insider, outsider and triopolist.

Proof of Proposition 2.3

Within each firm, it is always optimal for the managers to choose a corner solution, where none of them invests or all of them do. Managers in a monopoly invest if and only if $c \leq \overline{c}^m$ where $\overline{c}^m$ is implicitly defined by $\Pi_3^m - \overline{c}^m = \Pi_0^m$. When there is competition, firms condition their investment decisions to those of the rivals. In a duopoly, insiders' decision depends on the decision of the outsider and vice versa. The insiders invest if $c \leq \overline{c}_1^i$ and if $c \leq \overline{c}_0^i$ depending, respectively, whether the outsider invest or not, where $\Pi_{2,1}^i - \overline{c}_1^i = \Pi_{0,1}^i$ and $\Pi_{2,0}^i - \overline{c}_0^i = \Pi_{0,0}^i$. Similarly, the outsider invest if $c \leq \overline{c}_2^o$ and if $c \leq \overline{c}_0^o$ depending, respectively, whether the insiders invest or not, where $\Pi_{1,2}^o - \overline{c}_2^o = \Pi_{0,2}^o$ and $\Pi_{1,0}^i - \overline{c}_0^o = \Pi_{0,0}^o$. Finally, each triopolist invests if $c \leq \overline{c}_j^t$, where $\Pi_{1,j}^t - \overline{c}_j^t = \Pi_{0,j}^t$.

Lemma 1.9. *The relevant cutoffs are ordered as follows:* $\overline{c}_2^t < \overline{c}_1^t < \overline{c}_0^t < \overline{c}^i$; $\overline{c}^o < \overline{c}^i$; $\overline{c}_0^t < \overline{c}^m$ *and* $\overline{c}^o < \overline{c}^m$ *where for simplicity we denote* $\overline{c}^i \equiv \overline{c}_0^i$ *and* $\overline{c}^o \equiv \overline{c}_2^o$.

Proof. By definition, the cutoff points for the triopolists are $\overline{c}_2^t = \frac{3k(2-k)}{16}$, $\overline{c}_1^t = \frac{3k(2+k)}{16}$ and $\overline{c}_0^t = \frac{3k(2+3k)}{16}$. In a duopoly, $\overline{c}_1^i = \frac{4k(1+k)}{9}$, $\overline{c}_0^i = \frac{4k(1+2k)}{9}$, $\overline{c}_2^o = \frac{4k(1-k)}{9}$ and $\overline{c}_0^o = \frac{4k(1+k)}{9}$. Notice that $\overline{c}_0^o$ is not relevant. In the region where the outsider does invest only if the insiders do not ($\overline{c}_2^o < c < \overline{c}_0^o$), the latter always invest ($\overline{c}_0^i > \overline{c}_1^i = \overline{c}_0^o$). Similarly, $\overline{c}_1^i$ is not relevant because when the insiders would stop investing if the outsider invested, the latter never invests. Finally, in a monopoly, $\overline{c}^m = \frac{k(2+3k)}{4}$. The ordering follows from straightforward algebra. □

The following Lemma characterizes the four different regions in Proposition 2.3.

Lemma 1.10. *The investment decision levels are the following.*

a) If $c \leq \min\{\overline{c}^o, \overline{c}_2^t\}$ *all managers in all firms invest.*

b) If $\min\{\overline{c}^o, \overline{c}_2^t\} < c \leq \min\{\overline{c}^i, \overline{c}^m\}$*, managers in the monopoly and insiders in a duopoly invest but single-manager firms may not.*

c) If $\min\{\overline{c}^i, \overline{c}^m\} < c \leq \max\{\overline{c}^i, \overline{c}^m\}$*, either the insiders or the monopolists invest while the rest never does. If* $k \leq \frac{2}{5}$ *we have that* $\overline{c}^i \leq \overline{c}^m$ *and only the monopolists invest whereas if* $k > \frac{2}{5}$ *we have that* $\overline{c}^i > \overline{c}^m$ *and only the insiders invest.*

d) If $c > \max\{\overline{c}^i, \overline{c}^m\}$*, no manager invests.*

Proof. a) and d) From Lemma 1.9, if $c \leq \min\{\overline{c}^o, \overline{c}_2^t\}$ all the cutoffs are above and hence all firms invest whereas if $c > \max\{\overline{c}^i, \overline{c}^m\}$ all the cutoffs are below and hence no manager invests.

b) In this region, by definition, the insiders and the monopolists invest. Within the region, as c increases the single-manager firms stop investing gradually (in different order depending on k).

c) From Lemma 1.9 the cutoffs for all single-manager firms are below and hence they never invest. Straightforward algebra shows that when $k \leq \frac{2}{5}$ we have that $\overline{c}^i \leq \overline{c}^m$ and therefore only the monopolists invest whereas when $k > \frac{2}{5}$ then $\overline{c}^i > \overline{c}^m$and only the insiders invest. □

This completes the proof of Proposition 2.3. QED.

Proof of Proposition 2.4

Each manager in a monopoly invests as long as $c \leq \widetilde{c}_j^m$ when j other managers invest $(j = 0, 1, 2)$, where $\Pi_{j+1}^m - \widetilde{c}_j^m = \Pi_j^m$. When the outsider invests in the duopoly, each insider invests if $c \leq \widetilde{c}_{j,1}^i$ depending whether the other insider invests or not $(j = 0, 1)$ where $\Pi_{j+1,1}^i - \widetilde{c}_{j,1}^i = \Pi_{j,1}^i$. Similarly, when the outsider does not invest, the cutoff points are $\widetilde{c}_{j,0}^i$ $(j = 0, 1)$ with the analogous definitions. The cutoff values for the single-manager firms are the same as in the proof of Proposition 2.3, $\widetilde{c}_j^o = \overline{c}_j^o$ and $\widetilde{c}_j^t = \overline{c}_j^t$.

