

A Contract-Theoretical Approach to Merger Remedies

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Chapter 1

Introduction

*Nowadays people know the price of everything
and the value of nothing.*

Oscar Wilde, *The Picture of Dorian Grey*

1.1 Motivation and issue

This thesis deals with structural merger remedies and their efficient implementation under European merger control law. Therefore, our work belongs to the competition policy field of research.¹

In general, a competition authority² is in charge of investigating horizontal concentrations³ with regard to the potential detrimental effects they may have on the effectiveness of post-merger competition on the markets concerned. The competition authority might clear the merger if the merging parties commit to the fulfillment of so called merger remedies.⁴ Such reme-

¹According to Motta (2004), competition policy comprises "the set of policies and laws which ensure that competition in the marketplace is not restricted in a way that is detrimental to society". C.f. Motta (2004), p.30. For a state of the art work on theoretical, empirical and legal aspects of competition policy compare Neumann and Weigand (2006).

²The notion of competition authority is often treated as synonymous with the rather American English expression of an antitrust authority.

³In the following, we treat horizontal concentrations as synonymous with mergers. For a legally correct definition of a concentration, see Appendix (8.1).

⁴In this thesis and in line with literature on merger remedies, we will not differentiate between the notion of "commitments" or "remedies". For a detailed and legally accepted

dies constitute an important tool of European merger policy since 38% of horizontal concentrations appraised by the European competition authority, DG Competition, were approved upon commitments offered by the merging parties.⁵

There are two types of merger remedies that are applied in the practice of international competition authorities:

(1) *Structural merger remedies*

Structural commitments enforce a change in the allocation of ownership rights among the firms that are active in a certain business segment. Structural remedies therefore imply divestitures which vary from case to case in scale and scope.⁶ Depending on the merger endeavour under investigation, the competition authority can either require to divest the whole business, a firm division or subsidiaries, or demand partial divestitures in the form of single assets sales.

(2) *Behavioural merger remedies*

Behavioural commitments offered by the merging firms foresee restrictions in their property rights. Concretely, the parties enter into binding agreements not to deploy certain assets in an anti-competitive way or to sign contracts with third parties that have detrimental effects on post-merger competition.

Each merger investigation involves forecasts of anti-competitive effects due

definition of this notion, compare Appendix (8.1).

⁵According to the latest publicly available European Merger Control - Council Regulation 139/2004 - Statistics, from 21 September 1990 to 31 March 2008 the European Commission received 3759 notifications for review. Of these, 1182 cases were cleared upon simplified procedures in a shorter Phase I investigation (Article 6(1)b decision of the European Merger Regulation). Additionally, 161 cases were approved upon commitments, where the Commission initially raised doubts with respect to effective post-merger competition (Article 6(1)b in conjunction with Article 6(2)). Finally, we add 84 Article 8(2) decisions after an intensive Phase II appraisal of merger cases. Compare European Merger Control - Council Regulation 139/2004 - Statistics, <http://ec.europa.eu/comm/competition/mergers/statistics.pdf>

⁶For the European Commission's legal definition of a divestiture, refer to Appendix (8.1).

to the concentration. Remedying possibly harmful impacts requires a case by case analysis in order to determine whether structural- or behavioural merger remedies are viable tools to restore effective post merger competition. Apart from positive competition healing effects, both types of commitments bear different costs and risks, the competition authority has ex ante to control for.

The implementation of *behavioural remedies* involves continuous monitoring by so called monitoring trustees which ensure that the competition authority's obligations are fulfilled at any point in time after the merger clearance, therefore inducing recurring additional costs.⁷ Apart from costs of monitoring, the risk which is involved with behavioral remedies is rather small since the degree of regulatory intervention is not that deep compared to divestitures. In the case of behavioural commitments, the authority's decisions are easily reversible and investments in implementation are low, in cases where they prove to be ineffective or even harmful for competition.

Structural merger remedies also require monitoring but it is restricted to the point in time, when the asset is integrated in the purchaser's business, that is at the closing of the transaction. From that moment on, the merging parties' competitor, in her position of being new owner of the divested assets, acts as an independent counterbalance in the market, not involving recurring costs of supervising the fulfillment of obligations. For this to be valid, we presume the competition authority's right choice of the divestiture object as well as it's efficient implementation by the merging parties and the purchaser.

Hence, we conclude that the post-merger effectiveness of divestitures strongly depends on two main factors:

- (1) the determination of scale and scope of the commitment,⁸

⁷A monitoring trustee is usually a private firm such as a consultancy, an investment bank, a law firm, an audit firm or a consortium, engaged by the Commission.

⁸The scale and scope of a structural merger remedy means the size of the divestiture, i.e. the question whether only a single asset, a bundle of several assets, a business unit or even a subsidiary has to be sold as a remedy. Depending on the existence of a competitor

(2) implementation efficiency.

Choosing the right remedy (matter of effectiveness) and providing the legal background for inducing merging parties and purchaser to implement it properly (matter of efficiency) are the main tasks of a competition authority when deciding on merger clearance or prohibition.

Both phases of the transaction are decisive for the effectiveness of structural merger remedies since once a change in the allocation of ownership rights has been put in place, it is irreversible and the resulting competitive damage cannot be undone. Apart from this general factor which puts the divestiture's effectiveness at risk, the phase of finding the right remedy and the implementing phase each carry individual systematic risks which are very different in nature.

The *risk* involved in finding the right remedy, that is defining the size of the divestiture, is obvious. Depending on the scale of the divestiture, the commitment may be too small to be effective such that the merging parties are able to increase prices post-merger.⁹ This would harm effective competition and reduce the consumers' welfare. The opposite risk is to require too large a divestment. This potentially harms the merging parties and possibly increases the market power of the purchaser such that overall prices increase and the consumers' welfare is reduced.¹⁰ Nevertheless, the risk of choosing the wrong structural merger remedy is a systematic one, it is inherent in the nature of divestitures and cannot be eliminated since the true effects on the

who acquires the asset, the divestiture will be integrated in an existing firm or a new firm will be founded based on the asset. Divestitures that operate on a stand-alone basis are called "carve-outs".

⁹In the language of competition policy, price increases deriving from a concentration are called unilateral effects.

¹⁰This is especially the case with mergers under divestitures in very concentrated markets. In such markets, symmetry among the players is pro-competitive in the sense that each firm has the same market power. Too large divestitures increase post-merger asymmetry in a market thus increasing the likelihood of weakened competition. This phenomenon can be shown in the Cournot model with divestitures as developed by Medvedev (2004).

effectiveness of competition can only be measured ex post.

The *risk* deriving from the implementation of structural merger remedies is significantly higher, much more complex and thus more interesting from an academic point of view as well as from a practical perspective since it involves strategic interaction between the merging parties and the purchaser of the asset to be divested. Independent of the structural merger remedy case under consideration, each divestiture process involves two-sided sequential restructuring investments during the implementing phase in order to realize the asset transfer and thus induce the competition authority's clearance decision.¹¹ The merging parties engage in restructuring in order to isolate the asset; the purchaser adjusts her business processes accordingly and finally integrates the asset for being competitive. Since these investments are only observable for the merging parties and for the buyer, thus not being verifiable for the competition authority, moral risk is involved in every divestiture process. In the following, we call this issue the "double moral hazard"-problem with structural merger remedies which lies at the core of this thesis.¹² The risk of inefficient restructuring investments is also an idiosyncratic one. We will show that it can only be reduced or eliminated if the competition authority admits changes in the allocation of ownership rights at the beginning of the divestiture process.

Comparing these main categories of merger remedies, it becomes obvious that the degree of regulatory intervention is much deeper, requiring structural merger remedies compared to the case of behavioural commitments. Thus, by requiring structural commitments, the Commission runs a higher risk of reducing synergy gains by inefficient restructuring investments or choosing

¹¹If the divestiture does not fulfill the Commission's requirements or significantly deviates from commitments offered by the merging parties, the Commission prohibits the merger transaction.

¹²The notion of double moral hazard derives from contract theory, where moral hazard describes adverse actions by an agent that are unobservable for a principal. Double moral hazard in the context of structural merger remedies means that merging parties and purchaser both choose restructuring investments that are lower than efficient, i.e. they invest less than the competition authority would invest if she was perfectly informed.

the wrong remedy, which is irreversible once it has been implemented.

The present thesis will not address the question of how to find effective structural merger remedies since there is a vital discussion in practice and also some economic literature on that subject, as will be presented later on. Not that the determination of scale and scope of divestitures was not of great importance for the restoration of effective competition. It is mainly hard to find general principles for the shape of divestitures that naturally differ from case to case.

The central object of research of the present work will be divestiture processes involving two-sided sequential restructuring investments under EC merger law due to the following reasons.

Five reasons in favour of dealing with the implementation efficiency of structural merger remedies under EC merger law

i.) Firstly and most importantly, structural merger remedies are the most *effective, convenient and frequently used tool* to eliminate competition concerns interrelated with a merger transaction potentially restricting post-merger competition. Divestitures have an agreeable property of destroying the link between merging parties and purchaser of the asset which guarantees independence in decision making and reduces the likelihood of post-merger collusion.¹³

ii.) Secondly, an answer to the double moral hazard problem reaches a *higher degree of generality* since every divestiture process involves restructuring investments and does not depend on each merger case individually.

¹³The notion of independence of the purchaser from the merging parties post-merger is required by EC merger law for good reasons. In the case that the competitor still depends on the merged entity's knowledge or resources, the competitor could be forced or even incited to undertake actions that post-merger could harm competition. Post-merger links between merging parties and purchaser should be eliminated only to exclude likelihood of collusion.

iii.) From an academic perspective, structural commitments are of greater interest than behavioural remedies since the divestiture process, i.e. the implementing phase, involves *restructuring investments* that are:

- two-sided,
- sequential,¹⁴
- (partially) unobservable for the competition authority,
- non-verifiable in court,
- highly relationship-specific,
- irreversible,
- sunk,
- inducing a change in the allocation of ownership rights.

Real world restructuring investments form an essential part of successful divestiture processes since they are a necessary condition for the completion of the asset transfer, eventually triggering merger clearance. The alignment of firm-individual business processes to the altered situation as well as the implementation of structural merger remedies involve large-scale investments. Hence, the competition authority has first to make sure that the object to be divested is able to restore competition, that is the scale and scope of the divestiture must be appropriate, then the asset has to be implemented in a way that its effectiveness will not be reduced throughout the divestiture process. Restructuring investments are sunk in the run of the divestiture process. The sequentiality of the restructuring investments induces strategic interaction between merging parties and purchaser. Under certain plausible assumptions, a change in the allocation of ownership rights implies an alteration of the incentives by the actors which are involved in the divestiture process.

¹⁴It is in the nature of the divestiture process that the restructuring efforts of the merging parties have to be expended chronologically before the efforts or investments of the buyer become relevant. In industry mergers, for example, it is often the case that machinery and key personnel first have to be identified and isolated for the transaction to be successful. Once the machinery is ready for transfer, the buyer comes into play and restructures its processes in order to optimally integrate it in the existing production.

Restructuring investments are unobservable for the competition authority, non-verifiable in court and highly transaction-specific. Therefore, they involve asymmetrically distributed information and moral hazard. Including the fact that they are relationship-specific, they comprise the three main categories of models in economic contract theory.¹⁵

Therefore, we believe that the nature of restructuring investments provides an optimal starting point for the *first-time application of contract-theoretical models* in the context of merger remedies.

iv.) There is *empirical evidence* which confirms the existence of double moral hazard problems involved in real world divestiture processes.

In 2005 the European competition authority published an in-depth analysis of all merger cases that involved remedies: the *Merger Remedies Study*.

The aim of the study was to find out about the ex post effectiveness of the commitments, the Commission required for the clearance of a merger.¹⁶

The study on merger remedies has shown, that the effectiveness of a remedy indeed strongly depends on the way it is implemented, that is on the level of restructuring investments that is chosen by the merging parties and a suitable purchaser.¹⁷ This is especially the case with structural commitments where the merging parties are forced by the EC Merger Regulation No 139/2004¹⁸, to invest in the preservation of independence, economic viability, marketability and competitiveness, and the purchaser is obligated to integrate the asset in her business and to make all arrangements that are necessary to form a viable and strong competitor against the merged entity.¹⁹

¹⁵ Compare Schweizer (1999), p.4 for an introduction. The author divides the theory of contracts in models that differ in their assumptions on the underlying informational structure: hidden information, hidden action and relationship-specific investments.

¹⁶ According to DG Competition's empirical findings, the effectiveness of a remedy is of paramount importance since such a commitment aims to restore competition post-merger on all relevant markets. That is, after the merging parties are allowed to merge under certain restrictions, the competitive level must not be worse post-merger compared to the pre-merger situation.

¹⁷ Compare the EC Merger Remedies Study (2005), p.154 ff.

¹⁸ More precisely by the Commission Notice on remedies acceptable under Council Regulation (EEC) No 4064/89 and under Commission Regulation (EC) No 447/98.

¹⁹ See the EC Merger Regulation, p.120, § 14 and p.125 § 50. The notions of a "viable business" and a "suitable purchaser" play an important role in the divestiture process. The

Therefore, both-sided restructuring investments are legally enforceable by the Commission, but as the Merger Remedies Study (2005) has shown, there are significant issues with the degree of efficient restructuring investments in the process of implementation. The study points out that the lack of post-merger effectiveness of numerous remedies can be traced back to double moral hazard issues involved in the implementation of the structural commitments. Thus, from an empirical point of view, the degree of efficiency of the implementation is of major importance for the effectiveness of structural merger remedies.

v.) Finally, this thesis is motivated by the fact that up to now the incentives for restructuring investments in the implementing phase have neither been subject to theoretical analysis in merger theory nor in practice. The European competition authority is aware of the problems which arise in divestiture processes but puts an exclusive focus on the question of how far suboptimal incentives for restructuring investments reduce the effectiveness of the structural remedies to restore competition after the concentration has taken place.²⁰

In addition to the previously indicated *failing practical focus* on efficient restructuring investments, in general there is virtually *no academic work on efficient implementation of structural merger remedies*. In particular, restructuring investments have not been subject to explicit modeling in the theory of oligopolistic competition nor has contract-theoretical modeling of structural merger remedies been undertaken in the literature on competition policy up to now.

Hence, these are five good reasons that form a starting point for a theoretic-

EC Merger Regulation requires that "[...] a viable business that, if operated by a suitable purchaser, can compete effectively with the merged entity on a long-lasting basis."

²⁰From a modeling point of view one could say that the Commission assumes inefficient divestiture procedures as exogenously given, pointing to the relationship with suboptimal effectiveness of the commitments. A pure focus on effectiveness will fight the symptoms but not the cause.

cal discussion of restructuring investments in the context of merger remedies under European competition law.

In order to be able to apply contract theoretical models to structural merger remedies, we have to assume a certain degree of generality which holds true for a large set of divestiture processes under EC competition law.

In the present thesis, we consider the following *standard divestiture process*: the merging parties are forced to divest an asset or a package of assets for the merger to be cleared. We assume that the remedy chosen by the European competition authority is effective in the restoration of competition.²¹ Subsequently, some predetermined viable competitor potentially buys the assets. For this structural remedy to be implemented, both players have to engage in restructuring investments, that is undertake all the actions regulated by EC competition law and necessary to prepare for the asset transfer as well as to preserve it's functionality, marketability and competitiveness.

We depart from the assumption that the EC Merger Regulation, which provides the legal background and institutional processes that govern the implementation of structural merger remedies, creates a restructuring investment game between merging parties and purchaser. Due to the empirically observable sequentiality and sub-optimality of restructuring investments, we analyze a two-stage moral hazard problem where the restructuring investments of the merging parties are vital for a successful transfer of the assets in the first period, while the restructuring engagements of the buyer become important in the subsequent second phase of the divestiture process. The surplus²² deriving from the asset transfer, which induces merger clearance, is realized at the end of the divestiture game, when all players have undertaken their complementary restructuring investments.

The surplus or the synergy gains that derive from the merger give reason

²¹This implies that we completely abstract from questions regarding scale and scope of a structural merger remedy.

²²Surplus in this context means synergy gains which are only realizable upon merger clearance.

for two firms to merge but the competitor of the merging parties cannot be forced to buy the divestitures. We assume that the players only participate in the divestiture process if the transaction has a positive added value for both of them.²³ Thus, our modeling departs from the assumption that the merger indeed uncovers substantial synergy gains which could materialize in economies of scale and scope, for example. These synergy gains represent the added value of the merger transaction. The realization of the value depends on one hand on the fulfillment of the commitments by the merging parties, on the other hand on the successful asset transfer to the purchaser. Under the assumption that only one suitable purchaser exists, the former is vital for the realization of synergy gains. Knowing this, the purchaser will require a fair share of the synergy gains.²⁴ Thus, the common interest will be the profitable clearance of the merger, where the merging parties are supposed to be able to acquire some positive fraction from efficiency gains.²⁵ Depending on the bargaining power of the buyer, they will have to pay over some fraction of these efficiency gains to the buyer.²⁶

In order to exactly reproduce the issues that show up in practice and due to the complexity of the divestiture process, the actual value of the asset transfer is assumed to be uncertain. The value of the merger transaction thus not only depends on both-sided restructuring investments but also on a source of uncertainty that reflects fast-changing conditions on the relevant

²³Therefore, the merger remedy game gets the touch of an alliance that is not only made among the merging parties but also between the merging parties and the buyer of the assets.

²⁴Precisely, we equate the synergy gains with the value of the transaction. Since the transaction only takes place if the unique buyer agrees, the value of the whole merger endeavour depends on the cooperation of the purchaser. Thus, we deduce that the value of the merger is equal to the value of the divestiture relationship. The success of the divestiture process in turn depends on the value of the asset that has to be transferred to the buyer as a structural merger remedy. Hence, the actual value of the asset to be divested can be equated with the total added value of the merger.

²⁵For example some share of the net present value of synergy gains deriving from the merger.

²⁶An alternative interpretation would be that the merging parties acquire the right to merge on the market for merger remedies from the buyer with the appropriate willingness to pay.

market.

Like in real world divestiture processes, both players observe the level of restructuring investments and the resolution of uncertainty. As assumed in contract theoretical models, these variables are too complex to be verifiable by DG Competition. As a consequence, first-best efficient restructuring investments cannot be enforced by law.

At the core of the analysis is the question of whether there is an appropriate incentive compatible mechanism that induces merging parties and purchaser to invest in restructuring efficiently which implementable in real world divestiture processes.

To answer this question, we take the following approach. In a first step we create a model based on the institutional prescriptions of the EC jurisdiction that create a game between the merging parties and the viable competitor who potentially buys the divestiture object at a later point in time. In our base case model, we assume that the players do not sign a formal initial agreement that governs their further relationship within the divestiture process. Hence, we take the classical perspective of the theory of incomplete contracts in restricting the class of contracts in an ad hoc way. This approach is intuitive and in accordance with empirical evidence since at the point in time when they enter into a relationship with the buyer, the merging parties are the owners of the asset. The key issue in this context is that although being initial owner of the assets, the merging parties will not invest in restructuring optimally. Assume the merging parties act in the best interest of the buyer and undertake all actions that are necessary in order to prepare for the asset transfer and the subsequent clearance of the merger. The transaction has no value unless the buyer is willing to undertake restructuring investments accordingly in order not to evoke a prohibition of the merger or substantial fines. However, the buyer of the assets will not invest in the case that the merging parties remain owner of the assets at the point in time when she has to prepare for the integration of the assets.²⁷ The reason is that her in-

²⁷The transaction may fail due to the incompleteness of the contract.

vestments in restructuring would not realize returns that accrue exclusively to her but to the merging parties. We will show by a backwards induction argument that the merging parties anticipate the buyer's behaviour and will therefore not invest efficiently as well. In consideration of the surplus, both players will be incited to renegotiate the initial agreement after the merging parties have fulfilled the EC's requirements for an asset transfer. As a result of these renegotiations, the buyer finally becomes owner²⁸ of the asset before she is about to integrate the assets into her business. This induces the buyer to restructure in a conditionally optimal way since she has become residual claimant of her own investments at that point in time. Still, the purchasing firm's restructuring investments are a function of the investments undertaken by the merging parties. Therefore, by transferring ownership rights to the purchaser before she invests in restructuring, we can solve the underinvestment problem on her side.²⁹

At the core of every divestiture process lies the change in the allocation of ownership rights which induces altered incentives to invest in restructuring.³⁰ Since the merging parties and the buyer negotiate the terms and conditions under which the transaction should be executed, there will always be renegotiations of initially chosen allocation of property rights as part of an equilibrium implementation inducing altered incentives to invest in restructuring.³¹ According to the Merger Remedies Study of the European Commission there are several reasons for renegotiations that eventually can all be traced back to opportunistic behaviour by the selling parties. For instance, in 12% of all divestiture remedies which required extensive carve-outs of tangible assets, the committing parties have consciously interfered in the carve-out of some

²⁸It is immaterial to differentiate between factual ownership and the acquirement of ownership rights since the asset does not remain with the merging parties.

²⁹We assume that after the merging parties have invested, they have no further impact on the implementation success with the buyer.

³⁰The theory of incomplete contracts analyzes the impact of changes in ownership of a bundle of assets on the incentives of the players. Thus, the interpretation of an asset transfer as a change in ownership enforced by EC law seems here to find an intuitive application.

³¹We will show that incentives for the merging parties to invest in restructuring are a function of their bargaining power in renegotiations with the buyer of the assets.

assets that forced the buyer to renegotiations before she undertook her own investments in the transaction. There were cases where the parties did not transfer machines although they were dedicated to the divested business and the buyer already paid for them. In some cases, during the transfer of the business, the buyer realized that the assets belonging to the business to be divested were in bad shape or incomplete. According to the EC, "[...]The Study also found that in a number of instances, the buyers resorted to ad hoc negotiations with the sellers to expand the scope of the divested business to resolve carve-out problems they had identified."³² Our theoretical findings show that, as seen in the merger remedy practice, contracts cannot be made directly contingent on the investments of the seller and the buyer or the final value of the transaction. Therefore, the optimal incomplete contract will be renegotiated at the point in time when the purchaser of the assets has to undertake restructuring investments.

In our present model we give a theoretical explanation for the empirically observable underinvestments on both sides of the transaction based on an incomplete contract, that requires the merging parties to hold all the bargaining power in renegotiations with the buyer in order to be induced to first-best efficient restructuring investments. For any tiny positive fraction of bargaining power on the side of the buyer, the merging parties cannot fully appropriate their marginal return on restructuring investments. Before renegotiations actually take place they will anticipate this fact and hence underinvest.³³

1.2 Aim of the thesis

The superior *aim of the thesis* is to apply contract theory to structural merger remedies and to improve the efficiency of their implementation.

This is the first work on merger remedies as part of the competition policy

³² Compare for Merger Remedies Study, p.75, §10.

³³ A necessary but natural assumption is that the restructuring efforts are significantly complementary for this result to hold.

literature which deals with a theoretical modeling of efficiency aspects regarding the implementation phase of divestitures.

Our theoretical modeling approach is twofold and very different in nature. In the first part of the thesis we introduce the idea of a costly implementation of divestitures in an existing Cournot model with divestitures. The major second part of this work takes a more fundamental approach by introducing contract theory to structural merger remedies.

Thus, on one side we deal with a model of imperfect competition, while on the other side we treat contract-theoretical models. These two totally different approaches in economic theory have only one thing in common: they both make use of game-theoretical models. Our solution method in games with several stages will be backwards induction leading to sub-game perfect Nash equilibria.³⁴

In order to be more precise, chronologically expressed, the first aim this thesis is to introduce the notion of restructuring costs to existing oligopoly models and to quantify the impact of an additional cost parameter on the industry outcome, that until now has been neglected. Thereby, we intend to create awareness of the fact that substantial restructuring, involving large investments, in general significantly decreases potential synergy gains as postulated in various merger efficiency defences. In particular, not only may reductions in efficiency be neglected by leaving restructuring investments unconsidered, but we will show that the effectiveness of divestitures strongly depends on the scale of restructuring investments that are necessary to implement the former.

The second and more important part of the thesis is a contract-theoretical approach to structural merger remedies.

Initially, the aim of this work is to undertake basic research, that is to bring

³⁴The notion of sub-game perfectness traces back to the highly known work by Selten (1965).

contract theoretical models in the context of structural merger remedy processes under explicit consideration of the legal background provided by the EC Merger Regulation.³⁵

Our theoretical analysis starts with the empirically observable double moral hazard problem which is involved in real world divestiture processes according to the EC Merger Remedies Study. We assume that the EC Merger Regulation creates a divestiture game between merging parties and the purchaser. We design the game in accordance with the legal prescriptions of the EC Merger Regulation and give proof for two-sided inefficient restructuring investments that necessarily have to evolve due to the design of the Regulation. Subsequently, we show that with the help of modern contract-theoretical models, the empirically observed and theoretically proven double moral hazard problem can be resolved. The solution involves the theory of incomplete contracts, where firms are interpreted as bundles of assets, which comes close to the idea of structural merger remedies where bundles of assets are physically transferred and allocations of property rights are legally enforced. In dependence on the allocation of ownership rights on the assets, the firms have different incentives to engage in restructuring investments. We will show that contractually agreed ownership structures at the beginning of the divestiture process are decisive for the incentive steering. In order to be able to implement first-best efficient restructuring investments and thus establish implementation efficiency, we admit for flexible ownership structures that involve options on ownership for the purchaser of the assets to be divested. We deduce a need for redesigned institutional divestiture processes that set restructuring incentives optimally. Thereby we aim to close the research gap of failing contract-theoretical analysis in the context of merger remedies. Based on these findings, we suggest how to change the legal framework governing divestiture processes in the European Union, for the European competition authority to be in the position to implement first-best restructuring investments.

³⁵This approach is completely new and was not previously undertaken in the literature on competition policy.

1.3 Literature on merger remedies

In general, there is only little *literature on structural merger remedies* in the competition policy field of research involving theoretical modeling. To date, articles have focused on questions of effectiveness and scale and scope of merger remedies and divestitures as efficiency gains screening devices. Thereby the authors abstract from efficiency considerations concerning the actual implementation of the remedies and neglect modeling the divestiture process as well as the incentives that are involved.

The first authors who addressed the effect of asset transfers on industry profits and welfare in a Cournot framework without explicitly referring to merger remedies are Farrell and Shapiro (1990,a). More recent articles by Compte, Jenny and Rey (2002) as well as Vasconcelos (2005) also base their asset transfer analysis on a Cournot model and put it in an explicit merger remedy setting, but their models work against the background of a collusive industry.

Rey (2000) and Gonzalez (2003) also deal with divestitures as a remedy that helps to eliminate competitive harm deriving from a merger. They focus on the recreation of effective post-merger competition and consider divestitures as screening devices that help the competition authority to reveal information about the level of efficiency gains of the merger.

Medvedev (2004) also founds his work on the prominent model by Farrell and Shapiro (1990,a) and those of Perry and Porter (1985) and McAfee and Williams (1992).³⁶ One of Medvedev's (2004) major contributions is the modification of the assumption that capital in an industry is fixed.³⁷ In his model, partial divestitures of assets are allowed. Principally, he formalized the intuition that the amount of asset transfer necessary to remedy the com-

³⁶The commonality of all those models is that they undertake an equilibrium analysis of a Cournot market before and after a merger. Thereby they analyze the effects on profitability and welfare changes.

³⁷The production cost of a firm is a function of the amount of fixed capital a firm holds.

petitive harm depends on the amount of efficiency gains. Thus, Medvedev (2004) provides a first theoretical foundation for a discussion of merger remedies and their effects on the industry as well as on consumer welfare.

Cosnita and Tropeano (2005) base their analysis on Medvedev's (2004) results and assume a Cournot game with homogenous products and constant marginal cost. They suppose synergy gains from a merger which materialize in a new marginal cost function.³⁸ The authors also establish a direct relationship between the amount of assets that have to be sold and the cost savings that are expected as a result of the merger.

There are two authors, Cabral (2001) and Farrell (2003), who take a different approach to the analysis of merger remedies. Cabral (2001) considers a spatially differentiated oligopoly where two firms merge assuming a free-entry equilibrium pre- and post-merger, focusing on consumer welfare effects.³⁹ One of his major results is that asset sales as merger remedies hinder competitors starting a new business on their own, therefore the consumers suffer from reduced supply.

Farrell (2003) at first discusses the role of negotiations in the merger enforcement process whose importance was already mentioned by Baer and Redcay (2001). He uses the Nash bargaining solution in order to find the optimal welfare standard a competition authority should have when evaluating merger efficiencies. This article differs from the other articles in two important ways. Firstly, Farrell's model is detached from a Cournot model. Secondly, he focuses on the importance of negotiations in the divestiture process. Both points are true for our model, too.⁴⁰

³⁸According to Farrell and Shapiro (1990,b) the merger increases prices on the market if there are no substantial synergy gains.

³⁹Cabral (2001) shows that cost efficiencies (lower marginal cost) decrease the likelihood of entry, and therefore harm consumers compared to the status of exogenous barriers to entry.

⁴⁰Farrell's (2003) findings will be addressed later when discussing the role of negotiations in the merger remedy process.

In a recent article, the authors Lyons and Medvedev (2007) pick up Farrell's (2003) idea. They analyze the standard of the two-phase investigation and remedy negotiations which are observed in the practice of the European competition authority and try to answer questions regarding the structure of the investigation, the efficiency in revealing information or the potential appropriation of gains from superior information by the merging parties.

1.4 Research gap and approach

Obviously, there is only a small amount of literature on the theoretical modeling of merger remedies. Studying previous work leads to the following *research gap*, which we aim to close with the help of this thesis.

The question of efficient implementation of structural merger remedies has neither been addressed in models of imperfect competition nor been made the research object in contract theory. Concretely, there are Cournot models which admit partial divestitures in the industry but there is no consideration of the fact that the implementation of structural merger remedies is costly. Before this thesis, research in this field has not posed the question of whether restructuring costs could be a decisive factor for the size of a divestiture as well as a cost component which reduces expected synergy gains that potentially derive from a concentration.

Contract theory is a powerful tool in order to describe and analyze incentives that are involved in relationships between several strategically interacting players subject to varying information distributions. Thus, contract theory is applicable to a great variety of economic questions. Nevertheless, contract theory in general and incomplete contracts in particular have not been applied to structural merger remedies before in order to analyze implementation efficiency.

This work is the first theoretical academic discussion of moral hazard problems in relation to merger remedies. Motivated by the empirical findings of the Merger Remedy Study of the EC, we focus on the incentives that are

involved in the structural merger remedy process using the theory of incomplete contracts. In a broader scope, the aim of our research is not only to demonstrate proof of a holdup problem, which is in fact prevalent in the remedies practice, but also to present contract theoretical solutions to this obvious incentive problem and to give policy implications in order to improve the efficiency of the divestiture process.

Summing up, we contribute to closing this research gap in that we:

- **introduce restructuring investments to Cournot models involving partial divestitures**
- **deliver a theoretical explanation for over-fixing mergers**
- **find critical values of divestitures that maintain the pre-merger price level for any value of positive restructuring investments**
- **bring contract-theoretical models in the context of merger remedies**
- **provide a theoretical explanation for the two-sided holdup problem involved in the implementation process of structural merger remedies under EC competition law**
- **give a formal proof of two-sided inefficient sequential restructuring investments as a result of a insufficient legal design of structural merger remedies processes**
- **introduce the reference solution for restructuring investments as a benchmark for implementation efficiency in divestiture processes**
- **apply the theory of incomplete contracts in order to find allo-**

cations of ownership rights that improve restructuring investments

- make the purchaser partial owner of the asset to be divested at the beginning of the divestiture process, thus changing her restructuring investments
- introduce options on asset ownership in accordance with famous work by Nöldeke and Schmidt (1998), providing a solution mechanism that implements both-sided first-best efficient investments and thus solve for the initially discovered inefficiency
- derive policy implications for a more efficient divestiture process with a focus on EC jurisdiction
- improve the effectiveness of structural merger remedies through efficient implementation

1.5 Organization of work

This thesis is organized as follows. In part I we give a short introduction to the legal background of structural merger remedies under EC competition law. Following this, we discuss major economic issues with structural merger remedies as observed by the European Commission and address possible approaches to finding implementable solutions. In chapter 3 we present Medvedev's (2004) modeling of Cournot competition in the presence of capital divestitures. Subsequently, we extend Medvedev (2004) by introducing costly restructuring investments that accrue only to the merging parties and derive the impact on the equilibrium outcome analytically. We show that restructuring costs themselves have the character of increasing the total cost of production as is the case with divestitures in a Cournot framework, thus over-fixing the competition problem if these costs are not taken into consideration by the competition authority in designing the divestiture.

Section II forms the main part of the thesis. In chapter 4 we introduce to the

contract-theoretical modeling of structural merger remedies, thereby trying to answer the question of why contract theory is a valid and an insightful tool to approach this topic, simultaneously forming the methodological background for our divestiture model in chapter 5. Here we start with designing a divestiture game between merging parties and a purchaser according to the legal prescriptions provided by the EC Merger Regulation. After having shown that under prevalent merger remedies practice, the Commission clears mergers involving inefficient restructuring investments that potentially exceed proposed efficiency gains, we suggest making the purchaser partial owner of the asset to be divested right from the beginning of the divestiture process. This induces both-sided improved restructuring investments, that are in some cases even first-best efficient. Finally, we make use of an option mechanism developed by Nöldeke and Schmidt (1998) in order to give the Commission an incentive optimizing mechanism which solves the double moral hazard problem. Eventually, in chapter 6 we make our own approach subject to criticism and give policy implications for a redesign of divestiture processes towards implementation efficiency.

Part I

Cournot mergers, remedies and restructuring investments under EC competition law

Chapter 2

Merger remedies under EC law

In 2005, the European competition authority, DG Competition, published an ex post investigation of merger remedies in 40 cleared merger cases in the time frame 1996 to 2000. This is the first analysis by a European competition authority focusing on the design, implementation and effectiveness of merger remedies.¹

Within the European Union, the EC Merger Regulation foresees the merging parties' right to modify the notified concentration in the run of the Commission's assessment of the merger's impact on effective competition. Such modifications or commitments intend to eliminate negative effects on the relevant post-merger market thus rendering the merger transaction compatible with the Common Market. The Commission may accept merger remedies conditionally on the question whether the commitments proposed are proportionate to the competitive issue and eventually will solve it.²

¹Several other reviews have been undertaken by international competition authorities, taking a different approach and not being that profound in investigations. The UK competition authority, for instance assessed the ex post effectiveness of merger decisions focusing on the market analysis undertaken during the review. C.f. Joint Report of the Office of Fair Trading, Department of Trade and Industry and the Competition Commission, "Ex-post Evaluation of Mergers" (2005). In the US, the FTC undertook a similar study with a focus on divestitures in the year 1999. We will not undertake a comparison with different empirical studies since our aim is to exclusively analyze the EC's approach to structural merger remedies.

²C.f. EC Merger Regulation, Articles 6(2) and 8(2).

Allowing for merger remedies as an instrument in order to restore effective competition post-merger, enlarges the set of possible outcomes of a merger assessment. Otherwise we would only observe merger clearances or prohibitions, whereas the amount of the latter decisions would presumably increase significantly. Apart from purely negative, i.e. competition restricting effects, mergers often reveal substantial synergy gains that materialize, for instance in cost reductions. Absent any merger remedies, these beneficial effects would not be realized thus prohibiting the creation of economies of scale which could be at least partially passed on to the consumer in the form of reduced prices. Therefore, a merger remedy can be seen as a tool which aims to eliminate all competition concerns with respect to a merger transaction giving room to efficiencies deriving from the concentration. This is the ideal case of a proportionate merger remedy. If the Commission fails to find the right remedy for the competition problem, she not only reduces or even eliminates post-merger efficiencies, she also may admit mergers under commitments which are harmful for consumers in that the remedies are not effective in protecting competition. Thus, design and implementation of merger remedies are of major importance.

The Commission's Merger Remedies Study aims to quantify whether her current remedy policy is able to restore competition with respect to two dimensions, design of the commitment, i.e. scale and scope, and its subsequent implementation. The purpose is to identify key determinants that influence the effectiveness of merger remedies in restoring competition in order to derive measures that improve the Commission's decision-making and to use the results in order to revise the guidelines for assessing mergers: the Merger Remedies Notice and the Model Divestiture Commitments and Trustee Mandate. These two documents are part of the best practice guidelines of the EC Merger Regulation, playing an important role, when it comes to the implementation of the commitments.

A basic understanding of the EC merger law, especially with respect to pre-

scriptions concerning merger remedies, is of paramount importance when it comes to the application of contract theoretical models to merger remedy processes. Since contract theory provides us with a powerful tool to analyze institutions and legal provisions with respect to incentives they evoke on the side of the parties that are involved, we try to isolate key drivers of strategic interaction in the merger remedy process. Thereby we assume that legal texts provide the framework for a merger remedy process which controls for certain actions parties have to undertake at different points in time. The strategic interaction is based on incentives that are dependent on the chronological structure of the remedy game. The relevant players are on one hand, the EC competition authority, DG Competition, as merger investigating and regulating instance in the case of requiring structural merger remedies and all other actors that represent the executive of DG Competition such as monitoring trustees in charge of surveillance of proper implementation of merger remedies. On the other hand we have two or more merging parties and their competitors as well as other undertakings that are most likely to be concerned by the merger.³

The remainder of this chapter is structured as follows. In the following section (2.1) we lay out basic important traits of EC competition law since the present work deals with mergers that fall under the legislation of the European Union. Hence, any merger which has Community dimension according to the turnover thresholds as defined in the EC Merger Regulation, is subject to investigations by the European competition authority. So are structural merger remedies and their implementation. For analyzing the divestiture process and the incentives of the actors, we need to gain a basic understanding of the legal framework. In section (2.2) we address key issues that are related to merger remedies based on the findings of the EC Merger Remedies Study. Section (2.3) discusses economic issues that are involved in the implementation of structural merger remedies. Finally, in section (2.4) we address important parts of selected legal documents that form the legal

³The set of competitors becomes evident in the process of determining the relevant geographical market and the relevant product market.

background of the EC merger policy giving room for opportunistic behaviour of the merging parties and the purchaser in the run of the divestiture process.

2.1 EC competition law and merger remedies

This thesis is about modeling structural merger remedies under European competition law. In order to understand the setting of our model, we give a short introduction to the background of European merger law, since the legislation and the resulting divestiture process have significant influence on the strategic interaction between the merging parties and the purchaser of the asset to be divested.

Within the European Union, the Council Regulation (EC) No 139/2004 which is also called the EC Merger Regulation, forms the legal basis for the appraisal of mergers. The EC Merger Regulation entered into force in its newest version in 2004 with a new guideline for the assessment of mergers which provides that a notified concentration should be declared as incompatible with the common market if it "[...] would significantly impede effective competition, in the common market or in a substantial part of it, in particular as a result of the creation or strengthening of a dominant position".⁴

According to the Regulation, there is an obligatory procedure for the assessment of mergers, based on the Council Regulation (EC) No 139/2004. Whenever at least two firms intend to merge, the so-called merging parties are forced to notify the planned concentration with DG Competition. In general, not all concentrations are subject to the Commission's investigations. They are mandatory for the case that the concentration has Community dimension.⁵

Horizontal concentrations first have to be notified with the Commission and

⁴C.f. The EC Merger Regulation (2004), p.3. In what follows The EC Merger Regulation will be abbreviated to "the Regulation".

⁵There are turnover thresholds indicated in the Regulation which define whether a horizontal concentration has Community dimension or not. For an exposition of the thresholds compare for the Regulation, p.8.

can either subsequently be implemented before the Commission's decision or the merging parties wait until the Commission has declared the merger intention compatible with the common market.