Lemma 1.11. *The relevant cutoffs are ordered as follows:* $\widetilde{c}_2^t < \widetilde{c}_1^t < \widetilde{c}_0^t < \widetilde{c}_0^o$*;* $\widetilde{c}^m < \widetilde{c}_1^t$*;* $\widetilde{c}^m < \widetilde{c}_1^i < \widetilde{c}_0^i < \widetilde{c}_0^t$*;* $\widetilde{c}_2^o < \widetilde{c}_0^o$ *and* $\widetilde{c}_1^i < \widetilde{c}_1^t$ *where for simplicity we denote* $\widetilde{c}^m \equiv \widetilde{c}_2^m$ *and* $\widetilde{c}_j^i \equiv \widetilde{c}_{1,j}^i$*.*

Proof. In the monopoly structure, $\widetilde{c}_0^m = \frac{k(2+k)}{12}$, $\widetilde{c}_1^m = \frac{k(2+3k)}{12}$ and $\widetilde{c}_2^m = \frac{k(2+5k)}{12}$. We have that all the managers investing is an equilibrium whenever $c \leq \widetilde{c}_2^m$ whereas no manager investing is an equilibrium whenever $c > \widetilde{c}_0^m$. Between $\widetilde{c}_0^m$ and $\widetilde{c}_2^m$ both equilibrium coexist but the former is chosen because it Pareto dominates the latter. Then $\widetilde{c}_0^m$ and $\widetilde{c}_1^m$ are not relevant. In the duopoly structure, the cutoffs for the insiders are $\widetilde{c}_{0,0}^i = \frac{2k(1+k)}{9}$, $\widetilde{c}_{0,1}^i = \frac{2k}{9}$, $\widetilde{c}_{1,0}^i = \frac{2k(1+3k)}{9}$ and $\widetilde{c}_{1,1}^i = \frac{2k(1+2k)}{9}$. The same argument as in the monopoly case applies here and only the cutoffs in which the partner invests are relevant. In turn, the relevant cutoffs for the outsiders are the ones in which none or all the insiders invest. The cutoffs for the outsider and the triopolists are obtained in the proof of the previous proposition. Straightforward algebra leads to the ordering. □

Lemma 1.12. *The investment decision levels are the following.*

a) If $c \leq \widetilde{c}^m$ *the managers in the monopoly and the insiders in the duopoly invest.*

b) If $\widetilde{c}^m < c \leq \widetilde{c}_1^i$ *or* $\max\{\widetilde{c}_1^i, \widetilde{c}_2^o\} < c \leq \widetilde{c}_0^i$ *there is an equilibrium in which the insiders in the duopoly invest whereas the managers in the monopoly never invest.*

c) If $\widetilde{c}_1^i < c \leq \min\{\widetilde{c}_2^o, \widetilde{c}_0^i\}$ *and* $\widetilde{c}_0^i < c \leq \widetilde{c}_0^o$ *the insiders and the monopolists never invest and at least one single-manager firm invests.*

d) If $c > \widetilde{c}_0^o$ *nobody invests.*

Proof. a) We can distinguish two subcases: a.1) When $c \leq \min\{\widetilde{c}^m, \widetilde{c}_2^o\}$, from Lemma 1.11, all the managers invest because all the cutoffs are above. a.2) When $\widetilde{c}_2^o \leq c < \widetilde{c}^m$ the outsider does not invest by definition and there may be a triopolist that does not invest (when $\widetilde{c}_2^t \leq c < \widetilde{c}^m$). In other situations, all managers invest.

b) Here the monopolists stop investing. Again we can distinguish two subcases: b.1) when $\widetilde{c}^m < c \leq \widetilde{c}_1^i$ the insiders always invest independent of the outsider decision. From Lemma 1.11, depending on the combination of parameters, the outsider may or may not invest whereas there are two or three triopolists doing so. b.2) If $\max\{\widetilde{c}_1^i, \widetilde{c}_2^o\} < c \leq \widetilde{c}_0^i$ there are two possible equilibria in the duopoly: either the insiders do invest and the outsider does not or vice versa. Again from Lemma 1.11 we can check that there might be one or two triopolists investing.

c) Here the insiders and the monopolists never invest. We distinguish five subcases: c.1) when $\widetilde{c}_1^i < c \leq \widetilde{c}_2^t$ the three triopolists and the outsider invest, c.2) when $\max\{\widetilde{c}_2^t, \widetilde{c}_1^i\} < c \leq \min\{\widetilde{c}_2^o, \widetilde{c}_1^t\}$ or when $\max\{\widetilde{c}_2^o, \widetilde{c}_0^i\} < c \leq \widetilde{c}_1^t$ two triopolist and the outsider invest, c.3) when $\max\{\widetilde{c}_1^t, \widetilde{c}_0^i\} < c \leq \widetilde{c}_0^t$ one triopolist and the outsider invests, c.4) when $\widetilde{c}_0^t < c \leq \widetilde{c}_0^o$ only the outsider invest and c.5) when $c > \widetilde{c}_0^o$ no one invests. □

This completes the proof of Proposition 2.4. QED.

Proof of Proposition 2.5

In the following Lemma, we show that in our game we cannot have multiple stable regions when there is no conflict .

Lemma 1.13. *For any combination of parameters, there is at most one stable structure.*

Proof. Remember that we denote π^m, π^i and π^o the 'net' profits for each monopolist, insider and outsider (the equilibria in investment are unique). In order to consider all the possible cases in the triopoly, denote $\pi^t_a \geq \pi^t_b \geq \pi^t_c$ the net profits obtained by each triopolist. In what follows we state the conditions needed to ensure stability. The monopoly is stable when: (1) $\pi^m \geq \pi^i$ and (2) if $\pi^t_b \leq \pi^i$ then $\pi^m \geq \pi^o$ whereas if $\pi^t_b > \pi^i$ then $\pi^m \geq \pi^t_a$ (remember that the deviator is always "optimistic"). The duopoly is stable when (3) $\pi^i > \pi^m$ or $\pi^o > \pi^m$ and (4) if $\pi^t_b \leq \pi^i$ then $\pi^i \geq \pi^o$ whereas if $\pi^t_b > \pi^i$ then $\pi^i \geq \pi^t_a$. The second part of condition (4) is never satisfied ($\pi^t_a \geq \pi^t_b$) and hence condition (4) can be rewritten as (4') both $\pi^t_b \leq \pi^i$ and $\pi^i \geq \pi^o$ should hold. Finally, the triopoly is stable whenever (5) $\pi^t_a > \pi^m$ and (6) $\pi^t_b > \pi^i$.

We are going to show the result by contradiction. Suppose firstly that the monopoly and the duopoly are stable at the same time. From (1) and (3), we get that $\pi^o > \pi^m$ and from (2) and (4') that $\pi^m \geq \pi^o$ and hence a contradiction. Secondly, the duopoly and the triopoly can not be simultaneously stable structures because (4') and (6) can not be satisfied at the same time. Finally, suppose that the monopoly and the triopoly are stable structures. From (2) and (6) we obtain that $\pi^m \geq \pi^t_a$ which is in contradiction with (5). □

Thanks to the following lemma, we know that the triopoly will never be a stable structure.

Lemma 1.14. *Managers always prefer the monopoly to the triopoly.*

Proof. Suppose firstly that the monopolists do not invest. By Lemma 1.9 none of the triopolists invests either. Since $\Pi^m_0 = \frac{1}{12} > \frac{1}{16} = \Pi^t_{0,0}$ the monopoly is always preferred. Next suppose that a given manager invests both in monopoly and in triopoly. Again, the monopoly is always preferred since $\Pi^m_3 = \frac{(1+3k)^2}{12} > \frac{(1+3k)^2}{16} = \Pi^t_{1,0} > \Pi^t_{1,1} > \Pi^t_{1,2}$. Last, take the case in which a manager would invest as a monopolist but not as a triopolist. He would prefer a monopoly to a triopoly in which none of the other triopolists invests when $\Pi^m_3 - c > \Pi^t_{0,0}$ or in other words when $c < \frac{1+24k+36k^2}{48}$. This is always the case in this region since $c < \overline{c}^m < \frac{1+24k+36k^2}{48}$. When there are one or two other triopolists investing, the monopoly is even more preferred. □

Lemma 1.15. *Managers prefer the monopoly than being insiders in a duopoly.*

Proof. First suppose that a given manager invests both in the monopoly and being insider in a duopoly. Since $\Pi_3^m = \frac{(1+3k)^2}{12} > \frac{(1+4k)^2}{18} = \Pi_{2,0}^i > \Pi_{2,1}^i$, the insiders would never deviate from a monopoly. Second, he always prefers the monopoly whenever he does not invest in either situation because $\Pi_0^m = \frac{1}{12} > \frac{1}{18} = \Pi_{0,0}^i > \Pi_{0,1}^i$. Third, take the case in which he would invest in the monopoly but not in the duopoly (from Lemma 1.9 the outsider does not invest in this region either). The monopoly is preferred whenever $\Pi_3^m - c > \Pi_{0,0}^i$ or in other words when $c < \frac{1+18k+27k^2}{36}$. This is always the case here since $c < \overline{c}^m < \frac{1+18k+27k^2}{36}$. Finally suppose that as an insider he would invest but not as a monopolist (again the outsider does not invest). He prefers the monopoly as long as $\Pi_0^m > \Pi_{2,0}^i - c$ or $c > \frac{-1+16k+32k^2}{36}$. Since $c > \overline{c}^m > \frac{-1+16k+32k^2}{36}$ this is always the case in this region. □

Lemma 1.16. *The monopoly is the unique stable structure when being in a monopoly is better than being an outsider ($\pi^m \geq \pi^o$) or when insiders in a duopoly would break for triopoly ($\pi_b^t > \pi^i$) . Otherwise, no industry structure is stable.*

Proof. Each one of these conditions, together with Lemma 1.14 and Lemma 1.15, ensure that conditions (1) and (2) in the proof of Lemma 1.13 are satisfied and hence the monopoly is the (unique) stable structure. We show the second statement by contradiction. Suppose firstly that these conditions are not satisfied and that the duopoly is stable. From Lemma 1.13 the duopoly could only be stable when the monopoly is not or in other words when $\pi_b^t \leq \pi^i$ and $\pi^o > \pi^m$. From Lemma 1.15 we have that $\pi^m > \pi^i$ and hence $\pi^i \geq \pi^o$. This contradicts the condition (4') in the proof of Lemma 1.13. Secondly, from Lemma 1.14 the triopoly is never stable. □

Lemma 1.17. *When there is no internal conflict within firms, the monopoly is the only stable structure. No stable structure exists when (c, k) are such that $k_1 \leq k < k_2$ and $c \leq \overline{c}_2^t$, where $k_1 = \frac{4\sqrt{2}-5}{21}$ and $k_2 = \frac{2\sqrt{3}-3}{3}$.*

Proof. We are going to prove this lemma following the four parts identified in Lemma 1.10:

a) We have that $\pi^t = \Pi_{1,2}^t - c > \Pi_{2,1}^i - c = \pi^i$ whenever $k < k_1 = \frac{4\sqrt{2}-5}{21}$ and that $\pi^m = \Pi_3^m - c \geq \Pi_{1,2}^o - c = \pi^o$ whenever $k \geq k_2 = \frac{2\sqrt{3}-3}{9}$. From Lemma 1.16 the monopoly is stable if $k < k_1$ or $k \geq k_2$ whereas if $k_1 \leq k < k_2$ no industry structure is stable.

b) We are going to show that at least one of the two conditions in Lemma 1.16 is satisfied. On the one hand we show that when $k \geq \frac{1}{15}$ we have that $\pi^m \geq \pi^o$. If the outsider does invest, $\pi^m = \Pi_3^m - c \geq \Pi_{1,2}^o - c = \pi^o$ when $k \geq k_2$ and in particular when $k \geq \frac{1}{15}$. If the outsider does not invest, $\pi^m = \Pi_3^m - c \geq \Pi_{0,2}^o = \pi^o$ when $c \leq \frac{-1+34k+11k^2}{36}$. This inequality is always satisfied when $k \geq \frac{1}{15}$ and $c < \overline{c}^i$.

On the other hand we show that when $k < \frac{1}{15}$ we have that $\pi_b^t > \pi^i$. Take first the case in which no triopolist invests ($c > \overline{c}_0^t$). We have that $\pi^t = \Pi_{0,0}^t > \Pi_{2,0}^i - c$ (and in particular that $\pi^t > \Pi_{2,1}^i - c$) whenever $c > \frac{-1+64k+128k^2}{144}$. This is always satisfied when $k < \frac{1}{15}$ and $c > \overline{c}_0^t$. Second consider the case where only one triopolist invests. From the definition of the cutoffs (see proof of Lemma 1.9), the outsider always invests in this region when we impose $k < \frac{1}{15}$. In addition, we have that $\pi_b^t = \Pi_{0,1}^t$. We have that $\pi_b^t = \Pi_{0,1}^t > \Pi_{2,1}^i - c = \pi^i$ whenever $c > \frac{-1+66k+63k^2}{144}$. This is always satisfied when $k < \frac{1}{15}$ and $c > \overline{c}_1^t$. Last take the case in which two triopolists invest (again here the outsider would invest). In this case $\pi_b^t = \Pi_{1,1}^t$ and $\pi_b^t = \Pi_{1,1}^t - c > \Pi_{2,1}^i - c = \pi^i$ whenever $k < \frac{\sqrt{2}-1}{6}$ and in particular when $k < \frac{1}{15}$.