Since the European merger policy is deadline driven, at the day of an official and complete notification the initial examination Phase I starts. From that point in time, the Merger Network gathers together in case teams in order to assess the notification and possibly ask for more detailed information on the notified merger. The case team in charge of the notified concentration now engages in deeper analysis which requires further information by the merging parties, interviews with the management as well as consultations of Member State competition authorities. At the end of Phase I, i.e. after 25 working days post-notification, the Commission has to arrive at an Article 6 decision.⁶

Depending on the results of the merger assessment, three different outcomes are possible. In the case that the competition authority comes to an Article 6(1)a decision, that is the planned merger does not fall within the scope of the Regulation, the merger case will be passed on to the competition authority in charge of the investigation, possibly involving merger remedies.

If the Commission's investigations show that the notified concentration will not have negative impact on the post-merger competition in the common market, she will clear the merger after an Article 6(1)b decision.

The last possible decision at the end of Phase I investigations is an Article 6(1)c decision. In the case that the planned merger raises serious doubts with regard to effective competition, the investigation requires more information, deeper investigations and detailed market tests especially if the potential harm deriving from the concentration may be eliminated by requiring merger remedies. In the case of uncertainty regarding the post-merger effect

⁶Phase I can be extended to further ten working days upon a Member State request according to Article 9(2) or if the merging parties already offered commitments to the commission that have to be at least superficially market tested.

deriving from the concentration, the Commission refers the final decision on the merger case to Phase II investigations.

Right on the date of the Article 6(1)c decision, Phase II begins. Subsequent to the initiation of proceedings, the Commission engages in detailed analysis of potential effects on the relevant market. The merging parties are allowed to offer commitments in order to eliminate potentially negative effects deriving from the concentration. The Commission will, where appropriate, accept the commitments and adopt them as legally binding merger remedies. During Phase II investigations, the Commission will market test the remedies, interview competitors as well as retailers in order to quantify the impact of the merger in the presence of merger remedies. Thereby, the Commission puts a clear focus on the effectiveness of merger remedies, i.e. she aims to clear the merger if and only if the commitments restore effective competition among the remaining players in the post-merger market. In the case the Commission raises serious concerns regarding post-merger competition, she issues a statement of objections.⁷

There are three final decisions at the end of Phase II investigations that are of interest for our present work. In the case the EC concludes that the concentration will not harm post-merger competition, the authority declares the merger to be compatible with the common market and thus clear the transaction under an Article 8(1) decision.

Possibly, the notified transaction has negative effects on the post-merger competition but the EC accepts merger remedies as proposed by the merging parties which are effective in eliminating competition concerns. Therefore, the EC, assuming an Article 8(2) decision, declares the merger to be com-

⁷According to the EC, a Statement of Objections (SO) is a formal step in the Commission's merger investigations in which the Commission informs the merging parties in writing of the objections raised against them. The addressee of a Statement of Objections can reply in writing to the Statement of Objections, setting out all facts known to it which are relevant to its defence against the objections raised by the Commission. The Commission may then take a decision on whether conduct addressed in the Statement of Objections is compatible or not with the EC Treaty's antitrust rules. Sending a Statement of Objections does not prejudice the final outcome of the procedure.

patible with the common market.

Finally, if a deeper Phase II assessment shows that commitments are not effective in restricting the merging parties' post-merger market power, the Commission adopts an Article 8(3) decision thereby prohibiting the merger transaction.

2.2 The EC Merger Remedies Study

The European Commissions' merger remedies study analyzes 96 different remedies that were part of 40 merger decisions over the period from 1996 to 2000. Based on interviews and questionnaires that were submitted to merging parties, purchasers of the assets and monitoring trustees, the study presents cases where the commitments were ineffective in solving competition concerns as identified by the Commission. This fact is mirrored in the study's statistics, in that structural merger remedies in the form of divestitures, were only effective in 56% of the cases in solving issues raised by the merger.

In our following discussion, we will focus on structural merger remedies not only because they are the most important tool for the Commission to restore effective competition but also because the study provides more empirical findings on this type of remedies compared to behavioural ones. Divestiture remedies are preferred by competition authorities since they are considered to be an effective tool to restore competition which does not cause further costs of monitoring as is the case with behavioural remedies. Hence, in the Notice on merger remedies, the European Commission reveals her preference for structural merger remedies as a tool to remedy mergers that create or strengthen a dominant position: "[...] the most effective way to restore effective competition, apart from prohibition, is to create the conditions for the emergence of a new competitive entity or for the strengthening of existing competitors via divestiture."⁸

⁸Commission Notice on remedies acceptable under Council Regulation 4064/89 and under Commission Regulation 447/98, (Notice on Merger Remedies), § 13.

Nevertheless, the results of the study pose the Commission's preference in question since it documents substantial issues associated with structural merger remedies. Especially regarding the effectiveness of structural commitments, the statistics provides strongly contrasting results. Hence, the study concludes that in 56% of the cases, divestitures were in fact able to effectively restore competition but 25% were only partially effective. The effectiveness of a structural merger remedy means that the divested entity remained a viable and effective competitor in three to five years post divestiture. In order to measure effectiveness in detail on a more reliable quantitative basis, the Commission used the following proxies: whether the buyer of the divestment was still operating, the market share evolution of the divested business and of the merging parties, as well as a comparison of the evolution.

Comparing the effectiveness of structural merger remedies as adopted by the Commission after a Phase I decision with remedies which have to be implemented post Phase II decisions, Phase I divestitures are more effective according to the study. This may be due to the fact that Phase I competition issues are in general clear cut and easier to be eliminated. Often, Phase I decisions with commitments deal with issues that do not require regulatory interventions that are as deep as Phase II decisions involving divestitures.

Furthermore, the study identified that the pure existence of a divested business on the post-merger market does not guarantee effectiveness of competition per se. Therefore, as indicated above, the Commission compares the evolution of market shares in order to get a clearer picture of the effectiveness of post-merger competition. Here too, the study provides statistics which question the effectiveness of structural commitments since in 44% of the cases, the market share of the divested entity decreased, partially by 50%. Only 34% remained more or less on a constant level. In approximately 60% of the cases, the merging parties' operations on the relevant market performed better than the divested business. However, this is not necessarily an indicator for failing effectiveness but could be the result of very intense

post-merger competition.

The study analyzes structural merger remedies under the classification of a "transfer of a market position". Such divestiture commitments are further sub-divided into:

- (i) divestiture of control rights in a firm
- (ii) divestiture of a business unit
- (iii) divestiture of mix-and-match assets
- (iv) divestiture or grant of a long-term exclusive licence.

We will focus on categories (i) and (ii) of divestitures since they imply a reallocation of ownership rights which is in line with the contract-theoretical perspective of structural merger remedies.

Apart from the question of choosing the right divestiture, the implementation has proven to be very difficult in practice according to the study. Thus, the Commission identified *two main categories of risks* that are involved in the implementation of structural commitments:

- choosing the wrong design of the divestiture, i.e. scale and scope
- failing to ensure a proper implementation,

that is finding a suitable purchaser and make sure that the asset or business to be divested will not be reduced in its functionality and value.

In the remainder of this section we present the main risks that are involved in the determination of the design and the implementation of divestitures.

2.2.1 Risk of choosing the wrong divestiture

In 79% of the cases where structural merger remedies raised issues concerning their effectiveness, the Commission has chosen the wrong size of the divestiture, i.e. the scope of the divested entity was insufficient. The Commission in general runs the risk of either over- or under-fixing the competition issue. One of the greatest competition damages that arise due to the wrong choice of assets, is because the Commission fails to identify such assets that are vital for the viability of the business to be divested. This traces back to the fact that the merging parties are not forced to disclose information on key assets. Hence, merging parties are incited to hide such assets that are factually most important for competition on the relevant market. Thus, the purchaser acquires assets that are not sufficiently viable and strong competitive forces on the post-merger market.

Another risk the Commission runs in the design of structural merger remedies is that the scope of the business to be divested is often exclusively put into relationship with the overlap in the merging parties' operations. Hence, the study shows that under current merger remedy policy, the Commission's perspective is too much focused on market shares and market structure instead of questioning, whether the asset itself is able to restore effective competition independent of how much overlap is reduced by the divestiture. The Commission's prevalent approach to unilaterally concentrate on the overlap neglects finding key determinants for the viability of a business such as size of the asset, the role of intellectual property rights and links that persist post-merger between the divested business and the merging parties remaining assets.⁹

The type of divestiture chosen by the Commission represents another source

⁹Post-merger, there may be still upstream- or downstream links between the purchaser and the merging parties that in any case lead to competitive damages since they either restrict the purchaser's freedom in decision-making or incite the purchaser to collude with the merging parties. That is, the likelihood that we may observe either unilateral or coordinated effects harming the consumer, is strongly increased in the presence of post-merger links.

of risk for effective competition. The study concludes that the divestiture of a stand-alone business is more likely to be effective post-merger than carve-outs or a "mix-and-match"-approach.¹⁰ In 18% of the cases, carve-outs caused significant issues for competitiveness post-merger. According to the study, almost all carve-outs raised issues since the complex carve-out process cannot be fully planned. Hence, the study found out a lot of unforeseeable problems.¹¹ Furthermore, the study concludes that the purchaser of the carve-out or any other market participant is not able to safeguard properly carve-outs. By consequence, the commitments have to allow for more flexibility in order to react on unexpected issues that arise in the run of the divestiture process. Additionally, the Commission has to install oversight mechanisms through divestiture trustees and hold-separate managers.

2.2.2 Risk involved in implementation

Subsequent to the Commission's decision on the nature of the divestiture remedy, a suitable purchaser has to be identified. According to the study, this essential factor for effective competition also involves considerable risk since in 48% of divestiture remedies investigated, the suitability of a purchaser raised issues. Hence, in minimum 11 cases that required divestitures, the wrong choice of a buyer led to partially ineffective structural commitments. The commission developed a tool in order to mitigate the problems related with the suitability of a purchaser: the up-front buyer clause. Although this clause was only applied in one case, the study gives proof for mainly positive effects deriving from this institution. Based on the findings of the study, the Commission concludes that an up-front buyer leads to shorter divestiture processes and thus reduces the likelihood of two-sided opportunistic behaviour. In addition, through the existence of an up-front

¹⁰The definition of a carve-out according to the study is the following: A carve-out consists of the legal and physical separation of the assets of the divested business from the parties' retained business, so that the divested business can operate on a stand alone basis, is able to compete successfully on a lasting basis and is independent of the divesting parties. C.f. Merger Remedies Study.

¹¹The fact that carve-outs are complex and involve unforeseeable issues will find explicit consideration in our divestiture model.

buyer, the competition issue is fixed first, before merger proceedings have been undertaken. Both factors taken together have proven to reduce the risk of deterioration of the assets to be divested throughout the divestiture process. However, there are countervailing arguments by practitioners that say that the need to find in advance a suitable purchaser does not accelerate the whole divestiture process but in fact postpones the closing of the transaction giving the up-front buyer too much weight in the divestiture process.¹² Naturally, the duration of the divestiture process is essential for the success of the divestiture and thus for the merger transaction itself. The longer the divestiture process, the more likely become moral hazard issues on both sides of the transaction. Additionally, the realization of synergy gains is delayed, thus the present value of the added value decreases which sends negative signals to the capital market. Furthermore, the value of the divested business becomes more volatile due to increased uncertainty, therefore leading to a reduced purchase price of the divested entity.

One of the major risks which are involved in the divestiture process is the risk of reduced competitiveness of the asset to be divested. The study found out that during the interim preservation phase, several measures were undertaken with the intention to harm the competitiveness of the divestiture object. The Commission, in order to make sure that the asset will not be degraded in the interim phase, tries to maintain control over the divestiture process with the help of the Remedies Notice and the Model Divestiture Commitments as important part of the EC Merger Regulation. Hence, merging parties are forced by law on one hand to maintain the functionality and to preserve the value of the assets to be divested. On the other hand, she requires the assets to be held separate from the retaining business of the merging parties in order not to give room for opportunistic behaviour throughout the divestiture process.

¹²C.f. Papandropoulos and Tajana (2006), p.447. In our divestiture model, we assume a moderate leverage power of the purchaser which results in an equally distributed bargaining power among the merging parties and the purchaser.

The study found out that there are several different cases where the Commission identified ex-post moral hazard by the merging parties. The latter not only consciously neglected their obligation to maintain functionality, viability and competitiveness of the divested entity, but undertook actions that degraded the assets in value and competitiveness. In particular, the merging parties engaged in front-loading, i.e. they damaged the post-merger market of the business to be divested by skimming all market demand pre-merger. Concretely, in such cases, the merging parties sell products for extremely low prices, thus facing all demand before the business is sold to the purchaser. After the asset is transferred to the buyer, the market price is too low to be profitable in the long run. Hence, sooner or later, the newly created business exits the market due to unprofitability.¹³ In other cases, merging parties retained key workforce and know-how necessary to effectively operate the business or undertook pricing campaigns prior to divestiture in order to decrease sales in the post-merger phase.

Due to these implementation issues, the study concludes the necessity of hold-separate managers that guide the whole divestiture process in order to make sure that all remedies are implemented according to the Commission's requirements related to asset preservation.

Up to this point in time, merging parties are allowed to identify suitable buyers of the asset, naturally being incited to choose only those that post-merger form the least effective competitor.

Hence, the divestiture process is characterized by strong incentives, especially of the merging parties, to jeopardize the assets functionality, viability and competitiveness although there are substantial fines for any breach of contract.

¹³The UK Competition Commission describes front-loading as "[...] the process of selling sufficient quantities of a product on to the market before the divestiture such that the purchaser faced a period of very low demand just after having acquired the assets." C.f. Competition Commission (2007), [http : //www.competition – commission.org.uk/our_role/analysis/understanding_past_merger_remedies.pdf](http://www.competition-commission.org.uk/our_role/analysis/understanding_past_merger_remedies.pdf).

To sum up, according to the study, the main sources of risk related to the implementation of divestitures are the following:¹⁴

- asset damaged and not operational at the point in time when transferred to the purchaser
- key parts of the assets are retained
- necessary input by the merging parties not delivered, thus holding purchaser up.

These issues led the EC to engage trustees that monitor the implementation of remedies. In practice, a trustee's duty is to enforce the Commission's remedies. The Commission distinguishes between two types of trustees with respect to their function within the divestiture process. On one hand there are monitoring trustees or so-called hold-separate managers, on the other hand there are divestiture trustees. Although the Commission often argues in favour of such trustees due to a lack of resources, in fact such trustees have proven to be an effective institution in reducing information asymmetries between the competition authority and the merging parties. Not only the pure existence of such an institution reduces the incentives to opportunistic behaviour, trustees also provide industry-specific knowledge. After the Commission's clearance decision, the trustee observes compliance to the obligations set out in the divestiture contract.

Regarding the risks that are involved in the asset transfer, the study has shown that the ex-post effectiveness of a divestiture strongly depends on the way, the divested entity is managed within the divestiture process. The relevance of opportunistic behaviour should be obvious with regard to the study's results. In one extreme case, the Commission found out that the merging parties succeeded to damage the asset till inoperability before sale.

¹⁴C.f. Merger Remedies Study, section II.E, § 8.

We can thus conclude that a monitoring instance is of paramount importance for divestitures to be effective but it cannot be assured in any case that unobservable opportunistic actions are undertaken in the case of information asymmetries between merging parties and monitoring trustee. Thus, trustees can reduce the risk of opportunistic behaviour but they cannot eliminate it. In so far this institution not only represents an additional cost factor which reduces synergy gains but fights the symptoms not the cause. Our divestiture model will change the players' incentives thus making monitoring trustees eventually superfluous.

2.3 Economic issues with structural merger remedies

In the preceding chapter we discussed key findings of the EC's study on merger remedies which should have made obvious that research is necessary to find answers on the issues that are prevalent in structural merger remedies processes.

However, this is not the first work which tries to mitigate issues observed in the practice of the Commission's structural merger remedies process. As we have pointed out in the introduction, there are several theoretical articles that discuss the economics of merger remedies on an imperfect competition basis. This approach achieved important results for the design of structural merger remedies but less for the subsequent implementation. Hence, in the following, we engross our thoughts on opportunistic behaviour as empirically observed part of the divestiture process and relate them to existing contributions.

According to Papandropoulos and Tajana (2006), there are three classes of contributions that:

(1) focus on the impact of asymmetric distributed information and strategic

behaviour on structural remedies;

(2) analyze whether the Commission's affinity to structural merger remedies is justified or not;

(3) assess the effects of so-called over-fixing on the ex-ante merger incentives.

With the help of the study it became a matter of fact that scale and scope of divestitures as well as the subsequent implementation are subject to strategic behaviour, especially in the case of a strong information asymmetry between the merging parties and the purchaser on one hand and between the merging parties and the Commission on the other. Naturally, the merging parties are not incited to engage in first-best efficient investments in order to provide an asset that strengthens their post-merger competitor. Indeed, they found out that the merging parties behave hostile in that they degrade assets, choose the wrong assets or retain vital information and important workforce.¹⁵ Furthermore, purchasers who are new in the industry, or business units that post-merger operate on a stand-alone basis, purchase assets of limited competitive value and finally are not able to represent an appropriate counterweight against the merged entity.

Assuming that only merging parties behave strategically throughout the divestiture process would be far beyond reality. The purchaser may be incited to opportunistic behaviour as well whenever she is able to make use of information asymmetries. The purchaser may be interested in restricting competition, too. This is the case in markets with high symmetry of market shares, where firms are likely to engage in tacit collusion. On such markets, an asset divestiture could even increase symmetry among the players and thus increase the likelihood of coordinated effects. Increased symmetry as a result of a structural remedy has not been subject to the Commission's investigations in the study. Motta, Polo and Vasconcelos (2003) address the

¹⁵ C.f. Merger Remedies Study, section II.E.

issue of increased symmetry due to a reallocation of productive capital among the main players in a market, leading to an increased likelihood of collusive behaviour. They conclude that post-merger, the market has to be assessed with respect to the intensity of competition in order to detect coordinated behaviour.

As a consequence, the purchaser's incentives have to be subject to investigations as well. Therefore, the Commission should refrain from her prevalent attitude to consider the purchaser as a kind of victim of the planned concentration.

Earlier, we addressed the EC's preference for structural merger remedies which is founded on good reasons since often divestitures are more appropriate in the destruction of post-merger links and in the creation of an independent competitive force. However, as the study concludes, structural remedies involve serious issues. For instance, the effectiveness of divestitures suffers from moral hazard which is prevalent in nearly every divestiture process. In the worst case, the purchaser acquires an asset which is worthless for competing with the merging parties. Hence, structural commitments are not per se better than behavioural remedies. Besides the risk of collusion, Rey (2003) stresses the issue of irreversibility and the impact of bad divestitures thereby referring to the practice of international regulators which are very cautious with asset sales as a remedy.

2.4 Implications for modeling

The aim of the present chapter is twofold. Firstly we give a rough picture of the merger investigation process based on the European Commission Merger Regulation No 139/2004 which represents the essential legal basis for the appraisal of notified mergers in the EC. Thereby we roughly indicate possible sources of opportunistic behaviour as a result of an insufficiently defined legal framework.

There are three legal documents with relevance within the European Eco-

conomic Area which are of decisive importance for the merger remedy process. These texts provide the legal framework within which mergers have to be assessed being eventually possibly cleared under merger remedies. These documents contain all rights and liabilities of the merging parties as well as of the potential buyer creating a chronological structure of the divestiture process and thereby defining the major principles for our divestiture game. Mergers differ from case to case. Thus, merger remedies or divestiture commitments have to be tailored to the underlying market conditions. Legal texts can only give direction to the assessment and design of effective remedies and their efficient implementation. Apart from some key features of the divestiture process like the sequentiality of the restructuring investments, there will always be room for opportunistic behaviour which is unobservable for the EC.