c) In the part of this region where only the monopolists invest we have that $\pi^t = \Pi_{0,0}^t > \Pi_{0,0}^i = \pi^i$ and hence the monopoly is the stable structure. When the insiders invest, we have that $\pi^t = \Pi_{0,0}^t > \Pi_{2,0}^i - c = \pi^i$ whenever $c > \frac{-1+64k+128k^2}{144}$. This condition is always satisfied since $c > \overline{c}^m \geq \frac{-1+64k+128k^2}{144}$.

d) Similar to the first part of part c), the monopoly is stable since $\pi^t = \Pi_{0,0}^t > \Pi_{0,0}^i = \pi^i$. $\square$

This completes the proof of Proposition 2.5. QED

Proof of Proposition 2.6

In this and in the following proofs we are going to use, when possible, Lemma 1.13. In fact, it applies as long as there is not multiplicity of equilibria in the duopoly investment decisions. As we have seen in the proof of Lemma 1.12 the region (a) can be divided in two parts.

a.1) When any manager in any situation invests, the stable structures and the proofs are identical to those of Proposition 2.5 when everyone was investing.

a.2) The monopoly is stable because it is preferred to any other position in any other industry structure. We have that $\pi^m = \Pi_3^m - c > \Pi_{2,0}^i - c = \pi^i$ and that $\pi^m > \Pi_{1,1}^t - c > \Pi_{1,2}^t - c$ and hence managers prefer the monopoly to being insiders and being triopolists investing (independent of being two or three of them doing so). They prefer the monopoly to being outsiders when $\pi^m \geq \Pi_{0,2}^o = \pi^o$ or when

$c \leq \frac{-1+34k+11k^2}{36}$ and the monopoly to being triopolists not investing when $\pi^m \geq \Pi^t_{0,2}$ or when $c \leq \frac{1+36k+24k^2}{48}$. These two conditions are always satisfied in this region ($\widetilde{c}^o_2 \leq c < \widetilde{c}^m$). Thus, the monopoly is stable and from Lemma 1.13 it is unique.

Proof of Proposition 2.7

As we have seen in the proof of Lemma 1.12 this region can be divided in two parts.

b.1) Here the uniqueness result still applies. Managers prefer being insiders than monopolists whenever $c \leq c_1(k) = \frac{-1+12k+18k^2}{36}$: when the outsider invests $\pi^i = \Pi^i_{2,1} - c > \Pi^m_0 = \pi^m$ precisely when $c \leq c_1(k)$ whereas when he does not we have that $\pi^i = \Pi^i_{2,0} - c > \Pi^m_0 = \pi^m$ is always satisfied in this region. In addition, $\pi^i \geq \pi^t_b$ independent of the number of triopolists investing and of the choice of the outsider. They also prefer to be an insider than an outsider, $\pi^i \geq \pi^o$, independent of the outsider investment decision. This three conditions are necessary and sufficient to ensure duopoly stability (see proof of Lemma 1.13).

When $c > c_1(k)$, we have that managers in a monopoly do not invest whereas in any other situation all managers invest (see proof of Lemma 1.12). Managers prefer the monopoly to being insiders by definition. They also prefer the monopoly to the triopoly $\pi^m = \Pi^m_0 > \Pi^t_{1,2} - c = \pi^t$ and hence the triopoly is never stable. Choices between monopoly and outsider and between insider and triopoly are going to determine three different regions. Managers prefer being monopolists than outsiders whenever $c \geq c_2 = \frac{1}{36}$ and they prefer being insiders to triopolists whenever $k \geq k_1$ (see proof of Proposition 3). This defines three regions because: (a) $c_1'(k) > 0$ and the k^* such that $c_1(k^*) = \widetilde{c}^i_1(k^*)$ is larger than the k^{**} such that $c_2 = \widetilde{c}^i_1(k^{**})$ and (b) the k^{***} such that $c_2 = \widetilde{c}^i_0(k^{***})$ is larger than k_1. In the first region, when $k \leq k_1$, the monopoly is stable because condition (1) and the second part of (2) are satisfied. In the second region, when $k \geq k_1$ and $c < c_2$ no structure is stable. The monopoly is not stable because condition (2) is not satisfied and the duopoly is not stable because managers prefer being outsiders than insiders ($\pi^o > \pi^m \geq \pi^i$) breaking condition (4'). Finally, when $c \geq c_2$ (and $c > c_1(k)$) the monopoly is stable because condition (1) and the first part of (2) are satisfied.

b.2) There are two different equilibria in the duopoly (Lemma 1.12): either the two insiders or the outsider invest. The profits in the investing equilibrium are always higher than in the non-investing one for both the insiders and the outsider ($\Pi^i_{2,0} - c \geq$

$\Pi^i_{0,1}$ and $\Pi^o_{1,0} - c \geq \Pi^o_{0,2}$). Denoting the net profits in the insiders-investing equilibrium as π^i_d and π^o_d and in the outsider-investing one as π^i_e and π^o_e, we have that $\pi^i_d > \pi^i_e$ and $\pi^o_d < \pi^o_e$.

We restate the stability conditions in order to accommodate this multiplicity. The monopoly is stable when: (M1) $\pi^m \geq \pi^i_d$ and (M2) if $\pi^t_b \leq \pi^i_e$ then $\pi^m \geq \pi^o_e$ whereas if $\pi^t_b > \pi^i_e$ then $\pi^m \geq \pi^t_a$. The insiders-investing duopoly is stable when (M3) $\pi^i_d > \pi^m$ or $\pi^o_d > \pi^m$ and (M4) if $\pi^t_b \leq \pi^i_e$ then $\pi^i_d \geq \pi^o_e$ whereas if $\pi^t_b > \pi^i_e$ then $\pi^i_d \geq \pi^t_a$. The outsiders-investing duopoly is stable when (M5) $\pi^i_e > \pi^m$ or $\pi^o_e > \pi^m$ and (M6) if $\pi^t_b \leq \pi^i_e$ then $\pi^i_e \geq \pi^o_e$ whereas if $\pi^t_b > \pi^i_e$ then $\pi^i_e \geq \pi^t_a$. The second part of condition (M6) is never satisfied ($\pi^t_a \geq \pi^t_b$) and hence condition (M6) can be rewritten as (M6') both $\pi^t_b \leq \pi^i_e$ and $\pi^i_e \geq \pi^o_e$ should hold. Finally, the triopoly is stable whenever (M7) $\pi^t_a > \pi^m$ and (M8) $\pi^t_b > \pi^i_d$.

Now we are going to show that the insiders-investing duopoly is stable. Firstly $\pi^i_d = \Pi^i_{2,0} - c > \Pi^m_0 = \pi^m$ whenever $c \leq \frac{-1+16k+32k^2}{36}$ which is always true in this region. Hence condition (M3) is satisfied. We also have that $\pi^t_b > \pi^i_e$ independent of having one or two triopolists investing. If there is one clearly $\pi^t_b = \Pi^t_{0,1} > \Pi^i_{0,1} = \pi^i_e$ whereas if there are two $\pi^t_b = \Pi^t_{1,1} - c > \Pi^i_{0,1} = \pi^i_e$ whenever $c \leq \frac{1+52k+28k^2}{144}$ which is always true when $c < \widetilde{c}^t_1$. Finally, the condition $\pi^i_d > \pi^t_a$ is also satisfied since $\pi^i_d = \Pi^i_{2,0} - c > \Pi^t_{1,0} - c > \Pi^t_{1,1} - c$ in this region (as a triopolist, it is always better to be investing). The second part of condition (M4) is satisfied and hence this structure is stable.

This is the unique stable structure. The monopoly is not stable because, as we have seen, $\pi^i_d > \pi^m$ in contradiction with (M1). The outsider-duopoly is not stable either because $\pi^t_b > \pi^i_e$ and hence condition (M6') does not hold. Finally, the triopoly is not stable because $\pi^i_d > \pi^t_a \geq \pi^t_b$ contradicts condition (M8).

Proof of Proposition 2.8

As we have seen in the proof of Lemma 1.12 this region (c) can be divided in five parts. Here the uniqueness result applies. Managers clearly prefer to be monopolists rather than insiders ($\pi^m = \Pi^m_0 > \Pi^i_{0,0} > \Pi^i_{0,1}$). We also have that $\pi^t_b > \pi^i$ everywhere except when there are three triopolists investing (case c.1) where this is true only when $c < c_3(k) = \frac{1+34k+k^2}{144}$. Indeed, when there are three triopolists investing this is the condition such that $\pi^t_b = \Pi^t_{1,2} - c > \Pi^i_{0,1} = \pi^i$. When there are two investing we have that $\pi_b^t = \Pi_{1,1}^t - c > \Pi_{0,1}^i = \pi^i$ whenever $c < \frac{1+52k+28k^2}{144}$ which is always the case when $c < \widetilde{c}_1^t$. Clearly, when there is only one $\pi_b^t = \Pi_{0,1}^t > \Pi_{0,1}^i = \pi^i$ (the outsider always invests) and where there is none $\pi_b^t = \Pi_{0,0}^t > \Pi_{0,0}^i > \Pi_{0,1}^i$.

On the other hand, we have that $\pi^m \geq \pi_a^t$ in all cases except when there is only one triopolist investing where this is true only when $c > c_4(k) = \frac{-1+18k+27k^2}{48}$. Indeed, when there is only one triopolist investing this is the condition such that $\pi^m = \Pi_0^m \geq \Pi_{1,0}^t - c = \pi_a^t$ (we can check that the it is better to be the one investing). When there are two investing we have that $\pi^m = \Pi_0^m \geq \Pi_{1,1}^t - c = \pi_a^t$ whenever $c > \frac{-1+12k+12k^2}{48}$ and this is satisfied when $c > \widetilde{c}_1^i$. Therefore they also prefer the monopoly to being triopolist when the three invest. When none of the triopolists invests, clearly $\pi^m = \Pi_{0,0}^m > \Pi_{0,0}^t = \pi^t$.

Hence in all region c) except when there are three triopolists investing and $c \geq c_3(k)$ or when there is one triopolist investing and $c \leq c_4(k)$, the monopoly is the unique stable structure. Conditions (1) and (2) in the proof of Lemma 1.13 are satisfied.

When there is one triopolist investing and $c \leq c_4(k)$ the triopoly is the unique stable structure. In this region we have seen that $\pi_a^t > \pi^m$ and, as before, $\pi_b^t > \pi^i$ satisfying conditions (5) and (6).

Finally, when there are three triopolists investing and $c \geq c_3(k)$ there is no stable structure. We have that $\pi^o = \Pi_{1,0}^o - c > \Pi_0^m = \pi^m$ when $c < \frac{1+10k+7k^2}{18}$ and $\pi^o = \Pi_{1,0}^o - c > \Pi_{0,1}^i = \pi^i$ when $c < \frac{1+16k+16k^2}{36}$. These two conditions hold when $c < \widetilde{c}_2^t$. Then, since $\pi_b^t \leq \pi^i$, the monopoly is not stable because it would contradict condition (2). The duopoly is not stable either because $\pi^o > \pi^i$ contradicts condition (4'). Lastly, the triopoly is not stable because we have showed that $\pi^m \geq \pi_a^t$, which is in contradiction with condition (5).

Proof of Proposition 2.9

From (2.6), we have that consumer welfare is maximized when total production is highest. From (2.2), it is easy to calculate total production.

We are going to prove this lemma following the four parts identified in Lemma 1.10.

In region a) all managers would invest ($I_j = k$ for any j). Hence, $Q^{\Omega_M} = \frac{1+3k}{2}$, $Q^{\Omega_D} = \frac{2+3k}{3}$ and $Q^{\Omega_T} = \frac{3(1+k)}{4}$. Clearly since $Q^{\Omega_T} > Q^{\Omega_D}$ for $k < \frac{1}{3}$, $Q^{\Omega_T} > Q^{\Omega_M}$

for $k < \frac{1}{3}$ and $Q^{\Omega_D} > Q^{\Omega_M}$ for $k < \frac{1}{3}$, we have that the optimal industry structure is triopoly when $k < \frac{1}{3}$ and the monopoly when $k \geq \frac{1}{3}$.