Besides the EC Merger Regulation, i.e. the legal basis for assessing proposed concentrations in the EU, there is another legal document which is important for the design of a stylized divestiture game: the Implementing Regulation of the EC.¹⁶ In its latest edition it came into force in 2004 and provides time limits and procedures for submission of remedies acceptable under EC competition law.¹⁷

The Commissions Notice on remedies acceptable under the EC Merger Regulation constitutes the third legal source within the EU, giving general principles of merger remedies that are accepted by the EC.¹⁸

One of the most important legally fixed principles is the question of the burden of proof which means that the EC has to prove that a notified "[...] concentration creates or strengthens market structures which are liable to impede significantly effective competition in the common market."¹⁹ Whereas

¹⁶ Commission Regulation (EC) No 802/2004 of 7 April 2004 implementing Council Regulation (EC) No 139/2004 on the control of concentrations between undertakings. In what follows, we refer to the Implementing Regulation.

¹⁷ C.f. Article 18 and 19 of the Implementing Regulation.

¹⁸ C.f. Commission Notice on remedies acceptable under Council Regulation No 4064/89 and under Commission Regulation No 447/98.

¹⁹ *Ibidem*

the merging parties have to show that the remedies submitted are capable to restore effective competition on a lasting basis once they have been implemented successfully.

For the construction of a divestiture game which is in line with the legal framework as provided by the three earlier mentioned documents, the following articles are of great importance since they are responsible for the issues inherent in the remedy process. A short exposition of those articles helps to draw a clear picture of the latitude that is given the merging parties and the potential buyer. By identifying articles that give room for opportunistic behavior on both sides of the transaction, we approach the solution of the issues we identified in the previous sections.

Article 5 of the Commission Notice on remedies allows the merging parties to offer and to implement modifications in advance or within a certain time frame after the clearance decision. Thereby the EC indicates that it is common to have the remedies realized after the commitments are considered to be a viable instrument to render the concentration compatible with the common market.²⁰ This article turns out to be one of the major sources of inefficiency which is part of the restructuring process because after the merger is approved under a divestiture remedy, the merging parties as well as the buyer of the assets are locked in a relationship. All monetary investments and restructuring efforts that are necessary in order to prepare for the asset transfer become relationship-specific i.e. any effort concerning the conservation of functionality, marketability and competitiveness has no value outside this relationship. Hence, we observe a holdup problem since this issue will be anticipated by the merging parties as well as by the prospective competitor. The intuition behind this empirically observable phenomenon is clear. Why should the merging parties engage in optimal investments in an asset that will be transferred to a competitor who will be strengthened by the transfer? Obviously, the effectiveness of a remedy is uniquely related to the degree of efficiency that is involved in the implementation of structural merger reme-

²⁰Ibidem.

dies. Besides the timing of the implementation process, the Commission's Notice on remedies addresses the preferable nature of commitments that are potentially approved by the EC.

Until now, the EC merger policy only focuses on an effective implementation of merger remedies. Without an explicit consideration of the incentives of the players that are involved in the asset transfer on a case-by-case basis, the EC will always clear mergers under commitments that lack of efficiency and effectiveness.

For a realistic formulation of a divestiture game, part VI of the Implementing Regulation is of particular interest with respect to timing as well as monitoring institutions. This part deals with all requirements for implementation of commitments and by consequence lays out the timing and the structure of our divestiture game. Apart from the purely legal character of the document, it serves as guidance for merging parties in order to compose their commitment proposals.

Hence, the EC allows for an implementation of commitments after the clearance decision. This is normally the case in most merger remedies. In order to make sure that these commitments are implemented in time as well as in an effective way, the EC requires securities.²¹ These so called implementing provisions are part of the commitments. In the event that the merging parties do not follow their own implementing provisions, the commitment is not fulfilled and the clearance decision may be redeemed. Therefore, we can derive that the clearance decision can be made dependent on the implementing provisions as long as they are observable for the EC or some other institution that is in charge of monitoring the divestiture process.

Article 48 of the Implementing Regulation requires the divestment to be completed within a fixed time period. The day when the EC assumes the clearance decision under remedies, the divestiture process deadline begins.

²¹C.f. Implementing Regulation, Article 44.

Therefore we have a clear time frame for our divestiture game with a starting date when the EC decides on the notified merger in the light of the commitments made by the merging parties. The EC will not clear the merger in the case that at that date some provisions or commitments do not satisfy the EC's requirements.

Having introduced to the basic traits of EC competition law and merger remedies as well as their empirical assessment, the following chapters deal with theoretical models on structural merger remedies and their implementation.

Chapter 3

Merger remedies involving restructuring costs in a Cournot framework

The following analysis bases on Medvedev (2004) who firstly addressed the effects of structural merger remedies on a Cournot market with fixed production capital. Absent any efficiency improvements or synergy gains that may materialize in reduced cost or economies of scale and scope, the merged entity is incited to exercise market power by increasing prices thus reducing consumer surplus.¹ Medvedev (2004) shows that equilibrium prices are even lower post-merger but only if a merger realizes substantial economies of scale. Besides those positive, price decreasing effects, there are countervailing negative effects that derive from a sudden asymmetry in the market. Divestitures will proof to be an effective tool to increase post-merger symmetry in the market and thus incite more intense competition.

Within this Cournot modeling, we extend Medvedev (2004) by a parameter which reflects restructuring investments that are necessary to implement divestiture remedies. Here restructuring investments comprise all activities undertaken by merging parties in order to maintain functionality, marketabil-

¹For a discussion of efficiency gains in the context of horizontal concentrations compare for Motta (2004), p. 238 ff.

ity and competitiveness of the production capital which eventually will be integrated by the last remaining competitor in the market. The purpose of this model extension is to show how restructuring investments influence the industry outcome. As an important result, restructuring investments reinforce the beneficial effect of divestitures in that they increase the merging parties' total cost of production. Leaving restructuring costs unconsidered, the size of the divestiture will be too large and hence over-fix the competition issue. Thus, the introduction of this additional cost parameter extends the range of possible parameters which leave the post-merger price level unchanged compared to the pre-merger situation. As an important implication for merger policy, we find a theoretical explanation for the phenomenon of over-fixing which may not only harm the merging parties and increase market power of the competitor but also may reduce synergy gains to zero.

As already mentioned in the introduction, Medvedev's (2004) work departs from findings of Farrell and Shapiro (1990), Perry and Porter (1985) as well as McAfee and Williams (1992). These models undertake pre-and post-merger equilibrium analysis determining the effects on the industry profits as well as on welfare changes resulting from horizontal concentrations. All former models assume the existence of some fixed amount of capital that determines the individual firm's production costs. Medvedev (2004) relaxes this assumption by admitting partial divestitures within the industry. Under the assumptions that the capital stock of a firm is decisive for its cost of production, by consequence, changes in the amount of capital due to partial divestitures also have an impact on the cost structure within an industry. Due to the well know Cournot model mechanics, a change in production cost implies altered competition on the product market. In a general Cournot model, lower marginal cost of production can be interpreted as a competitive advantage.

Following Medvedev (2004), we assume that the competition authority in charge of merger investigations, is consumer surplus-oriented. This means that mergers, creating unilateral, i.e. price increasing effects are not al-

lowed, whereas mergers that reduce prices or maintain the former level on the relevant market will be cleared.² In the case that merging parties are able to proof significant synergy gains deriving from the merger, the effect of increased market power may be canceled or even over compensated by substantial cost reductions. The overall effect may be a reduced post-merger price level as discussed by Williamson (1968), Farrell and Shapiro (1990) and Werden (1996).

We start our analysis with a short introduction to the classical Cournot model in a general n - firm setting. Following Medvedev (2004) we first address the case of a merger to duopoly with symmetric cost functions. After a short introductory presentation of Medvedev's (2004) results, in section (3.2) we extend Medvedev (2004) by introducing restructuring investments that exclusively accrue to the merging parties. Finally, we discuss our findings with respect to the validity of our analysis.

3.1 A Cournot model with divestitures - Medvedev (2004)

The following analysis takes place in a generalized Cournot framework on a market with an inverse demand function $P(Q) = a - bQ$. Basically within the industry there are n firms competing in quantities, where q_i represents the individual output of firm i . Accordingly, the industry's total output amounts to $Q = \sum_{i=1}^n q_i$. Each firm's optimization problem is assumed to be identical. Therefore firm i maximizes

$$\max_{q_i} [a - bQ]q_i - C(q_i, k_i), \quad (3.1)$$

²There is a vital discussion among competition policy researchers such as Besanko and Spulber (1993), Neven and Roller (2000), Shapiro and Farrell (2001) as well as Motta (2004) about which measure should be applied in evaluating merger impacts, the consumer surplus or the total surplus. For the purpose of establishing comparable results, we follow Medvedev (2004) and stick to a consumer surplus perspective.

with k_i denoting the amount of assets in the hand of firm i . Medvedev (2004) assumes the following cost function which accounts for the firm's total capital:

$$C(q_i, k_i) = \frac{d_i}{k_i}. \quad (3.2)$$

Thereby parameter d_i represents firm i 's production technology.³ Building the first derivative of the cost function makes obvious, that the production costs fall with an increasing amount of assets, i.e. $\frac{\partial C(q_i, k_i)}{\partial k_i} = -\frac{d_i}{k_i^2} < 0$, since $d_i, k_i > 0$. This technical assumption implies that through the merger, the merged entity is able to realize economies of scale. The more assets a firm deploys, the cheaper the production of the underlying good.

Given these technical assumptions, each firm's optimization problem is formally expressed by,

$$\max_{q_i} [a - bQ]q_i - \frac{d_i}{k_i}q_i$$

for all $i \in \{1, n\}$.⁴ The equilibrium values for the following system of n first-order conditions are given by

$$a - 2bq_i - b \sum_{j=1, j \neq i}^n q_j = \frac{d_i}{k_i}.^5$$

Thus, the n -player Cournot equilibrium is characterized by firm i 's optimal choice of output

$$q_i^c = \frac{1}{(n+1)b} \left(a - n \frac{d_i}{k_i} + \sum_{j \neq i}^n \frac{d_j}{k_j} \right). \quad (3.3)$$

³Since $\frac{\partial C(\cdot)}{\partial q_i} = \frac{d_i}{k_i}$, we assume constant marginal costs.

⁴There is a kind of participation constraint for the firms. Depending on the constellation of the parameters it is worth to start production or not. Production is profitable in the case that $a - \frac{d_i}{k_i} > 0$.

⁵This is the set of best response functions given the output choice of all other competitors.

⁶ Aggregating over all individual output decisions yields the following total industry output

$$Q_{total}^c = \frac{1}{(n+1)b} \left(na - \sum_{i=1}^n \frac{d_i}{k_i} \right). \quad (3.4)$$

Plugging the total industry equilibrium output into the inverse market demand function, the equilibrium price assumes

$$P^c(Q) = \frac{1}{(n+1)b} \left(a + \sum_{i=1}^n \frac{d_i}{k_i} \right). \quad (3.5)$$

After a little bit of algebra, the individual pre-merger equilibrium profit of each firm amounts to

$$\pi_i^c = \frac{1}{(n+1)^2 b} \left(a - n \frac{d_i}{k_i} + \sum_{j \neq i}^n \frac{d_j}{k_j} \right)^2. \quad (3.6)$$

Medvedev's (2004) n -firm divestiture model shows that the idea of capital assets as an instrument to influence production costs and divestitures as a remedy against increasing market power, can formally easily be incorporated in a general Cournot model. The choice of model parameters k and d is intuitive but reduces mergers to pure scale effects.

In the following section (3.1.1) we apply Medvedev's (2004) general n -firm model to the case of an oligopolistic market structure, where three firms compete in quantity and share the market evenly. In the subsequent section (3.1.2) we assume that the competition authority allows for a merger between two firms of equal size without requiring any divestitures. Thus, market shares are distributed in a $(\frac{2}{3}, \frac{1}{3})$ -ratio. The main intention of this exposition is to give a benchmark for the case of introducing structural merger remedies that materialize in capital divestitures. This is the case in section (3.1.3). Here the competition authority requires the merged entity to divest some fraction of the newly acquired additional capital. In section (3.2) we

⁶For positive quantities in equilibrium, the following assumption concerning remaining parameters has to be made: $q_i = \frac{1}{(n+1)b} \left(a - n \frac{d_i}{k_i} + \sum_{j \neq i}^n \frac{d_j}{k_j} \right) > 0$.

depart from Medvedev (2004) and introduce the idea that the implementation of structural merger remedies requires substantial investments. Thus we integrate an additional parameter which represents restructuring investments. The aim of the analysis is to quantify the impact of different levels of restructuring investments on industry performance.

3.1.1 $n = 3$: pre-merger situation

We start our analysis with a market where only three firms are active, that is $n = 3$. In general, the following calculations could also be applied to markets with more than three firms. From a practical point of view, such oligopolistic market structures often occur in reality. Technically, an analysis involving more than three firms would increase algebraic complexity but would not change the economic intuition behind the results.⁷ Additionally, we assume an equal distribution of assets among competing firms, $k_1 = k_2 = k_3 = k$ and depart from identical production technologies $d_1 = d_2 = d_3 = d$.

In the pre-merger case, firms choose an identical individual output level of $q_1^c = q_2^c = q_3^c = \frac{1}{4b}(a - \frac{d}{k})$ due to the symmetry in the market. The resulting total quantity in Cournot equilibrium amounts to $Q_{total}^{pre} = \frac{3}{4b}(a - \frac{d}{k})$. Thus, the price in the Cournot equilibrium is $P(Q_{total}^{pre}) = \frac{1}{4}(a + 3\frac{d}{k})$. Finally, for the reason of having a benchmark, the individual firm's Cournot equilibrium profit is given by $\pi_i^{Pre} = \frac{1}{16b}(a - \frac{d}{k})^2$ for each of the three firms.⁸

First simple comparative statics show that in equilibrium, the amount produced by each firm increases with the amount of capital or assets a firm owns,

⁷This approach can be justified by the fact that results do not change by increasing the number of firms in the market. The more firms in the market, the smaller their market share. For the following analysis to be valid we only have to exclude the cases of $n \rightarrow \infty$ and a merger from $n \rightarrow \infty$ to $(n \rightarrow \infty) - 1$ since in this case the market structure is not oligopolistic anymore but approaches perfect competition. Under such a market structure, mergers and consecutive divestitures will not occur due to their failing influence on individual firm profits.

⁸For detailed calculations see Appendix 8.1.

i.e.

$$\frac{\partial q^c}{\partial k} = \frac{d}{4bk^2} > 0. \quad (3.7)$$

Having calculated benchmark values for the pre-merger case, in the next section we allow for a merger between two of the three firms in the market. Due to the symmetry of the firms, we can ignore the question of which two companies actually intend to merge.

3.1.2 $n = 2$: post-merger situation without structural remedies

Assume that two of three firms in the market have merged. By consequence, the market becomes more concentrated. Absent any structural merger remedies, the merged entity will hold twice as much assets, namely $(2k)$, compared to the single remaining competitor, whose capital stock (k) remains unchanged after the merger. Thus, there is no symmetry in the market anymore.⁹

Asymmetry in production capital also shows formally in different maximization problems. The merged entity's optimization problem, now incorporating twice as much production capital, assumes the form

$$\begin{aligned} \max_{q_M} [a - bQ]q_M - C(q_M, 2k) = & \quad (3.8) \\ \max_{q_M} [a - b(q_M + q_O)]q_M - \frac{d}{2k}q_M. & \end{aligned}$$

⁹In our analysis we restrict attention to purely unilateral effects that potentially result from a merger. That is, we do not control for coordinated effects among market players. If we did, the merger had a positive effect in that market symmetry would be abolished and collusion among firms would be less likely. Excluding the possibility of collusion, we will see that symmetry among competitors is a vital condition for effective competition in a Cournot market. Eventually, divestitures will help to re-establish symmetry in the market post-merger.

The last remaining competitor on the market simultaneously chooses her output that maximizes

$$\max_{q_O} [a - bQ]q_O - C(q_O, k) = \quad (3.9)$$

$$\max_{q_O} [a - b(q_M + q_O)]q_O - \frac{d}{k}q_O.$$

The total post-merger industry output amounts accordingly to $Q_{total}^{post} = q_M^c + q_O^c = \frac{1}{3b}(2a - \frac{3d}{k})$ with a market price of $P(Q_{total}^{post}) = [a - bQ_{total}^{post}] = \frac{a}{3} + \frac{d}{2k}$. The merged firm yields a profit of $\pi_M^{post} = \frac{1}{9b}[a - 2\frac{d}{2k} + \frac{d}{k}]^2 = \frac{a^2}{9b}$. The competitor gains $\pi_O^{post} = \frac{1}{9b}[a - 2\frac{d}{k} + \frac{d}{2k}]^2 = \frac{1}{9b}[a - \frac{3d}{2k}]^2$.

The following remark is taken from Medvedev (2004) and proves that a Cournot merger, involving substantial economies of scale, will not lead to an increase in prices post-merger absent any structural merger remedies.

Remark (1): *Absent any competition authority intervention, the post-merger price level, P^{post} , will not exceed the pre-merger price level P^{pre} . Formally, $P^{post} \leq P^{pre} \Leftrightarrow \frac{a}{3} \leq \frac{d}{k}$.*

Proof

$$\begin{aligned} P^{post} &\leq P^{pre} \Leftrightarrow \\ \frac{a}{3} + \frac{d}{2k} &\leq \frac{1}{4} \left(a + 3\frac{d}{k} \right) \Leftrightarrow \\ \frac{a}{3} &\leq \frac{d}{k} \end{aligned}$$

Q.E.D

The economic intuition behind this result is that, through the merger, the marginal costs of production are lowered by acquiring one-third of additional capital from the market. There are two opposite effects, a competition authority has to control for. On one hand, the merger creates market power which enables the merged firm to increase prices, thus exercising unilateral

effects. On the other hand, there is another countervailing effect which results from lower marginal costs due to economies of scale. Whenever the "lower-marginal-cost- effect" outweighs the ability to increase market prices as a result of increased market power, the merger does not lead to higher prices and thus unilateral effects will not harm the consumer surplus. Mergers that do not create unilateral effects will be cleared with out requiring commitments.¹⁰

In the case of admitting the merger without remedies, we have seen that there are reasonable parameter constellations that justify not to intervene in the merger process since synergy effects materializing in lower production costs will be passed on to consumers in a decreased market price.

3.1.3 $n = 2$: post-merger situation with divestitures δ

In what follows, we assume that the competition authority requires structural merger remedies from merging parties in order to avoid potential harm deriving from unilateral effects. Concretely, merging parties offer to sell an amount $\delta \in [0, k_j]$ to the competitor, where k_j represents the amount of assets which are contributed to the merged entity by the acquired firm. Naturally, k_j gives the upper bound for a divestiture commitment since otherwise, the merging parties would be forced to sell more assets than they actually acquired. The post-merger capital stock of the merged entity amounts to $2k$. Taking the divestiture commitment into consideration, they end up with an amount of assets which is equal to $(2k - \delta)$. Since we assume only one last remaining viable competitor, the divested assets will be transferred to the former who ends up with an amount of production capital equal to $(k + \delta)$.