In the first part of region c) (i.e. when $k < \frac{2}{5}$) only the monopolists would invest ($I_m = k$ and $I_j = 0$ for $j \neq m$). Hence, we have that $Q^{\Omega_M} = \frac{1+3k}{2}$, $Q^{\Omega_D} = \frac{2}{3}$ and $Q^{\Omega_T} = \frac{3}{4}$, and therefore the optimal structure is the triopoly for $k < \frac{1}{6}$ and the monopoly for $k \geq \frac{1}{6}$.In the second part of region c) (i.e. when $k \geq \frac{2}{5}$) only the insiders in the duopoly would invest ($I_i = k$ and $I_j = 0$ for $j \neq i$). Hence, we have that $Q^{\Omega_M} = \frac{1}{2}$, $Q^{\Omega_D} = \frac{2+2k}{3}$ and $Q^{\Omega_T} = \frac{3}{4}$, and therefore the optimal structure is the duopoly.

In region d) no manager invests ($I_j = 0$ for any j). Hence, since $Q^{\Omega_M} = \frac{1}{2}$, $Q^{\Omega_D} = \frac{2}{3}$ and $Q^{\Omega_T} = \frac{3}{4}$, the triopoly is the optimal industry structure.

In region b) the monopolists and the insiders in the duopoly invest but the single firms may not ($I_j = k$ for $j = m$ and $j = i$). We should distinguish seven different cases depending on whether the triopolists and the outsider invest. If the outsider invests, following the same process, we have that the monopoly is the optimal industry structure when $k \geq \frac{1}{3}$; the duopoly is optimal when $k < \frac{1}{3}$ and when $k \geq \frac{1}{6}$, $k \geq \frac{1}{9}$ or $k \geq \frac{1}{12}$ when two, one or no triopolist invest, respectively; and the triopoly is optimal otherwise.

Suppose now that the outsider does not invest. If no triopolist invests, the optimal industry structure is the monopoly when $k \geq \frac{1}{5}$, the duopoly when $\frac{1}{16} < k \leq \frac{1}{5}$ and the triopoly when $k < \frac{1}{16}$or $k \geq \frac{1}{12}$ when two, one or no triopolist invest, respectively; and the triopoly is optimal otherwise. If one (resp. two, three) triopolist invests, the optimal industry structure is the monopoly when $k \geq \frac{1}{5}$ (resp.$k \geq \frac{1}{4}$ and $k \geq \frac{1}{3}$) and the triopoly when $k < \frac{1}{5}$ (resp.$k < \frac{1}{4}$ and $k < \frac{1}{3}$).

The results are plotted in Figure 5.

Proof of Proposition 2.10

Following the same procedure as in the previous proof, we can obtain the results plotted in Figure 6.

Proof of Lemma 2.11

Let us denote the contract of manager i by the fixed fee (that we will denote F_i) and the share on the profits (denoted ϵ_i). Managers will determine the terms of the contract maximise the firm's profits taking into account the incentives that this agreement provides. The payoff of manager i in monopoly is $F_i + \epsilon_i[\pi^m(I_m = mk)]$ for all i, where F_i is the fixed fee, ϵ_i the share of the gross monopoly profits π^m having m managers in the firm investing k, making total investment in the firm $I_m = mk$. Since investment is not contractible, each manager privately bears the cost c if he invests. A manager's incentives to invest also depend on the other managers' behavior. For the equal sharing rule:

* If two managers invest, the third one will do so iff $\frac{(1+3k)^2}{4} - 3ck > \frac{(1+2k)^2}{4} \iff c < \frac{1}{6} + \frac{5}{12}k$.

* In one manager invests and the other does not, the third manager invests iff $\frac{(1+2k)^2}{4} - 3ck > \frac{(1+k)^2}{4} \iff c < \frac{1}{6} + \frac{1}{4}k$.

* In none of the other two managers invest, the third one does it iff $\frac{(1+k)^2}{4} - 3ck > \frac{1}{4} \iff c < \frac{1}{6} + \frac{1}{12}k$.

Proceeding in the same way for the other possible sharing rules, and checking the total profits that the monopoly will get for them, we conclude that:

For $c \in \left[0, \frac{1}{6} + \frac{5}{12}k\right)$, rewarding all managers a percentage of the profits ($F_i = 0$ and $\epsilon_i = \frac{1}{3}$) yields the best incentives.

For $c \in \left[\frac{1}{6} + \frac{5}{12}k, \frac{1}{4} + \frac{3}{8}k\right)$, the optimal contracts are:

$$\begin{aligned} F_1 &= \frac{1}{3}[\pi^m(I_m = 2k) - 2c] \text{ and } \epsilon_1 = 0, \\ F_2 &= F_3 = -\frac{1}{6}[\pi^m(I_m = 2k) - 2c] \text{ and } \ \epsilon_2 = \epsilon_3 = \frac{1}{2}. \end{aligned}$$

For $c \in \left[\frac{1}{4} + \frac{3}{8}k, \frac{1}{2} + \frac{1}{4}k\right)$ the optimal contracts are:

$$\begin{aligned} F_1 &= F_2 = \frac{1}{3}[\pi^m(I_m = 2k) - c] & \epsilon_1 = \epsilon_2 = 0, \\ F_3 &= -\frac{2}{3}[\pi^m(I_m = 2k) - 2c] & \epsilon_3 = 1. \end{aligned}$$

For $c \in \left[\frac{1}{2} + \frac{1}{4}k, \infty\right)$ no manager will invest. Then $F_i = 0$ and $\epsilon_i = \frac{1}{3}$ for $i = 1, 2, 3$ is optimal (any other sharing contract will provide to the same incentives).

Appendix to Chapter 3

Proof of Lemma 3.7

From the law of total expectations we can rewrite for firm 1 (**??**), $E_1(u-K \mid x_1) \geq 0$, as $E_1(u-K \mid x_1, x_2 \geq \widetilde{x}_2) \Pr ob(x_2 \geq \widetilde{x}_2 \mid x_1) + E_1(u-K \mid x_1, x_2 < \widetilde{x}_2) \Pr ob(x_2 < \widetilde{x}_2 \mid x_1) \geq 0$. The second term is null $E_1(u-K \mid x_1, x_2 < \widetilde{x}_2)$ because if firm 2 does not want to merge $(x_2 < \widetilde{x}_2)$, payoffs for firm 1 are 0, and it is then for firm 1 equivalent to $E_1(u-K \mid x_1, x_2 \geq \widetilde{x}_2) \geq 0$.