Allowing for partial divestitures, the merging parties face the following opti-

¹⁰As Medvedev (2004) points out, the merger has to be profitable for the merging parties, that is the aggregated profit of the merged firm has to be higher than individual profits of two separate firms pre-merger. Formally, $\pi_M^{post} > \pi_1^{pre} + \pi_2^{pre} \Leftrightarrow \frac{a^2}{9b} > 2\frac{1}{16b}(a - \frac{d}{k})^2 \Leftrightarrow \frac{a}{3}(3 - \sqrt{8}) < \frac{d}{k}$.

mization problem:

$$\begin{aligned} \max_{q_M} [a - bQ]q_M - C(q_M, 2k - \delta) &= & (3.10) \\ \max_{q_M} [a - b(q_M + q_O)]q_M - \frac{d}{(2k - \delta)}q_M. \end{aligned}$$

Equipped with additional capital $\delta \in [0, k_j]$, the last remaining competitor outside of the transaction will choose quantity according to:

$$\begin{aligned} \max_{q_O} [a - bQ]q_O - C(q_O, k + \delta) &= & (3.11) \\ \max_{q_O} [a - b(q_M + q_O)]q_O - \frac{d}{(k + \delta)}q_O. \end{aligned}$$

The total post-merger industry output amounts to $Q_{total}^{post}(\delta) = q_M^\delta + q_O^\delta = \frac{1}{3b}[2a - \frac{d}{2k-\delta} - \frac{d}{k+\delta}]$ with a post-merger equilibrium market price of $P^{post}(\delta) = [a - bQ_{total}^{post}(\delta)] = \frac{1}{3}[a + \frac{d}{2k-\delta} + \frac{d}{k+\delta}]$. In the presence of structural merger remedies $\delta \in [0, k_j]$, merging parties earn $\pi_M^\delta = \frac{1}{9b}[a - 2\frac{d}{2k-\delta} + \frac{d}{k+\delta}]^2$. The outsider firm's profit function assumes $\pi_O^\delta = \frac{1}{9b}[a - 2\frac{d}{k+\delta} + \frac{d}{2k-\delta}]^2$.

In order to be able to evaluate the merger's impact on market prices in the presence of a divestiture commitment, we compare the situation of a merger without remedies with the situation where a competition authority requires the divestiture of assets. If the structural merger remedies intends to be effective, the price level which adjusts in equilibrium has to be lower or at least equal to the case of no intervention by the competition authority.¹¹

The following proof is in line with Medvedev (2004):

Proposition (1): *In the presence of a symmetric cost structure, i.e. $d_1 = d_2 = d_3 = d$ and $k_1 = k_2 = k_3 = k$, any divestiture $\delta \in [0, k_j]$ leads to a lower price level compared to the case without regulatory intervention.*

¹¹ Again the condition of individual profitability must not be binding in equilibrium, i.e. $\pi_M^\delta > \pi_1^{pre} + \pi_2^{pre}$.

Proof

$$\begin{aligned} P^{post}(\delta) &\leq P^{post} \Leftrightarrow \\ \frac{1}{3} \left[a + \frac{d}{2k - \delta} + \frac{d}{k + \delta} \right] &\leq \frac{a}{3} + \frac{d}{2k} \Leftrightarrow \\ \frac{1}{2k - \delta} + \frac{1}{k + \delta} &\leq \frac{3}{2k} \Leftrightarrow \end{aligned}$$

$$2k^2 \leq (2k - \delta)(k + \delta),$$

which holds true since $\delta(k - \delta) \geq 0$ by assuming that divestitures are always strictly smaller than the amount of assets acquired, i.e. $\delta < k$.

Q.E.D

Obviously, the structural merger remedy increases symmetry in the market. Due to the convexity of the cost function, $C_{q_i} = \frac{d}{k}$, from a competition authority's perspective, the effect on the aggregate industry output deriving from assets sales and therefore on the market price is stronger than the positive effect from decreasing marginal costs by accumulating more capital through the merger. Departing from an identical cost structure, it is an intrinsic in the mechanics of Cournot models where firms compete in quantities, that the highest industry output and thus the lowest market price result under a symmetric distribution of assets among all competitors in the market. In the present case of a merger from three firms to a duopoly, the lowest price will be achieved by a divestiture of $(\frac{k}{2})$ assets. Thus, both firms hold an identical amount of capital post-merger, i.e. $(\frac{3}{2}k)$.

From previous considerations we know that the post-merger market price equals the pre-merger market price, if the following constellation of parameters holds: $\frac{a}{3} \leq \frac{d}{k}$. In this case a competition authority's intervention is redundant. Asset sales are not necessary to restore pre-merger competition, i.e. $\delta = 0$.

Following Medvedev (2004), we now address the question of how many as-

sets have to be divested in the case that $\frac{a}{3} > \frac{d}{k}$. The critical value can be easily calculated through simple algebra. The merging parties have to divest δ^* in order not to increase the market price post-merger, i.e. $P^{post}(\delta) \leq P^{pre}$:

$$\frac{1}{3} \left[a + \frac{d}{2k - \delta} + \frac{d}{k + \delta} \right] \leq \frac{1}{4} \left[a + 3\frac{d}{k} \right] \Leftrightarrow$$

$$-\delta^2 + \delta k + 2k^2 \frac{3d - ak}{9d - ak} \geq 0.$$

The required amount of assets that have to be transferred to the competitor amounts to:

$$\delta^* = \frac{-k \pm k \sqrt{\frac{33d - 9ak}{9d - ak}}}{-2}. \quad (3.12)$$

For the structural merger remedy to make sense, we require $0 \leq \frac{33d - 9ak}{9d - ak} \leq 1$ and $(9d - ak) > 0$. Otherwise the competition authority demands more divestments than the acquiring party would buy through the transaction. Therefore, in the presence of asset sales, the post-merger price will not change compared to the pre-merger situation if and only if

$$\delta_1^* = \frac{-k + k \sqrt{\frac{33d - 9ak}{9d - ak}}}{-2} \quad \text{and} \quad \delta_2^* = \frac{-k - k \sqrt{\frac{33d - 9ak}{9d - ak}}}{-2}, \quad (3.13)$$

with $0 \leq \frac{33d - 9ak}{9d - ak} \leq 1 \Leftrightarrow \frac{9a}{33} \leq \frac{d}{k} \leq \frac{a}{3}$.

In line with Medvedev (2004), we restrict our attention to the smaller amount of assets, that have to be divested, i.e. δ_1^* , since competition authority interventions and regulatory actions should be as small and rare as possible.¹²

As an interim result, the possibility of allowing mergers under divestitures, loosens the former "no price increase"-condition from $\frac{a}{3} \leq \frac{d}{k}$ to $\frac{9a}{33} \leq \frac{d}{k}$. Within

¹²Differently put, the larger divestment would yield an even lower price level than pre-merger. The competition authority's objective should be to correct for mergers that exercise unilateral effects, i.e. price increases but not to install even lower prices compared to the pre-merger situation. This in turn could harm the firms and may force some of them to exit the market in the longer run.

the range of $0 \leq \frac{33d-9ak}{9d-ak} \leq 1$ there are structural merger remedies $\delta \in [0, \frac{k}{d}]$, that allow for a merger under remedies without leading to unilateral effects. Thus, consumer surplus will not be negatively affected by the merger. Hence, divestiture is a function of the parameters (a, d, k) , i.e. $\delta = f(a, d, k)$.¹³

Before introducing restructuring investments in the following section, we highlight that under certain parameter constellations, structural divestitures are in fact able to reduce negative effects which derive from a decreasing symmetry in the market. We have seen that, contrasting to the regular perception in competition policy, market symmetry promotes stronger competition. It is important to notice that this holds only true for the case of quantity competition.

In the following section we reinforce positive and competition-healing remedy effects by introducing another cost component which is omnipresent in every real world structural merger remedy process in varying dimensions. Thereby, we want to create awareness for the fact that restructuring investments in Cournot competition increase the merging parties' costs and thus serve as a sort of remedy themselves. This fact has to be accounted for by the competition authority since otherwise, the size of the divestiture is too large and may harm the merging parties and reduce synergy gains. We will show that for any positive value of restructuring costs, the range of parameters that leave the consumer surplus on the pre-merger level will be enlarged. Hence, restructuring costs form a part of the structural merger remedy itself.

3.2 Introducing restructuring investments

In this section we modify the findings of Medvedev (2004) by introducing restructuring investments in order to give a more realistic picture of real world

¹³For example, if $\frac{9a}{33} = \frac{d}{k}$, then the required amount of assets to be divested amounts to $\delta^* = \frac{k}{2}$. The acquiring firm buys k and has to sell half of it to the competitor. As a result of this remedy, the two remaining firms operate under an equal amount of productive capital.

divestiture processes.¹⁴ As we already mentioned, up to now such restructuring investments have not been considered in the existing literature on merger remedies before. We want to close this gap by analyzing the impact of some restructuring cost parameter $r_M \in [0, k_j]$ on the industry outcome which exclusively accrues to the merging parties.¹⁵

According to the empirical findings as presented in the Merger Remedy Study (2005) by the European Commission, especially structural merger remedies require strong restructuring activities of the merging parties. In some cases, a structural commitment implies the pure legal transfer of ownership rights between firms. Such requirements are not very costly for the merging parties. In other cases, not only changes in the allocation of ownership rights are required but assets have to be isolated by the merging parties, maintained and eventually transferred physically to the purchaser. Such merger remedies cause significant additional costs, costs of remedy implementation that accrue to the merging parties, which decrease potential synergy gains. There are worst case scenarios thinkable where restructuring investments could lead to harm the consumer surplus in that they could exceed synergy gains which are expected to derive from the merger.

Up to now, we identified three major sources that affect equilibrium prices in a different manner.

Whenever the number of players in the market decreases, the price increases accordingly. This also holds true for the symmetry in the market. The less symmetric a market, the higher the market price. Lower marginal costs lead to lower market prices. These insights basically derive from rather easy comparative statics in Medvedev's (2004) Cournot modeling.¹⁶

¹⁴In the following we treat the notion of restructuring investments synonymous to restructuring costs.

¹⁵In what follows the terms restructuring cost and restructuring investments are treated in a synonymous way.

¹⁶It is important to notice that these relationships hold only true for competition in quantities where the firms' choice of output represents strategic substitutes.

By introducing another cost component in the form of restructuring investments that are supposed to accrue exclusively to the merging parties, we expect the industry outcome to be significantly altered. We make the plausible assumption that restructuring investments have to be lower than the amount of assets to be divested since otherwise, the merger would not be profitable from the merging parties' perspective.

The purpose of the following analysis is to quantify the impact of the introduction of this additional cost component on the equilibrium industry outcome. Technically, we modify the merging parties' cost function in the following way:

$$C_M(q_M, r_M) = \frac{d(1 + r_M)}{(2k - \delta)} q_M.$$

Thus, marginal costs of production increase in the following way:

$$\frac{\partial C_M}{\partial q_M} = \frac{d(1 + r_M)}{(2k - \delta)}. \quad (3.14)$$

Due to the existence of another cost component, we expect some further reduction of the positive effects for the merging parties deriving the capital concentration.

In what follows, we firstly derive the Cournot equilibrium in the presence of restructuring investments analytically in order to prove that the additional cost factor strengthens the influence of structural merger remedies in recreating the symmetry in the market. In a second step, we undertake some comparative statics for quantifying the sensitivity of main model parameters such as market price, equilibrium output and the equilibrium level of divestitures with respect to different values of restructuring investments. Alongside, we find some critical value for restructuring investments \tilde{r}_M , that post-merger establishes the same price-level as pre-merger for any given positive value of divestitures. That is we show that restructuring costs are able to replace parts of the divestiture hence being equally effective in terms of keeping the post-merger market price unchanged.

3.2.1 Analytical derivation

By analytically introducing restructuring costs to a Cournot model in the presence of divestitures, we provide a model extension of Medvedev (2004). The purpose of the analysis is to point out that restructuring costs have to be taken into consideration when mergers may be cleared under divestiture commitments. Depending on the level of restructuring investments, the merger may be unprofitable from a merging firm's perspective in the sense that restructuring investments could exceed capital additions, i.e. formally, $r_M > k$. Differently expressed, the divestiture's effectiveness could be reduced in the sense that post merger prices are higher than originally intended by the anti-trust authority.

We continue to assume that all firms in the market have perfect information. This implies that each firm knows about the cost structure of the other firm. This assumptions hold true for the introduction of restructuring costs.¹⁷ In the presence of the new cost function, the merging parties choose q_M in order to solve the following optimization problem:

$$\begin{aligned} \max_{q_M} [a - bQ]q_M - C(q_M, r_M, 2k - \delta) = & \quad (3.15) \\ \max_{q_M} [a - b(q_M + q_O)]q_M - \frac{d(1 + r_M)}{(2k - \delta)}q_M. & \end{aligned}$$

The competitor chooses her output q_O , accounting for the altered situation with restructuring costs on the merging parties' side:

$$\begin{aligned} \max_{q_O} ([a - bQ]q_O - C(q_O, k + \delta)) = & \quad (3.16) \\ \max_{q_O} [a - b(q_M + q_O)]q_O - \frac{d}{(k + \delta)}q_O. & \end{aligned}$$

¹⁷We are aware of the fact that this assumption is a strong one but it is very common to assume perfect information in the theoretical modeling of imperfect competition as a starting point in order to isolate the effects which derive from introducing further parameters.

The total post-merger industry output amounts accordingly to

$$Q_{total}^{post}(\delta, r_M) = q_M^\delta(r_M) + q_O^\delta(r_M) = \frac{1}{3b} \left[2a - \frac{1}{2} r_M \frac{(3-d)}{2k-\delta} - \frac{3dk}{(2k-\delta)(k+\delta)} \right].$$

The new equilibrium market price assumes

$$P^{post}(\delta, r_M) = [a - bQ_{total}^{post}(\delta, r_M)] = \frac{1}{3} \left[a + \frac{1}{2} r_M \frac{(3-d)}{2k-\delta} + \frac{3dk}{(2k-\delta)(k+\delta)} \right].$$

The merging parties' aggregated profit will take the form of following expression:

$$\pi_M^\delta(r_M) = \frac{1}{36b} \left[\frac{[(3-7d)kr_M - (3r_M - 6d - 7dr_M)\delta + 2a(2k-\delta)(k+\delta)][-(3+d)\delta + 2a(2k-\delta)(k+\delta)]}{(-2k+\delta^2)(k+\delta)^2} \right]$$

whereas the competitor, remaining the last firm outside of the transaction, earns

$$\pi_O^\delta(r_M) = \frac{1}{18b} \left[\frac{(3d(\delta-k) + dr(k+\delta) + a(2k-\delta)(k+\delta))(6d(k-\delta) + dr_M(k+\delta) - (k+\delta) - (2a(2k-\delta) + 3r_M))(-1)}{(-2k+\delta^2)(k+\delta)^2} \right].$$

In the following remark we want to show formally, that additional cost parameters such as restructuring costs necessarily increase the post-merger equilibrium price level whenever these parameters enter the cost function in the following way:

$$C(q_M, r_M, 2k - \delta) = \frac{d(1 + r_M)}{(2k - \delta)} q_M.$$

This preliminary result finds attention in remark (2):

Remark (2): *For any positive level of restructuring investments $r_M \in (0, k_j]$, the post-merger price level with restructuring investments always exceeds the post-merger price level without restructuring investments. This holds true for any divestiture parameter $\delta \in (0, k_j]$.*

Proof

$$\begin{aligned} P^{post}(\delta, r_M) &= P^{post}(\delta) \Leftrightarrow \\ \frac{1}{3} \left[a + \frac{1}{2} r_M \frac{(3-d)}{2k-\delta} + \frac{3dk}{(2k-\delta)(k+\delta)} \right] &= \frac{1}{3} \left[a + \frac{d}{2k-\delta} + \frac{d}{k+\delta} \right] \Leftrightarrow \\ r_M &= 0. \end{aligned}$$

Q.E.D

By consequence, the introduction of restructuring investments has two effects on the equilibrium outcome of the Cournot model. On one hand, restructuring costs increase total costs of the merging parties thus reinforcing the effect of divestitures. As a result, the individual output of the merging parties is lowered and their market power measured in terms of market share is reduced. This observation considered in isolation has no negative effect on consumer surplus in the case that the competitor increases equilibrium output. Here is, where the negative effect of restructuring costs comes into play since they reduce total output on the Cournot market thus leading to a higher equilibrium market price consequently reducing consumer surplus. For any positive value of r_M , the Cournot equilibrium price level increases post-merger.

Through the integration of restructuring costs as part of the merging parties' total cost function, we thus have two countervailing effects which are dependent on the size of the structural merger remedy:

a direct positive and intended price decreasing effect through the remedy alone and a direct unintended price decrease offsetting effect through the costly implementation of the structural remedy, decreasing output on the post-merger market. Therefore, by taking restructuring costs into account, the analysis should depart from a consideration of the net effect.

In the following comparative statics analysis we intend to measure the effects of introducing restructuring costs in the model of Medvedev (2004) on

key modeling parameters in an analytical as well as graphical way.

Building the first derivative of the post-merger market price with respect to restructuring costs yields

$$\frac{\partial P^{post}(\delta, r_M)}{\partial r_M} = \frac{1}{6} \left[\frac{3-d}{2k-\delta} \right] > 0 \text{ for all } d < 3.$$

Departing from the initial assumption that $k - \delta > 0$, the price is thus a linearly increasing function of restructuring costs. Function $P(r_M)$ takes the following graphical form for given values of a, d, b, k and δ :¹⁸

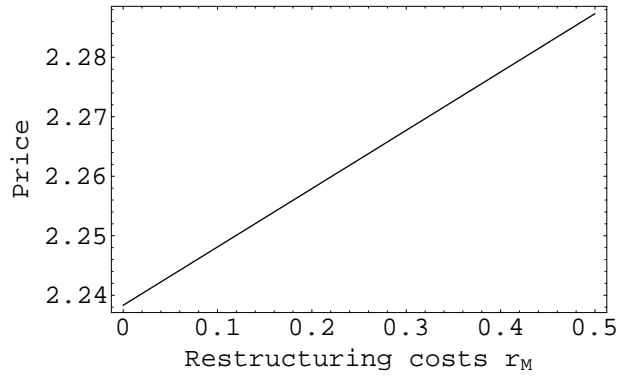


Figure 3.1: Price as a function of r_M

Obviously, the introduction of restructuring costs foils the price reducing effect from asset sales.

Despite of the costly implementation of divestiture remedies, in the Cournot equilibrium, divestitures still achieve price decreases for fixed numerical values of a, d, b, k and δ and a variable level of restructuring costs r_M .

Formally, the first derivative of price with respect to the divestiture param-

¹⁸In what follows, we assume following parameter values: $a = 4, b = 1, d = 1, k = 1, \delta = 0.3$ and $r_M = 1.5$.

eter is negative, i.e.

$$\frac{\partial P^{post}(\delta, r_M)}{\partial \delta} = \frac{1}{6} \left[\frac{r_M(k + \delta^2)(3 - d) - 6dk(k - 2\delta)}{(-2k + \delta)^2(k + \delta)^2} \right] < 0.^{19}$$

As can be read from the following graph, there is a non-linear negative relationship between market price and divestitures for any positive level of restructuring investments r_M .²⁰

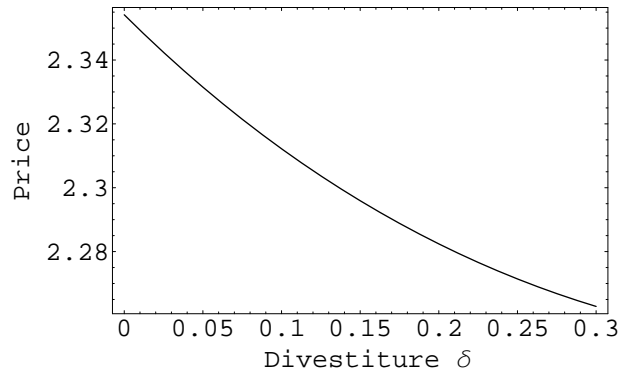


Figure 3.2: Price as a function of δ

These considerations can also be undertaken regarding the industry equilibrium output. Analytically, the partial derivative of total output with respect to restructuring costs is negative, i.e.

$$\frac{\partial Q^{post}(\delta, r_M)}{\partial r_M} = -\frac{3 - d}{6b(2k - \delta)} < 0,^{21}$$

which graphically shows in a decreasing quantity-restructuring-investments diagram.

Conversely, the total equilibrium output produced on the market is an in-

¹⁹The denominator is a quadratic expression and therefore positive for every parameter constellation. It is necessary to assume $d < 3$ since otherwise the expression would be positive and the price became an increasing function of the level of divestments, which is counterintuitive.

²⁰The graph assumes restructuring costs of $r_M = 0.25$.