Proof of Lemma 3.8

First take a pair $(\widetilde{x}, \widetilde{\widetilde{x}})$ that satisfies part (a). Suppose that firm j is using this switching strategy with cutoffs $(\widetilde{x}, \widetilde{\widetilde{x}})$. From (3.10) and by definition of $(\widetilde{x}, \widetilde{\widetilde{x}})$, firm's i best response is to use, in the integration stage, a switching strategy with cutoff $\widetilde{\widetilde{x}}$. Suppose first that firm i receives a private signal x_i that is below $\widetilde{\widetilde{x}}$. Knowing that it is not going to integrate, we show that it is not going to merge, that is $m(x_i, \widetilde{x}, \widetilde{\widetilde{x}}) < 0$. Since $m()$ is an increasing function of x_i we have that $m(x_i, \widetilde{x}, \widetilde{\widetilde{x}}) < m(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}})$. By definition of g, h and m, we have that $m(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) - g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}})$ By definition $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and since $h()$ is an increasing function in x_i and $h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ it is true that $h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) < 0$. Hence $m(x_i, \widetilde{x}, \widetilde{\widetilde{x}}) < 0$ and firm i does not want to merge. Suppose secondly that firm i receives a private signal x_i that is above $\widetilde{\widetilde{x}}$. Then it is going to merge, knowing that it is going to integrate whenever $x_i \geq \widetilde{x}$ by definition of $h()$. We have shown that firm i is going to merge whenever its private signal is above $\widetilde{x}$ and therefore we have shown part (a).

We proof that when we have a pair $(\widetilde{x}', \widetilde{\widetilde{x}}')$ that satisfies $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $h(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ but $\widetilde{\widetilde{x}}' > \widetilde{x}'$, then $(\widetilde{x}', \widetilde{\widetilde{x}}')$ can't be an equilibrium. Suppose that firm j uses a switching strategy with cutoffs $(\widetilde{x}', \widetilde{\widetilde{x}}')$. Firm's i best response is to use, in the integration stage, a switching strategy with cutoff $\widetilde{\widetilde{x}}'$. Suppose that firm i receives a private signal $x_i = \widetilde{x}' - \varepsilon$. Knowing that it does not integrate, it will merge whenever $m(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') \geq 0$. But since $m(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') = h(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') - g(x_i, \widetilde{x}', \widetilde{\widetilde{x}}')$ and $g(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') < 0$ and $h(x_i, \widetilde{x}', \widetilde{\widetilde{x}}')$ is arbitrarily close to 0 when ε tends to 0, $m(x_i, \widetilde{x}', \widetilde{\widetilde{x}}') > 0$ and it will merge. Then $\widetilde{x}'$ can't be a cutoff point.

The same arguments apply for (b)

Proof of Proposition 3.9

Clearly $E(\theta \mid \widetilde{\widetilde{x}}, x_j \geq \widetilde{x})$ and $\Pr ob(x_j \geq \widetilde{\widetilde{x}} \mid \widetilde{\widetilde{x}}, x_j \geq \widetilde{x})$ are increasing functions of $\widetilde{x}$ and therefore $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}})$ is also increasing in $\widetilde{x}$. We can easily show that, in the uniform signal structure, when $l \geq \frac{3d(d-2)}{2(d-2)^2}$ then $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}})$ is also increasing in $\widetilde{\widetilde{x}}$. By the implicit function theorem, we have then that $\widetilde{\widetilde{x}}$, such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ is a decreasing function of $\widetilde{x}$.Similarly we can show that $h(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}')$ and $m(\widetilde{x}'', \widetilde{x}'', \widetilde{\widetilde{x}}'')$ are increasing functions of $\widetilde{x}'$ and decreasing of $\widetilde{\widetilde{x}}'$. Again by the implicit function theorem we have then that $\widetilde{x}'$ and $\widetilde{x}''$, such that $h(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and that $m(\widetilde{x}'', \widetilde{x}'', \widetilde{\widetilde{x}}'') = 0$, are decreasing functions of $\widetilde{\widetilde{x}}'$ and $\widetilde{\widetilde{x}}''$, respectively. Therefore there is a unique pair $(\widetilde{x}, \widetilde{\widetilde{x}})$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and $h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and a unique pair $(\widetilde{x}', \widetilde{\widetilde{x}}')$ such that $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $m(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$.

Suppose firstly that $\widetilde{x} \leq \widetilde{\widetilde{x}}$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and $h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$. This is by definition an equilibrium and we need to show that $(\widetilde{x}', \widetilde{\widetilde{x}}')$ such that $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $m(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ is not. Since $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and $h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) \geq h(\widetilde{x}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$, we have that $m(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) - g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) \geq 0$. Since $\widetilde{\widetilde{x}}(\widetilde{x})$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ is a decreasing function, the combination $(\widetilde{x}', \widetilde{\widetilde{x}}')$ such that $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $m(\widetilde{x}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ should satisfy $\widetilde{x}' \leq \widetilde{x}$ and $\widetilde{\widetilde{x}}' \geq \widetilde{\widetilde{x}}$. But then since $\widetilde{x} \leq \widetilde{\widetilde{x}}$ then $\widetilde{x}' \leq \widetilde{\widetilde{x}}'$ and therefore, from the previous lemma $(\widetilde{x}', \widetilde{\widetilde{x}}')$ cannot be an equilibrium. If, secondly, $\widetilde{x} > \widetilde{\widetilde{x}}$ then $(\widetilde{x}, \widetilde{\widetilde{x}})$ is not an equilibrium by the previous lemma. However, following a similar reasoning as above we can show that $\widetilde{x}' > \widetilde{\widetilde{x}}'$ and therefore $(\widetilde{x}', \widetilde{\widetilde{x}}')$ is an equilibrium.

Proof of Proposition 3.10

(a) Since $E(\theta \mid \widetilde{x}, x_j \geq \widetilde{x}) = \frac{1}{d-1}$ and $\Pr ob(x_j \geq \widetilde{x} \mid \widetilde{x}, x_j \geq \widetilde{x}) = 1$, we have that when $K + \Pi = \frac{1}{d-1}$, $g(\widetilde{x}, \widetilde{x}, \widetilde{x}) = h(\widetilde{x}, \widetilde{x}, \widetilde{x}) = m(\widetilde{x}, \widetilde{x}, \widetilde{x}) = 0$. Since, by the previous proposition there is a unique equilibrium, we have that $(\widetilde{x}, \widetilde{\widetilde{x}})$ is such that $\widetilde{\widetilde{x}} = \widetilde{x}$ is the unique equilibrium, proving part a). In fact, it can easily be proven that $\widetilde{\widetilde{x}} = \widetilde{x} = \frac{d}{d-1} - \frac{l}{3}$.