²¹Again we assume that $d < 3$.

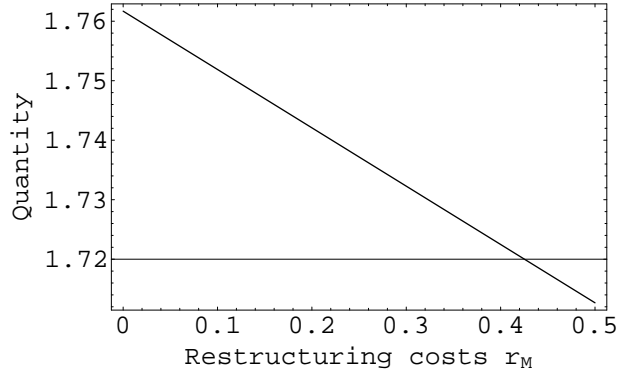


Figure 3.3: Quantity as a function of r_M

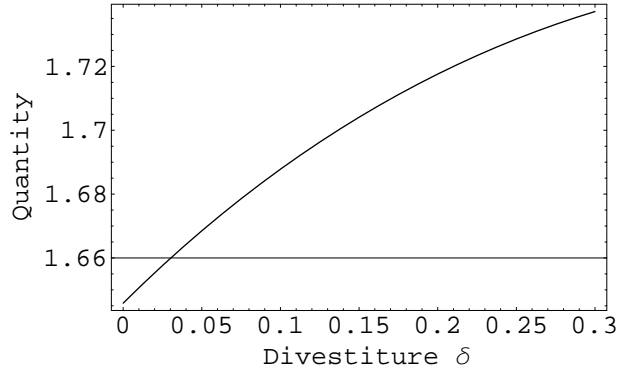


Figure 3.4: Quantity as a function of δ

creasing function of structural divestments:

$$\frac{\partial Q^{post}(\delta, r_M)}{\partial \delta} = \frac{\frac{3dk}{(2k-\delta)(k+\delta)^2} - \frac{3dk}{(2k-\delta)^2(k+\delta)} - \frac{(3-d)r_M}{2(2k-\delta)^2}}{3b} > 0,$$

as becomes graphically evident for a particular parameter constellation in figure (3.4).

From the analysis of Cournot models under asymmetric cost structures we know that an additional cost component, in this case for the merging parties, reduces individual profits of the firm concerned.

In a Cournot game, the choice of quantity represents strategic substitutes.

The introduction of an additional cost component such as restructuring costs incites merging parties to generate a lower equilibrium output. This in turn increases the output level of the competing outsider. Hence, restructuring investments positively affect the outsider's profits and negatively influence the merging parties profit function. This coherence is reflected by the partial derivatives of the firm's profit functions with respect to restructuring investment costs:

$$\frac{\partial \Pi_M^\delta(\delta, r_M)}{\partial r_M} = \frac{((3+d)(-3+7d)kr_M + (24d^2 + (3+d)(-3+7d)r_M)\delta - 8ad(2k-\delta)(k+\delta))}{18b(-2k+\delta)^2(k+\delta)} < 0.$$

Therefore, we analytically observe decreasing profits with increasing divestitures on the side of merging parties which are reinforced by the existence of restructuring costs.

This negative functional relationship can be graphically presented in the following way:

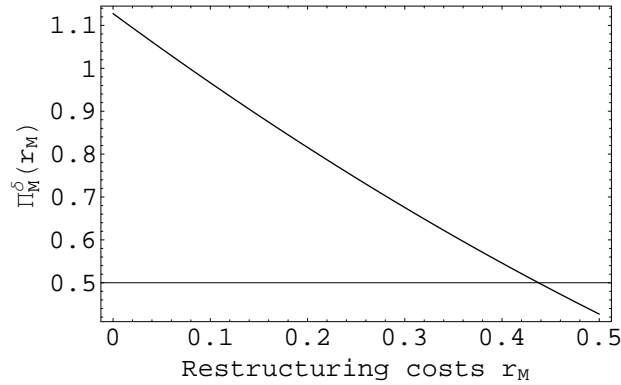


Figure 3.5: Profit merging parties as a function of r_M

In contrast to that, the outsider gains from merging parties' additional costs. Analytically, the outsider's profits rise with increasing restructuring costs of the merging parties. Formally, the partial derivative of the outsider's profit

function with respect to restructuring costs yields:

$$\frac{\partial \Pi_O^{\delta}(\delta, r_M)}{\partial r_M} = \frac{-((3+d)k(3d-2ak)+2(-3+d)dkr+(-3(3+d)(3d+ak)+2(-3+d)dr\delta+a(3+d)\delta^2))}{18b(-2k+\delta)^2(k+\delta)} > 0.$$

Graphically expressed, the competitor's profit function is increasing in larger values of restructuring costs.

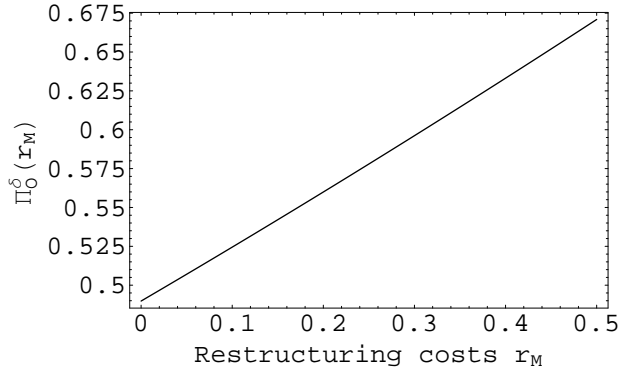


Figure 3.6: Profit outsider as a function of r_M

If there are countervailing positive and negative effects deriving from divestitures and their costly implementation, then there must be a threshold value for restructuring investments that exactly balances out these effects. The critical value for the merging parties' restructuring costs \tilde{r}_M in order not to increase post-merger price level compared to the pre-merger situation, can be found through following considerations.

Remark (3): *Given a symmetric pre-merger cost structure and some value of $\delta \in (0, k_j]$, the upper bound for the merging parties' restructuring costs amounts to*

$$\tilde{r}_M \leq \frac{ak(2k^2 + k\delta - \delta^2) + 3d(-2k^2 - 3k\delta + 3\delta^2)}{2k(d-3)(k-\delta)}. \quad (3.17)$$

If and only if restructuring investments remain within this range, the post-merger equilibrium price remains on the same level as the pre-merger price in the presence of divestiture and their costs of implementation.

Proof

$$\begin{aligned}
 P^{post}(\delta, r_M) &= P^{pre} \Leftrightarrow \\
 \frac{1}{3} \left[a + \frac{1}{2} r_M \frac{(3-d)}{2k-\delta} + \frac{3dk}{(2k-\delta)(k+\delta)} \right] &= \frac{1}{4} \left[a + \frac{3d}{k} \right] \Leftrightarrow \\
 \tilde{r}_M &\leq \frac{ak(2k^2 + k\delta - \delta^2) + 3d(-2k^2 - 3k\delta + 3\delta^2)}{2k(d-3)(k-\delta)}.
 \end{aligned}$$

Q.E.D

As an important interim result, despite of the introduction of a new cost parameter, there are possible constellations of divestitures and restructuring investments that post-merger establish a price level which is lower or equal to the pre-merger level. Hence, effectiveness of divestiture remedies may be reduced by restructuring costs in that they lower the equilibrium output and therefore increase the post-merger price level but the effect will not be completely canceled since restructuring costs have a remedying effect on the merging parties. The necessary condition for structural merger remedies to be effective in the presence of restructuring investments is that the latter remain below the upper bound \tilde{r}_M .

In proposition (1) Medvedev (2004) has shown that for certain plausible parameter constellations the deployment of structural merger remedies is even a stronger tool than synergy gains in order to decrease the equilibrium price post-merger.

The following proposition can be understood as a continuation of proposition (1) in the sense that we additionally allow for restructuring costs. We try to find an interval of restructuring investments for which proposition (1)

still holds. The central insight is that restructuring investments have two different opposite effects: one negatively affecting the price level through lower total market output, the other positively affecting the equilibrium price in reducing the asymmetry between the firms. We will show that there is a range of admissible values for restructuring investments which maintains the post-merger price level in the presence of divestitures and related implementation investments on the post-merger price level without the competition authority's intervention.

Therefore we restate proposition (1) in the following way:

Proposition (2): *In the presence of a symmetric cost structure, i.e. $d_M = d_O = d$, an equal distribution of productive capital among the merging parties and the last remaining competitor, i.e. $k_M = k_O = k$ and in the presence of restructuring costs r_M , any divestiture $\delta \in (0, k_j]$ leads to a lower price level compared to the case without competition authority intervention, if and only if*

$$\bar{r}_M \leq \frac{3d\delta(-k + \delta)}{k(-3 + d)(k + \delta)}.$$

Proof

$$P^{post}(\delta, r_M) \leq P^{post}(\delta = 0) \Leftrightarrow \frac{1}{3} \left[a + \frac{1}{2} r_M \frac{(3 - d)}{2k - \delta} + \frac{3dk}{(2k - \delta)(k + \delta)} \right] \leq \frac{a}{3} + \frac{d}{3k} \Leftrightarrow$$

$$\bar{r}_M \leq \frac{3d\delta(-k + \delta)}{k(-3 + d)(k + \delta)}.$$

Q.E.D

Thus we have proven the existence of an upper bound for restructuring investments that still realizes price decreasing effects that are stronger than synergy effects from the merger without considering a competition authority's intervention.

In the case that the merging parties have to invest $r_M > \frac{3d\delta(-k+\delta)}{k(-3+d)(k+\delta)}$ in order to prepare the asset for sale, ex ante they will not notify with the competition authority since the cost of merging exceed the synergy gains.

Up to now we determined important threshold values for restructuring investments that accrue to the merging parties. In the remainder of this section, we address the functional relationship between the size of structural merger remedies and restructuring investments.

By remark (1) we know that divestitures are irrelevant if the inequality $\frac{a}{3} \leq \frac{d}{k}$ holds true. For any values $\frac{a}{3} > \frac{d}{k}$, we need divestitures in order to maintain the pre-merger price level. By the introduction of restructuring investments implementing divestitures, the post-merger price level rises and smaller divestitures may be necessary in order to offset the quantity reducing effect of restructuring costs.

In the following we try to find a minimum value for divestitures $\tilde{\delta} \geq 0$ whose legal enforcement ensures to maintain the post-merger price on the same level as pre-merger in the presence of restructuring investments.

Therefore, we start from the following known condition:

$$\begin{aligned}
P^{post}(\delta, r_M) &\leq P^{pre} \Leftrightarrow \\
\frac{1}{3} \left[a + \frac{d+r_M}{2k-\delta} + \frac{d}{k+\delta} \right] &\leq \frac{1}{4} \left[a + 3\frac{d}{k} \right] \Leftrightarrow \\
\delta^2 + \delta \frac{k(9d-ak+r)}{(ak-9d)} + \frac{k^2(r+15d-2ak)}{(ak-9d)} &\geq 0
\end{aligned}$$

Solving for the critical value of $\tilde{\delta}(r_M)$, representing the level of divestitures that are necessary in the presence of restructuring costs:

$$\tilde{\delta}(r_M) = \frac{k(9d - ak + 4r_M)}{2(9d - ak)} \pm \frac{k\sqrt{297d^2 + (3ak + 4r_M)^2 - 6d(19ak + 36r_M)}}{2(9d - ak)}. \quad (3.18)$$

Since we exclude divestitures which exceed asset acquisitions, i.e. $\delta < k$, for the upper equation, it must hold accordingly

$$\tilde{\delta}(r_M) = \frac{k(9d - ak + 4r_M)}{2(9d - ak)} \pm \frac{k\sqrt{297d^2 + (3ak + 4r)^2 - 6d(19ak + 36r_M)}}{2(9d - ak)} < k.$$

From this equation it becomes immediately obvious that given $(9d - ak) > 0$, $\frac{k(9d - ak + 4r)}{2(9d - ak)} > \frac{k}{2}$ for positive values of r_M .

The determination of a valid solution of the upper quadratic equation requires the following case differentiation:

$$i) \frac{k(9d - ak + 4r_M)}{2(9d - ak)} + \frac{k\sqrt{297d^2 + (3ak + 4r_M)^2 - 6d(19ak + 36r_M)}}{2(9d - ak)} < k$$

The first part of the equation exceeds $\frac{k}{2}$ for all positive values of r_M . Thus, the whole expression must be smaller than k and part $\frac{k\sqrt{297d^2 + (3ak + 4r_M)^2 - 6d(19ak + 36r_M)}}{2(9d - ak)}$ must be negative. Since $\frac{k}{d} > 0$ and $(9d - ak) > 0$, the numerator must be negative. Since the square root of negative values has no solution, this expression is not defined and will be rejected.

$$ii) \frac{k(9d - ak + 4r_M)}{2(9d - ak)} - \frac{k\sqrt{297d^2 + (3ak + 4r_M)^2 - 6d(19ak + 36r_M)}}{2(9d - ak)} < k$$

For this solution to be valid, the expression under the square root has to be positive, i.e. $\sqrt{297d^2 + (3ak + 4r_M)^2 - 6d(19ak + 36r)} > 0$.

Thus, we found a unique solution to the quadratic equation and a minimum value of divestitures in order to maintain the pre-merger price level:

$$\tilde{\delta}_M(r_M) = \frac{k(9d - ak + 4r_M)}{2(9d - ak)} - \frac{k\sqrt{297d^2 + (3ak + 4r_M)^2 - 6d(19ak + 36r_M)}}{2(9d - ak)} \quad (3.19)$$

where $0 \leq \frac{\sqrt{297d^2 + (3ak + 4r_M)^2 - 6d(19ak + 36r_M)}}{(9d - ak + 4r_M)} \leq 1$.

For this level of divestitures, the opposite effects deriving from restructuring investments are exactly balanced out. Hence, the equilibrium market price post-merger remains on the pre-merger level.

3.2.2 Model evaluation

Medvedev (2004) developed an analysis of a Cournot market with fixed productive capital where divestitures as required by a competition authority, serve to prevent possible abuse of market power post-merger. We initially presented Medvedev's (2004) n -firm modeling and the resulting industry outcome in the pre-merger case, assuming that there are three players in the market having symmetric cost structures. The key assumption for rationalizing mergers in this Cournot market materializes in the firms' identical cost function. Medvedev (2004) assumes that the cost of production is a decreasing function in the amount of productive capital, a firm holds.

Thereby, we gave a benchmark case for the subsequent analysis where we assumed that a competition authority admits for a merger from three firms to a duopoly. Medvedev (2004) assumes that post-merger, absent any intervention by an antitrust agency, the merged entity holds 2/3 of the productive capital in the market. As a result of the doubled productive capital in the hand of the merged entity, the merged firm realizes positive economies of scale which countervail negative effects deriving from increased market power. Medvedev (2004) identifies a range of model parameters for which the positive cost decreasing effect from the merger weakly dominates the negative unilateral effect.

Following the benchmark case of no regulatory intervention, Medvedev (2004) admits for capital divestitures in the Cournot market, that is a capital transfer from merging parties to the last remaining competitor in the market. Since such a transfer of homogeneous productive capital reestablishes sym-

metry in the market, admitting for capital divestitures weakens the formerly found condition for economies of scale to weakly dominate negative effects deriving from increased market power. Thus, Medvedev (2004) found out that divestiture extends the range of model parameters in the case the competition authority is guided by the consumer surplus standard. By consequence, Cournot mergers will be cleared in the presence of capital divestitures.

Based on these findings, we extend Medvedev (2004) by introducing another model parameter which increases the cost of production for the merging parties in an asymmetric way. Through this step, the former modeling becomes more complex but gives a more realistic picture of real word divestiture processes where the implementation of structural merger remedies is costly.

If productive capital divestitures have a positive effect in the sense that they increase symmetry in the market post-merger and thus intensify competition putting pressure on the prices, thereby increasing consumer surplus, the consideration of restructuring investments, necessary to implement a structural merger remedy, has a negative impact on post-merger prices. This is simply due to the fact that the symmetry increasing effect through divestitures will be decreased by restructuring costs lowering the merging parties' post-merger output.

We show that there are constellations of model parameters that allow for mergers from three firms to a duopoly involving divestitures and related restructuring costs that overall have no negative impact on the consumer surplus standard if we take the pre-merger price level as a benchmark. By the proof of proposition (2) we find an upper bound for restructuring investments which maintain the post-merger price on the same level in the presence of divestitures and restructuring investments as in the case of a merger without any antitrust agency's intervention.

By the introduction of restructuring costs, we extend Medvedev (2004) with the intention to create awareness for the fact that restructuring investments

play an important role in the context of merger remedies in general, the implementation of structural merger remedies in particular. We find upper bounds and critical values for restructuring investments in order not to allow for mergers which ex post weaken competition although capital divestitures have been required.

As a first policy implication of this thesis, competition authorities should anticipate restructuring investments necessary to implement structural merger remedies, increasing the post-merger price level on a Cournot market. Since restructuring investments are a function of the level of divestitures, the authority can correct for the negative effects by increasing the required amount of assets that have to be divested.

Like every model, Medvedev (2004) and our extension work against the background of assumptions that are rather strong compared to how real world divestiture processes work. For the competition authority to be able to tailor an appropriate structural merger remedy in scale and scope, she has to know the cost of implementation in order not to require harmful divestitures. In reality, restructuring investments are private knowledge to the merging parties and can at most be controlled by the authority ex post, that is after the remedy has already been implemented. Apart from this asymmetry in information between merging parties and antitrust authority, forcing the players to reveal the true cost of restructuring would create incentives to overstate the former which led the authority to accept smaller divestitures.

Summarizing, we introduced the notion of restructuring investments which accrue only to the merging parties. Further research could deal with two-sided restructuring investments, that is the integration of the assets is assumed to be costly for the outside competitor. In general, there are a lot of model extensions thinkable which would cause more complex algebra, involving increasingly smaller intervals for divestitures and restructuring in-

vestments without significantly generating new insights.²² Our intention was to show the basic mechanics of restructuring investments in a Cournot model admitting for structural merger remedies.

Bringing restructuring investments in the context of models of imperfect competition delivers valuable insights in the sense that negative impacts on the consumer surplus become measurable. At the end of the day, the introduction of restructuring investments in a Cournot model aims to explain effectiveness of structural merger remedies. The higher the restructuring cost the less effective a divestiture in the sense of decreasing post-merger prices.

In the following we turn away from an analysis of the effectiveness of a structural merger remedies process and focus on the question of efficiency. Especially regarding the merger policy as practiced by the European competition authority, there is a clear weight on analyzing the ex post effectiveness of different types of remedies. As already mentioned, this is subject to the extensive Merger Remedy Study published in 2005 by the European Commission. As addressed in chapter 2 of this thesis, the Commission found several reasons for ineffective merger remedies. We show that this lack of effectiveness in parts can be tracked by to inefficiencies which are involved in the actors' incentive to invest in restructuring during the process of implementing structural merger remedies.

²²As in classical game theory textbooks like Gibbons (1992) there is a variety of different extensions of the classical Cournot model which could be introduced in our context as well. This is for example, ex ante asymmetry in cost functions or asymmetrically distributed information about cost components and many more.

Part II

Contract theory and Merger Remedies

Chapter 4

Contract-theoretical modeling of structural merger remedies

In the first part of this thesis we focused on the effects that derive from an introduction of restructuring investments in a Cournot market. In this part we leave oligopolistic models behind us and switch to a completely new approach to the modeling of structural merger remedies.¹ The following two chapters analyze the implementation of structural merger remedies with the help of contract-theoretical methods. Thereby we focus on the divestiture process, which induces strategic interaction between merging parties and the purchaser of the assets from the point in time when the actors enter into a binding divestiture agreement until the closing of the transaction which implies a successful transfer of the asset to the purchaser.

Modern contract-theoretical models have proven to be powerful analytical tools to analyze a variety of real word problems that arise whenever some parties enter into a contractual relationship. In the following, we bring famous and well-established contract-theoretical models in the context of structural merger remedies since contract theory has not been applied to merger remedies before. Thereby we apply these models to issues that have been identified by the Merger Remedies Study (2005) with respect to the imple-

¹The theoretical background in this chapter mainly bases on Schweitzer (1999).

mentation of divestiture remedies.

A comparison between these two different modeling approaches, oligopoly theory and contract theory, shows that a focus on institutions and incentives that are part of the divestiture process is more realistic than a rather macroscopic "strategic-firm-interaction"-perspective, where the choice of quantity is the only strategic variable.²

The contract-theoretical approach we take in this part of the thesis delivers a realistic mapping of the divestiture process, i.e. the implementing phase, as merger policy is executed in reality. Thus, the analysis will be significantly more complex. In the previous analysis, we abstracted from any legal provisions that influence the parties' behavior. We took nearly all of the relevant parameters as exogenously given. Now we introduce a timely structure which is a slightly simplified mapping of the prevalent European Commission's jurisdiction. Thus, we arrive at a richer model capturing divestitures and restructuring investments which eventually intends to give more realistic, detailed and implementable policy implications.

Apart from the fact that we now take the legal background of mergers and structural merger remedies under European merger law explicitly into account, there is another fundamental difference between the Cournot and the contract-theoretical modeling approach. Throughout our following analysis, we completely neglect strategic interaction post-merger and post-divestiture process. That is, we do not explicitly model the competition stage on the product market. The focus will be on the analysis of restructuring investments that accrue to merging parties, being forced by EC merger law to maintain functionality, marketability and competitiveness of the assets that have to be transferred to the buyer. Once an appropriate purchaser is found, she is required to invest in restructuring as well, in order to guarantee effec-

²However, the explicit modeling of restructuring cost involved in a Cournot merger provided valuable insights in negative consequences of neglecting restructuring investments as essential part of the divestiture process.

tive post-merger competition through proper asset integration.

The major purpose of this chapter is to bring contract-theoretical models in the context of merger remedies and to introduce to the methodological background of our divestiture model which will be discussed in depth in chapter 5. Up to now, the literature on competition policy has not yet posed the question, in how far contract theory is able and appropriate to give valuable insights into the modeling of merger remedies.

Since there is virtually no contract-theoretical analysis of the incentives that are involved in divestiture processes, we identified two conceivable ways to approach this research gap in a theoretical way. The first approach would be a normative one. We think that a purely normative approach is possible but not apt since it departs from a set of assumptions that detaches the model far from reality, possibly too far in order to eventually give policy implications that are implementable. Thus, our approach is initially a positive one in that we try to capture reality in our model in order to control for the prevalent incentives that are involved in the restructuring process between merging parties and some purchaser. The positive aspect of our modeling consists of a rigorous consideration of the legal background that creates strategic interaction between several actors involved in the divestiture process in a game-theoretic sense.

We will describe the divestiture game with a few plausible assumptions and show that the existing European merger legislation, regulating divestitures in the context of merger remedies, leads to double moral hazard problems where both players choose inefficient restructuring investments.

Since a broader scientific treatment of the topic does not end with a proof of suboptimal incentives to invest in restructuring but involves a solution to the holdup problem, we use existing contract-theoretical models in order to create a normative theory for efficient divestiture commitments. The normative modeling could represent the basis for a divestiture best practice or even

legal reforms.

Eventually, we question the applicability of well-established contract-theoretical models to merger remedies practice, since we are convinced that the application has to be justified if our model aims to give theoretically correct policy implications.³

As Schmitz (2001) points out, contract theory is one of the "[...] most active fields of research in contemporary microeconomics." With this statement, Schmitz aims at fundamental microeconomic research that provides increasingly complex mathematical models describing the interaction of agents with different informational distributions.⁴

Contract-theoretical models are indeed powerful tools to describe various economic situations. Consequently, new models quickly find their way into different sub-branches of economic theory, being often applied to practical questions since they elaborate the incentives of the agents within a certain economic conflict of interest. In fact, contract theory can be applied to any situation where several parties enter into some economic relationship, where information is unevenly distributed among the players. However, the application of contract-theoretical models to real word problems is not appropriate per definition. Especially when applying existing models or techniques to practical issues, it is important to ensure that the simplifications, necessary to elaborate the strategic interaction between the players, are not too strong. A model still has to account for all relevant incentives that institutions or contracts imply.

³We do not intend to present purely contract-theoretical models without reference to merger remedies since there are excellent introductions to this field of research such as Bolton and Dewatripont (2005), Mas-Colell, Whinston and Green (1995) and Schweitzer (1999). The main source of contract-theoretical models for the present thesis are Schweitzer (1999) as well as Mas-Colell, Whinston and Green (1995).

⁴It seems that the theory arrives at a point where the major theoretical concepts are well developed and accepted by the scientific community. Consequently, there is a lot of research effort spent on refinements of existing models as well as on more sophisticated equilibrium concepts deriving from game theory.

Economic contract theory is about the strategic interaction between individual parties that enter into an economic relationship.⁵ According to Schweizer (1999), a contract-theoretical analysis always departs from some assumption on the distribution of information among interacting parties.⁶

The literature on contract theory can be divided in three major classes according to the underlying information structure: hidden information, hidden action and relationship - specific investments.⁷ Due to the fact that restructuring investments are relationship-specific and major subject to our research, we focus on the application of contract-theoretical models involving relationship-specific investments.

The commonality of models involving relationship-specific investments is that all relevant contractual parameters are observable by the players but cannot be verified in court.⁸ This assumption is particularly relevant for a special part of contract theory, the theory of incomplete contracts.

Following the decision of the European Commission on merger clearance under divestiture remedies, the merging parties, where applicable, enter into a divestiture contract with some purchaser.⁹

Applying the definition of Schweizer (1999) to divestiture agreements, un-

⁵C.f. Schweizer (1999), p.1.

⁶Thereby Schweizer establishes a contrast to Williamson's (1985) notion of transaction costs, where institutions are compared on a purely monetary basis.

⁷For a detailed treatment of contract-theoretical models compare for Schweitzer (1999), Bolton and Dewatripont (2005).

⁸Whenever we address the question of verifiability in court, we mean the European Court of Justice (CoJ), having unlimited jurisdiction according to Article 229 of the European Commission Treaty. In merger remedy practice only few cases are submitted to the CoJ since the European Commission decisions are directly enforceable through the Merger Regulation of the European Commission. In so far we consider the European Commission, DG Competition respectively, as the institution which is unable to verify hidden actions undertaken by the parties involved in the merger remedy process.

⁹In the present context, we refer to the academic opinion on a contract which is in line with a common contract-theoretical literature.

der a contract, we understand all institutional provisions that define, coordinate and influence the parties that are involved in the divestiture process.¹⁰

The set of actors that hold stakes in the divestiture process necessarily contains the European competition authority, i.e. DG Competition, or in other words, the Commission and at least two merging firms as well as one remaining competitor which eventually buys the assets that have to be divested in order to clear the merger.¹¹

Regarding the informational distribution among the players involved in real world divestiture remedy processes, of course all classes of underlying informational structures are thinkable. We focus on the incentives to restructure firm-individual processes in order to prepare for an asset transfer, i.e. to undertake investments that are purely relationship-specific. Consequently, we assume that restructuring investments have no value outside of the transaction under consideration. Since actions that are necessary in order to restructure for an asset transfer, are neither observable by the Commission nor enforceable in Court, the players will choose an investment level which is lower than would be optimal from an efficiency perspective.

As the Merger Remedies Study of the EC found out, two-sided suboptimal restructuring investments or differently expressed, double moral hazard problems creating holdup are prevalent in mergers requiring structural merger remedies.

Given the informational issues involved in the divestiture process, we try to find divestiture contracts between the merging parties and the purchaser that mitigate or even solve the holdup problem. The improvement of efficiency in structural merger remedies involves changes in the existing institutional

¹⁰C.f. Schweizer (1999), p.1 ff. Institutional provisions are legal texts such as the EC Merger Regulation that define obligations and rights of the parties that participate in a merger and divestiture process.

¹¹Merging parties and last remaining competitor, in the following are simply called "the players".

framework of the merger remedies process. Advanced contract-theoretical models will help to find divestiture contracts that solve the sub-optimality of restructuring investments.

The comparison of institutions and the different incentives they trigger on behalf of the decision makers, traces back to Grossman and Hart (1986), the founders of the theory of incomplete contracts, nowadays representing a particularly popular branch of contract theory.

A basic trait of character of models with incomplete contracts is that assets, packages of assets or whole firms are interpreted as property rights. Whenever those assets change hands, we observe a change in the allocation of ownership rights and therefore an alteration of incentives. Another fundamental feature of these models is that incomplete contracts involve relationship-specific investments, meaning that all actors can appropriate the returns on their investments to the full extent only within the relationship.

Restructuring investments involved in standard divestiture processes are firstly undertaken by the merging parties who isolate the assets and restructure their business processes in order prepare them for sale before in a second step, they are transferred to the buyer who adapts her own business processes to the new situation. These actions are highly dependent on the counterpart of the transaction and thus cannot be resold outside divestiture relationship.

There is a conflict of interest between the players since following the decision of the European Commission to sell the assets to a competitor, the merging parties are not incited to undertake first-best efficient investments concerning the preservation of functionality, marketability and competitiveness of the assets as required by European merger law since as soon as the assets are in the purchaser's ownership, they contribute to her competitiveness.

Due to the sequentiality of restructuring investments and changing market

conditions in the run of the divestiture process, at some later point in time, the players re-evaluate their relationship and are incited to renegotiate the initial divestiture agreement in order to adapt the contract to altered market conditions, for instance unexpected changes in the underlying asset value. Rational parties will anticipate the result of renegotiations and adopt their incentives accordingly. We make use of this theoretical finding by showing that under prevalent jurisdiction, first-best efficient divestiture processes are not implementable.

According to contract-theoretical literature, renegotiations restrict the possibility of entering ex ante binding agreements, i.e. timely before the restructuring game between the merging parties and the buyer actually starts. We can only depart from the assumption that the Commission intervenes upon observable actions by the merging parties or the purchaser, i.e. in cases where a breach of contract or an adverse behavior becomes evident. Due to her natural informational disadvantage, ex ante the Commission is only in the position of determining the allocation of ownership rights but she is not able to keep fully track of the players actions neither with the help of a monitoring -nor with a divestiture trustee. By consequence the divestiture contract remains incomplete in a contract-theoretical sense.

A long time incomplete contracts were considered as to be a valid theoretical explanation for issues with respect to the boundaries of the firm as first addressed by Grossman and Hart (1986) and Hart and Moore (1990). Nowadays the theory of incomplete contracts comes to application in a wide range of modern economics. As already mentioned above, there is only little literature dealing with merger remedies. Most of the models focus on questions regarding the effectiveness of commitments required by the competition authority. Thereby these models neglect the important question of efficiency that plays a major role when it comes to the question whether the social cost of the merger including the restructuring investments necessary to implement the remedy outweigh the supposed efficiency gains from the merger.

Whatever the so called synergy potentials may be, whether they exist or not, in our model we focus on the incentives that are involved in the process of transferring an asset from the merging parties to a viable competitor. Whenever a competition authority asks merging parties to divest parts of their assets, a change in control of these assets takes place in the run of the divestiture process. Since the sale of the asset has to be prepared on both sides of the transaction, merging parties and viable competitor, we deal with both-sided sequential investments in the asset transfer. This legally prescribed change in the allocation of ownership rights through structural merger remedies in general and divestiture commitments respectively, comes very close to the perception of Grossman and Hart (1986) of a firm as a bundle of assets that are initially in the hand of one owner holding all residual- and control rights in the presence of an incomplete contract. The parties are not incited to exercise their residual rights but they will find it optimal to renegotiated the initial agreement. Within renegotiations ownership rights determine the bargaining position and therefore the share of the surplus one party is able to acquire as a result of successful renegotiations. Rational parties will anticipate the result of renegotiations. Therefore the pure existence or possibility of renegotiations which are prevalent in incomplete contracts, ex ante alters the parties incentives to relationship-specific investments. The scale of investments is by consequence a function of the distribution of control rights. The crucial question is, under which ownership structure are the merging parties as well as the buyer incited to undertake first-best restructuring investments. The following two sections intend to give a theoretical introduction in the methodology which underlies our restructuring game in chapter 5.

In the following sections we introduce the model of relationship-specific investments which plays an important role in institutional economics and relate it to restructuring investments as essential part of structural merger remedies.

Since restructuring investments are highly relationship-specific, we aim to discuss and test the applicability of the theory of relationship-specific invest-

ments to divestiture commitments. Relationship-specific investments are in general characterized by the fact that a maximum payoff can only be realized within the relationship of the parties that originally invested. In general such investments are rather long-term engagements. Within the process of desintegrating an asset on the merging parties' side, maintaining its functionality, marketability and competitiveness and transferring it to the buyer who eventually has to undertake integrating measures, timely inconsistency of interest is very likely. Thus, the merging parties may enter into renegotiations with the buyer of the assets in order to dissolve the original contractual agreement. Assuming rational behavior of all players in the divestiture game, the merging parties as well as the buyer will anticipate the result of renegotiations. Anticipated renegotiations in general alter incentives. In the special case of preparing an asset transfer for merger clearance, the players concerned may reduce their restructuring investments.

In the following section 4.1 we introduce to a basic model of relationship-specific investments as it could be applied to any economic situation which meets the rather small set of model assumptions. Here we postulate the validity of interpreting restructuring investments to be relationship-specific. In Section 4.2 we address the question of optimality of divestiture contracts. We use established contract-theoretical insights as presented by Schweizer (1999) in order to determine optimal contracts for divestiture remedies that assume that the merging parties and the buyer *ex ante* may exclude renegotiations of initially contracted conditions. We will show that by foreclosing the possibility of renegotiations per assumption, first-best restructuring investments are implementable.

Due to changing market conditions and based on the fact that we consider rather long-term divestiture relationships, it is not very plausible to exclude renegotiations.¹² The players are incited to resolve an initial contract whenever it appears to be advantageous for all of them. In section 4.3 we assume that there will be both-sided beneficial renegotiations within

¹²C.f. Schweizer (1999), p.183.

the relationship of a structural merger remedy process. As a basic finding of relationship-specific investments models, the distribution of possible gains from renegotiations influences investment decisions at an earlier point in time, i.e. renegotiations will be anticipated by the parties. As a fundamental result, the impossibility to exclude renegotiations leads to restructuring investments that are not first-best efficient.

In the contract-theoretical literature there are two ways of modeling how gains from renegotiations are distributed among the players. In the present thesis we focus on the perception of cooperative game theory which assumes that gains deriving from renegotiations are distributed in fixed proportions among the players.¹³

In the last section 4.4 of this chapter, we consider divestiture agreements between merging parties and purchaser as incomplete contracts and thus create the basis for our divestiture model in chapter 5. Starting with the interpretation of firms as bundles of assets defining ownership rights as firstly addressed by Grossman and Hart (1986), we assume that renegotiations cannot be excluded from the divestiture process. Thereby we admit for a larger class of contracts compared to the case where we excluded renegotiations per assumption. We will show that anticipated renegotiations are able to restrict ex ante divestiture contracts in such a way that the players and the competition authority can only agree upon an ex ante allocation of ownership rights on the asset to be divested. In chapter 5 we will show that these general aspects of ex ante asset ownership in some cases lead to a holdup problem which can be resolved by using more flexible distributions of ownership rights.

¹³Bolton and Dewatripont (2005), p. 563 ff. Rubinstein and Wolinsky (1992) criticize the modeling investment incentives using non-cooperative game theory and designing renegotiations with the help of cooperative game theory. They complain a mixture of two different approaches in game-theoretical solution concepts.

4.1 A basic model of relationship-specific restructuring investments

In the present section we will develop a rather general model of relationship-specific restructuring investments. The model should mainly have an introductory character and will thus be constructed on a helicopter perspective such that our insights may be applicable under various competition laws.

In a first contract-theoretical modeling approach to restructuring investments, we consider two risk neutral players, the merging parties and the buyer of the asset.¹⁴ At the beginning of the relationship, both players have to decide simultaneously on the level of restructuring investments x_i in order to fulfill the authority's requirements, where the corresponding costs of investments $c_i(x_i)$ accordingly accrue to each player individually.¹⁵ We assume the characteristics of the cost function to be normal, i.e. we assume that marginal costs are positive and increasing in restructuring investments x_i .¹⁶

Furthermore, we suppose that restructuring investments stochastically influence some information parameter θ_i of both parties.¹⁷ The stochastic influence of both parties' restructuring investments \mathbf{x} on the information parameter θ is given by a cumulative distribution function $F(\theta | x)$.¹⁸ The distribution is thus a function of the restructuring investments by the players.

¹⁴At this introductory stage of the model, the competition authority will not find explicit consideration.

¹⁵Within this abstract analysis, we do not want to differentiate between the investments undertaken by the merging parties and the buyer of the assets. We also want to admit for all thinkable restructuring decision, i.e. the choice of investment could be made based on the intervals $x_i \in [0, \infty]$ or $x_i \in [0, 1]$ or may be taken from the binary set $x_i \in \{0, 1\}$.

¹⁶In our divestiture game we depart from similar assumptions. Within this context, we believe that it is more tractable to equate the decision on restructuring investments with the cost of restructuring investments, i.e. $c_i(x_i) \equiv x_i$.

¹⁷The information parameter assumes values out of an interval $[\theta_{iL}, \theta_{iH}]$ or may be discretely distributed.

¹⁸In the case of a continuous distribution, the stochastic influence is given by the density function $f(\theta | x)$. In this case, $F(\theta | x)$ is the likelihood, that the information parameter θ will be smaller than or equal to θ_1 or θ_2 .

Addressing the timing of the a general relationship-specific restructuring game, following both players' restructuring investments, nature draws some specific value from the vector θ . Eventually, the merging parties and the buyer undertake an allocative decision, q .¹⁹ Party i 's profit deriving from the asset transfer thus amounts to $\Pi_i(q, \theta_i)$, neglecting the costs of restructuring investments. In the case that player i receives some incentive neutral transfer payment for the asset Γ_i , her net profit amounts to $\Pi_i(q, \theta_i) - c_i(x_i) + \Gamma_i$.²⁰

One of the decisive determinants for the scale of restructuring investments is the specification of the contractual agreeable parameters. With respect to the distribution of information, we assume that only player i knows her own effort level of restructuring investments x_i . By consequence x_i is a hidden action for all remaining players and the competition authority. Furthermore, we assume θ to be observable but not to be verifiable in court. Thus, both players know their own information parameter as well as the others. We assume that the subsequent allocative decision q is verifiable as well as observable for all players.²¹

Information parameter θ plays an important role in the context of relationship-specific investments and thus in our divestiture remedy context. By the introduction of an information parameter, we can model certain variables to be observable but not verifiable. Especially when it comes to the modeling of structural merger remedies, this assumption will become important. In merger remedy practice, restructuring investments are vital for a successful, i.e. effective implementation of structural merger remedies. Thus, they are subject to monitoring activities by a monitoring trustee who surveys the di-

¹⁹In the present context, we do not want to restrict the type of allocative decision which is taken by the players. In the context of structural merger remedies, an allocative decision could be an output decision at some later post-merger competition stage. However, for our modeling purposes, we focus on the incentives which are involved in the divestiture process. Thus, we do not explicitly model allocative decisions post asset transfer. Through the introduction of a option on ownership, the buyer will be endowed with a special kind of allocative decision in the sense that via option exercise, she may allocate the asset.

²⁰Negative values for Γ_i have to be interpreted as payment obligations.