(b) When $K > \frac{1}{d-1}$ then $h(\widetilde{x}, \widetilde{x}, \widetilde{x}) = m(\widetilde{x}, \widetilde{x}, \widetilde{x}) < 0$ and following an argument similar to the one presented in the proof of the previous proposition, we can show that the equilibrium satisfies part a) in Lemma 3.8. On the other hand when $K < \frac{1}{d-1}$ then $h(\widetilde{x}, \widetilde{x}, \widetilde{x}) = m(\widetilde{x}, \widetilde{x}, \widetilde{x}) > 0$ and then the equilibrium satisfies part b) in Lemma3.8.

Proof of Corollary 3.12

A lower K (or a lower Π) decreases $h()$ and $m()$ leaving $g()$ constant. Therefore, by the implicit function theorem and reminding from the proof of Proposition 3.10 that $h()$ and $m()$ are increasing functions of $\widetilde{x}$, $\widetilde{x}(\widetilde{\widetilde{x}}, K)$ such that $h(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', K) = 0$ or $m(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', K) = 0$ decreases with K.Since $\widetilde{\widetilde{x}}(\widetilde{x})$ such that $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ is a decreasing function of $\widetilde{x}$, we have that if $(\widetilde{x}, \widetilde{\widetilde{x}})$ satisfy $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}) = 0$ and $h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, K) = 0$ and $(\widetilde{x}', \widetilde{\widetilde{x}}')$ satisfy $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}') = 0$ and $h(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', K') = 0$ for $K' < K$ then $\widetilde{x} > \widetilde{x}'$ and $\widetilde{\widetilde{x}} < \widetilde{\widetilde{x}}'$.

Proof of Corollary 3.13

Tedious computations show that an increase in d decreases $g()$ and to a lesser extent.$h()$, $m()$. Following a similar argument to the one presented in the previous proof, we have that if $(\widetilde{x}, \widetilde{\widetilde{x}})$ satisfy $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, d) = 0$ and $h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, d) = 0$ and $(\widetilde{x}', \widetilde{\widetilde{x}}')$ satisfy $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', d') = 0$ and $h(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', d') = 0$ for $d' > d$ then $\widetilde{x} < \widetilde{x}'$ and $\widetilde{\widetilde{x}} < \widetilde{\widetilde{x}}'$.

Proof of Corollary 3.14

Similar to the previous proof, tedious computations show that a lower l decreases $g()$ and to a much lesser extent.$h()$, $m()$. Again following the same reasoning as in the previous proofs, we have that if $(\widetilde{x}, \widetilde{\widetilde{x}})$ satisfy $g(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, l) = 0$ and $h(\widetilde{\widetilde{x}}, \widetilde{x}, \widetilde{\widetilde{x}}, l) = 0$ and $(\widetilde{x}', \widetilde{\widetilde{x}}')$ satisfy $g(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', l') = 0$ and $h(\widetilde{\widetilde{x}}', \widetilde{x}', \widetilde{\widetilde{x}}', l') = 0$ for $l' < l$ then $\widetilde{x} < \widetilde{x}'$ and $\widetilde{\widetilde{x}} < \widetilde{\widetilde{x}}'$.

Beliefs: Synergy Gains

If θ is random variable with an improper distribution and y is a public signal such that $y = \theta + \upsilon$ with $\upsilon \sim U(-l, l)$, and θ and υ are independent, we have that $\theta \mid y \sim U(y-l, y+l)$. Firm i receives a second signal, $x_i = \theta + \varepsilon_i$, where $\varepsilon_i \sim U(-l, l)$ with both ε_i and θ, and ε_i and υ are independent. Since $\theta \mid y$ and ε_i are uniform, $(\theta \mid y) \mid (x_i \mid y)$ is also uniform with density function given by

$$f(\theta \mid y, x_i) = f((\theta \mid y) \mid (x_i \mid y)) = \frac{1_{\{\theta\}}(\max\{y, x_i\} - l, \min\{y, x_i\} + l)}{2l - |y - x_i|}.$$

Other's signal

Firm i does not observe firm j's private signal, x_j, but knows that $x_j = \theta + \varepsilon_j$ where $\varepsilon_j \sim U(-l, l)$ and ε_j and θ, ε_j and υ, ε_j and ε_i are independent. Since $\theta \mid y, x_i$ and ε_j are uniforms, we know that $x_j \mid y, x_i$ is a sum of uniforms, which gives a distribution function with density function (from Appendix 3 and setting $l_b \equiv l > l - \frac{|y - x_i|}{2} \equiv l_a$),

$$f(x_j \mid y, x_i) = \left\{ \begin{array}{ll} \frac{x_j - (\max\{y, x_i\} - 2l)}{2l(2l - (\max\{y, x_i\} - \min\{y, x_i\}))} & \text{if } x_j \in [\max\{y, x_i\} - 2l, \min\{y, x_i\}] \\ \frac{1}{2l} & \text{if } x_j \in [\min\{y, x_i\}, \max\{y, x_i\}] \\ \frac{\min\{y, x_i\} + 2l - x_j}{2l(2l - (\max\{y, x_i\} - \min\{y, x_i\}))} & \text{if } x_j \in [\max\{y, x_i\}, \min\{y, x_i\} + 2l] \end{array} \right\}.$$

Beliefs: Merger Updating

We can find $\theta \mid y, x_i, x_j \sim (\theta \mid y, x_i) \mid (x_j \mid y, x_i)$ which is a uniform again, because $x_j \mid y, x_i$ is a sum of a uniform $\theta \mid y, x_i \sim U(\frac{y+x_i}{2} - (l - \frac{|y-x_i|}{2}), \frac{y+x_i}{2} + (l - \frac{|y-x_i|}{2})) \sim U(\max\{y, x_i\} - l, \min\{y, x_i\} + l)$ and $\varepsilon_j \sim U(-l, l)$

$$\begin{aligned} f(\theta \mid y, x_i, x_j) &= \frac{1_{\{\theta\}}(\max\{\max\{y, x_i\} - l, x_j - l\}, \min\{\min\{y, x_i\} + l, x_j + l\})}{\min\{\min\{y, x_i\} + l, x_j + l\} - \max\{\max\{y, x_i\} - l, x_j - l\}} \\ &= \frac{1_{\{\theta\}}(\max\{y, x_i, x_j\} - l\}, \min\{y, x_i, x_j\} + l\})}{2l + \min\{y, x_i, x_j\} - \max\{y, x_i, x_j\}}, \end{aligned}$$

which is a uniform being the intersection of all the uniforms

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