²¹At the point in time when the players have to make their allocative decision, they are symmetrically informed.

vestiture and implementation of commitments. As empirically observed by the Merger Remedies Study, monitoring trustees are only partially effective in implementing efficient restructuring investments. The reason is that all actions necessary to desintegrate the asset, to maintain its functionality, viability and marketability can be written down in the divestiture contract, cash flows may be observable and enforceable but there is still too much room for bilateral underinvestments and opportunistic behaviour such as degrading assets, retaining key personnel and restricting the asset in its functionality.²²

Assuming the existence of variables in a divestiture contract that are functionally dependent on an information parameter θ , that are observable but not verifiable, from an analytical point of view, we achieve a strong reduction in complexity since at the point in time where the allocative decision has to be made by both players at the end of the divestiture process, both are symmetrically informed.²³

The contract-theoretical setting above is applicable to a large variety of economic situations. It is especially helpful in the present context when it comes to the modeling of structural merger remedies and their implementation. The story here is as follows. The merging parties, acting as one player due to the assumption of an identical objective function, enter into a divestiture contract with a some predetermined buyer of the assets that have to be divested, who is vital for the merger clearance decision of the competition authority. The purchaser of the asset is incited to participate in the divestiture process since she will receive a share of the proposed synergy gains.²⁴ Following the authority's clearance decision under structural merger remedies, both parties have to undertake relationship-specific investments. Thereby, the merging parties

²²C.f. EC Merger Remedies Study (2005).

²³In our divestiture game we will work with the assumption that the merging parties and the buyer have complete information. This assumption is necessary if we abstract from an allocative decision within the divestiture game. In the case that restructuring investments are unobservable for the counter-party, the players are symmetrically informed after restructuring investments have been undertaken and thus represent sunk costs.

²⁴We already mentioned that those gains can be interpreted as a significant part of synergy gains, i.e. cost savings that derive from the merger.

desintegrate the asset from the running business and the buyer prepares her business for asset integration. These are costly efforts, both parties want to keep as low as possible. Since we assume that there is only one viable buyer for the divested asset, all measures on both sides of the transaction are per se relationship-specific, i.e. there is no market for the restructuring investments outside the merger transaction.²⁵ Following both players' restructuring investments in the transaction, they try to extract the highest rent from the transaction. These individual rational actions reduce the overall economic return of the divestiture process since merging parties as well as purchaser anticipate this and consequently underinvest. Therefore we observe a holdup problem in the implementing phase of structural merger remedies.

Depending on the degree of complexity involved in designing a restructuring game, we can make different assumptions on the types of restructuring investments that are necessary for merger clearance. In general, contract-theoretical literature differentiates between two main classes of relationship-specific investments.²⁶ Since we argue in the context of structural merger remedies, we define relationship-specific investments with regard to the implementation of merger remedies.

In line with classical contract-theoretical literature, we differentiate between two kinds of one-sided restructuring investments: Restructuring investments with direct intrinsic impact and investments with direct extrinsic impact.²⁷

Definition: *One-sided restructuring investments with direct intrinsic impact*

Restructuring investments have direct intrinsic impact if the information parameters θ are independently distributed and restructuring investments only

²⁵We are aware of the fact, that this assumption is a rather strong one. Considering the fact, that remedies are tailored from case to case, all measures are highly transaction specific such that the existence of several suitable purchasers at maximum reduces the sunk cost of restructuring investments on the side of the merging parties but never shrink to zero.

²⁶C.f. Schweizer (1999), p. 186 ff.

²⁷C.f. Schweizer (1999).

influence the investing party's information parameter. In the case of intrinsic impact the common distribution function assumes

$$F(\theta_i, \theta_j | x_i, x_j) = F_i(\theta_i | x_i) F_j(\theta_j | x_j),$$

for $i \neq j$.²⁸

Definition: *One-sided restructuring investments with direct extrinsic impact*

Restructuring investments have direct extrinsic impact if the information parameters θ are independently distributed and restructuring investments exclusively influence the information parameter θ of the other player. The common distribution function accordingly assumes

$$F(\theta_i, \theta_j | x_i, x_j) = F_i(\theta_i | x_j) F_j(\theta_j | x_i),$$

for $i \neq j$.

Within the context of this abstract formulation of an introduction to restructuring investments, we admit two types of divestiture contracts that are subject to a structural merger remedies process. We assume that rational players are able to ex ante commit to never renegotiate an initial agreement. As will be addressed in the following chapter, we are thus able to write first-best divestiture contracts. In the case that such binding agreements are not feasible, the players are subject to renegotiations. At this introductory stage, the presence of some likelihood of renegotiations renders first-best restructuring unfeasible.²⁹

²⁸It is important to remark that an indirect impact on the other player through the allocative decision is still possible.

²⁹In the following chapter we follow contemporary contract-theoretical literature and restrict the class of possible divestiture contracts per ad hoc assumption. Contracts that are subject to renegotiations are called incomplete contracts. Although there is no theoretically established definition of such contracts, there are many examples in applied economics that suggest to depart from the existence of renegotiations.

In order to explain the mechanics of our divestiture model in chapter 5, in the following we address the model of Hart and Moore (1988) by relating their results to structural merger remedies.

We assume that, there are two merging parties, acting as one player and a buyer of the asset. The purchaser undertakes an allocative decision q which is binary, i.e. $q \in \{0, 1\}$ in the sense that depending on the the players' restructuring investments, the asset will be transferred, $q = 1$ or not $q = 0$. Timely before the allocative decision, the merging parties and the buyer undertake restructuring investments with direct intrinsic impact in order to prepare for the asset transfer. In analogy with Hart and Moore (1988), we assume that these restructuring investments influence the total cost of the divestiture process C as well as the profits V that amount to the merging parties and to the buyer, in a stochastic way. Given the merging parties' restructuring decision x_M , the cost parameter $C \in [C_L, C_H]$ is distributed according the distribution function $F(C|x_M)$. Intuitively, we assume that larger restructuring investments render lower total divestiture costs more likely. Expressed in a formal way, this means $\partial F/\partial x_M > 0$. Thus, by investing in restructuring, the merging parties lower the cost of "merger production". For higher levels of merger initiation costs, the likelihood of the buyer's willingness to pay to exceed costs is lower. In the worst case scenario, the divestiture procedure will not start, if restructuring investments by the merging parties are too low. In the case that merging parties choose an investment level $x_M = 0$, the merger production cost equals to $C = C_H$. We assume C_H to exceed the lowest possible willingness to pay of the buyer V_L . Thus, if merging parties speculate on favorable values of C to be drawn by nature, choosing a restructuring investment level equal to zero, the likelihood to end up with full merger initiation cost $C = C_H$ is approximatively one.

Given the buyer's restructuring decision x_B , her willingness V to pay for the asset is distributed according to the distribution function $G(V|x_B)$ on the interval $[V_L, V_H]$. The impact of the buyer's changing restructuring investments is as follows: The higher the buyer's investments in the restructuring process, the higher the likelihood for a larger willingness to pay, i.e.

$$\partial G/\partial x_B < 0.$$

Throughout this thesis, we assume that the stochastic influence of restructuring investments on costs and asset value or willingness to pay is normal in the following sense: $F_{xx} > 0$ and $G_{xx} > 0$. The rationale for this assumption is the following: in the presence of a low willingness to pay and high cost of implementing the remedy, this divestiture process should not be started, i.e. $V_L < C_H$. Otherwise, starting the divestiture process is economically rational for all scenarios where $V_H > C_L$. Expressed in terms of the model by Hart and Moore (1988), the profit function of the merging parties amounts to $\Pi_M = -Cq$, whereas the buyer's takes the form of $\Pi_B = Vq$.

Since the assumption of a normal relationship between restructuring investments, merger initiation costs and willingness to pay is crucial, we reproduce the following theorem in analogy to Schweizer (1999).³⁰

Theorem

If some distribution function $F(\Pi, x)$ is decreasing and convex in x , the expected profit $E[\Pi|x]$ as well as $E[h(\Pi)|x]$ for every monotonically increasing function $h(\Pi)$ of the profit show normal characteristics. Vice versa, if this condition holds true for every monotonically increasing function $h(\Pi)$ of the profit, the distribution function $F(\Pi|x)$ has to be decreasing and convex in x .³¹

Proof

If profit is continuously distributed and $h(\Pi)$ represents some arbitrary function, the expected profit amounts to

$$E[h(\Pi)|x] = \int_{\Pi_L}^{\Pi_H} h(\Pi)f(\Pi|x)d\Pi = h(\Pi_H) - \int_{\Pi_L}^{\Pi_H} h'(\Pi)F(\Pi|x)d\Pi \quad (4.1)$$

³⁰For a more detailed treatment, c.f. Schweizer (1999), p. 127 ff.

³¹For discrete restructuring decisions, the convexity condition refers to piecewise linear supplements of each function.

In what follows, we assume that the restructuring investment decisions by both players are continuous. Thus, for continuous investment decisions and decreasing and convex distributions functions in the decision variable x , for every monotone function ($h'(\Pi) \geq 0$) we find that

$$\frac{dE[h(\Pi)|x]}{dx} = - \int_{\Pi_L}^{\Pi_H} h'(\Pi) F_x d\Pi > 0,$$

and

$$\frac{d^2 E[h(\Pi)|x]}{dx^2} = - \int_{\Pi_L}^{\Pi_H} h'(\Pi) F_{xx} d\Pi < 0.$$

Hence, $E[h(\Pi|x)]$ in general has normal characteristics for every monotone function, in particular this holds also true for $h(\Pi) \equiv \Pi$. If the latter condition holds true for every monotone function, by choosing the function $h(\Pi)$ accordingly, we can show that the distribution function has the characteristics, we initially assumed. Let Π be some given value from the support (Π_L, Π_H) . We choose some monotone function for this value with $h'(\Pi) = 1$ and $h'(\tilde{\Pi}) \approx 0$ for $\tilde{\Pi} \neq \Pi$. Due to continuity considerations, the distribution function $F(\Pi|x)$ must be decreasing and convex in x for this special value of Π . Repeating this argument for every value of Π from the support completes the proof.

Q.E.D.

In order to be able to evaluate the level of restructuring investments that result from modeling structural merger remedies, we have to find a benchmark. Such a benchmark not only serves to technically identify underinvestments, it eventually helps to compare incentives under different ownership structures.³²

In what follows, we trace the basic patterns of a reference solution for a socially optimal divestiture process. Given the exposition of a basic model of restructuring investments, what is the logic behind a socially optimal implementation of a structural merger remedy by a perfectly informed competition

³²We will address the relationship between changing governance structures and their impact on incentives to invest in restructuring in the following sections.

authority?

First-best relationship-specific restructuring investments can be found by backwards induction, i.e. by solving the divestiture game from the final stage. At the end of the divestiture game, nature has revealed all uncertain parameters such that in the divestiture game the information parameters $\theta = (\theta_M, \theta_B)$ are known.

In order to determine the reference solution, we have to ask the following question: what kind of restructuring investment level would an omniscient and benevolent competition authority implement? Such an institution is interested in maximizing social welfare. Under the assumption that all consumers hold shares in both firms on the relevant market, the authority adopts an allocative decision that optimizes the sum of both profit functions, thereby establishing ex post efficiency. In other words, the competition authority chooses q optimally, i.e.:

$$q^* = q^*(\theta) = \arg \max_q \Pi_M(q, \theta_M) + \Pi_B(q, \theta_B) \quad (4.2)$$

In the case of first-best restructuring investments, the value of the transaction is maximal. All synergy gains, i.e. efficiency improvements that come along with the merger can now be uncovered without being reduced by incentives to underinvest in restructuring. Thus, the total value of the restructuring process amounts to

$$\Sigma(\theta) \equiv \Pi_M(q^*(\theta), \theta_M) + \Pi_B(q^*(\theta), \theta_B). \quad (4.3)$$

Since we assumed that restructuring investments positively influence the outcome which is a function of some uncertainty parameter, ex ante, i.e. before nature has drawn the values for the information parameter θ , the merging parties and the buyer choose the level of restructuring investments x_M and x_B under uncertainty. Therefore, ex ante the expected value of the asset

transfer is given by

$$\sigma(x) = \sigma(x_M, x_B) = E[\Sigma(\theta)|x]. \quad (4.4)$$

Ex ante a perfectly informed competition authority establishes first-best efficient restructuring investments. Formally, the authority chooses the restructuring investments such that

$$x^* = (x_M^*, x_B^*) = \arg \max_x \sigma(x) - c_M(x_M) - c_B(x_B). \quad (4.5)$$

Putting this rather abstract reference solution in the context of Hart and Moore (1988), we find an intuitive and simple explanation for the rationale behind first-best restructuring investments. Again, using a backwards induction argument yields the following optimal allocative decision: the competition authority, here deciding in the place of the purchaser of the asset since restructuring investments are assumed to be verifiable, chooses to transfer the asset from the merging parties to the buyer, i.e. $q^*(V, C) = 1$ for all states of the world, where the value of the transaction exceeds the cost of implementation, i.e. $V > C$. For transaction values smaller than costs of implementation, i.e. $V < C$, the ex post efficient allocative decision amounts to $q^*(V, C) = 0$ since any different allocative decision would destroy value. Thus, the total value of the divestiture relationship between merging parties and buyer is $\Sigma = \Sigma(V, C) = \max\{V - C, 0\}$.

In the following section, we address the question of optimality of allocative decision in the presence of relationship-specific restructuring investments. Roughly speaking, every structural merger remedies process can be characterized by two phases. The first phase comprises restructuring investments of both parties. These investments can either be undertaken simultaneously or sequentially.³³ Following restructuring investments, at the end of the divestiture process, the buyer considers the value of the asset for her operations and takes an allocative decision in the sense of accepting the asset and thus

³³In our divestiture game, we assume a sequential timing of restructuring investments since this sort of timing comes closer to a divestiture process as observed in reality.

clearing the merger or rejecting it hence inducing the authority to prohibit the merger.

Why should the buyer reject the asset after she already undertook restructuring investments? The reason is, that at the point in time when it comes to the allocative decision, restructuring investments are sunk costs and should not affect the buyer's allocative decision.³⁴

4.2 Optimal divestiture contracts

Under which circumstances is a competition authority able to implement Pareto optimal divestitures? Basically, in the context of relationship-specific investments, we depart from the assumption, that information is symmetrically distributed among the players before each party undertakes her investments. Due to symmetrically distributed information at the point in time when the divestiture contract is written, rational players will agree on a complete and verifiable divestiture contract. Under this contract, the parties are able to agree on an attainable allocation of the divested asset which is not dominated by another contractual attainable allocation according to the Pareto criterion. We deduce the following definition of a Pareto optimal divestiture remedy contract.

Definition: *Pareto optimal divestiture contracts*

A divestiture contract is *Pareto optimal* if and only if at the beginning of the contractual relationship, information is symmetrically distributed among the parties before each player undertakes restructuring investments. By consequence, the parties will commit to a complete and verifiable divestiture contract inducing the parties to contract an attainable allocation of the asset

³⁴The latter exposition may suggest that the decision of restructuring investments and the allocative decision are completely independent. This is not true, since the asset value or differently put, the value of the transaction is a function of the players' restructuring investments. Besides some stochastic influence parameter, it is the players decision on restructuring investments that increases the likelihood of the asset value to exceed costs, thus rendering the transaction profitable for the buyer.

which is not dominated by another asset allocation in the sense of Pareto optimality.

In general, Pareto optimality of allocations is only meaningful with respect to different classes of contractual agreements. That is, comparing Pareto optimality among classes of differing contractual agreements is not suggestive. If a contract realizes the reference solution, consequently, the allocation is Pareto optimal.

In the following we show that first-best efficient restructuring investments are contractually achievable, although the information parameters are non-verifiable the authority. At this stage of our introduction in the contract-theoretical mechanics of divestiture remedies, we do not allow for renegotiations that may alter initial contractual agreements, i.e. at the moment of signing the divestiture contract, the players agree to never renegotiate. Since this is a rather strong assumption which is not in line with the empirically observed divestiture practice, the following explanations intend to give a benchmark for the case of divestiture contracts that do not exclude renegotiations per assumption.

In the following we present a divestiture model which is renegotiation-proof, thus rendering first-best restructuring investments possible. As a result, the asset allocation at the end of the divestiture process will be characterized by Pareto optimality. In order to show the mechanics behind our basic divestiture model, we introduced on the basis of Hart and Moore (1988) in section 4.1.1, we make use of an extensive form exposition of the divestiture game as developed by Hermalin and Katz (1993). Consecutively, we will show that the reference solutions is implementable as subgame perfect Nash equilibrium in divestiture contracts that base on Hart and Moore (1988). The structure of a divestiture game excluding renegotiations per ad hoc assumptions is as follows:

t=1

The merging parties as well as the buyer choose their restructuring investments simultaneously, i.e. (x_M, x_B) .³⁵

t=2

Subsequently, nature draws the information parameters, i.e. $\theta = (V, C)$, where V denotes the buyer's valuation of the whole transaction or the value of the asset to be divested and C , the merging parties' costs to merge.³⁶ In dependence on the values that are realized, there are parameter constellations that render the divestiture relationship unprofitable. Formally expressed, this holds true, whenever $V < C$.

t=3

On this stage of the divestiture game, the merging parties choose some price p , the buyer has to pay for the assets that are going to be transferred in the run of the divestiture process. Hermalin and Katz (1993) additionally assume the existence of some basic fee, $\Gamma(p)$, the merging parties charge from the buyer. The implementation of some basic participation fee in the model of Hart and Moore (1988) is a rather technical means in order to be able to achieve first-best investments. In the present context, this fee could be interpreted as follows. Until now, we assumed that the competition authority arrived at the decision that only one competitor was able to effectively compete with the merging parties post-merger with the help of the newly acquired assets. Taking this perspective could be subject to serious criticism since we abstract from second offers, asset auctions or any other sort of competition for the asset to be divested among the remaining competitors in the market. This fee could have the meaning of a kind of entry fee to the divestiture process which has two very important side effects. Firstly, the competition authority and the merging parties thus ensure, that only those

³⁵At this stage of our model we do not address the question of sequentiality of restructuring investments. The reason is to focus on the effects of the non-renegotiable divestiture contracts. We will loosen the assumption and thus adopt to observations in reality in our divestiture model in chapter 5 of this thesis.

³⁶Alternatively, V can be interpreted as the buyer's willingness to pay for the asset.

buyer enter into negotiations that are seriously interested in the acquisition of the assets. Secondly, the basic fee can be seen as a kind of insurance premium against the case that the buyer is only interested in harming the merging parties by causing them restructuring costs.

t=4

At this point in the divestiture game, it is the buyer's turn to decide whether she wants to complete the divestiture process $q = 1$ or reject it, $q = 0$, in the case that the value of the asset does not exceed the price of the asset. The actual payment of the buyer is a function of her allocative decision. Thus, the total payment from the buyer to the merging parties consists of two components: a variable price and some basic fee. Formally expressed, the payment assumes $T = pq + \Gamma(p)$.

Hermalin and Katz (1993) assume that the players ex ante agree on a menu of admissible prices p and associated participation fees $\Gamma(p)$. The merging parties are endowed with the right to choose a menu of asset price and basic fee, the buyer eventually makes an allocative decision. The agreement on an appropriate menu of prices and basic fees is of crucial importance for the reference solution to be contractually attainable. The authors suggest to implement the following basic fee:

$$\Gamma(p) \equiv -E(C)[(p - C)q^*(C, p)|x_M^*]. \quad (4.6)$$

The efficient allocative decision $q^*(C, p)$ should thus be triggered in the case that the stochastic information parameter V , i.e. willingness to pay for the asset, exactly assumes the price p which has been contracted after restructuring investments have taken place. In line with Hermalin and Katz (1993) we assume the realization of the costs to be random. The distribution function of the cost C is assumed to be conditional on ex ante efficient restructuring investments x_M^* by the merging parties and thus enters the optimal basic fee equation in the form of conditional expectation value.

In order to show that the reference solution is factually attainable and meaningful for our contract-theoretical modeling of structural merger remedies, we will solve the divestiture game as outlined above by backwards induction, i.e. is we start reasoning back from the last stage in the divestiture process.

In $t = 4$, nature reveals the true value of the asset. The buyer knows the price, the merging parties charge for the asset and thus the participation fee $\Gamma(p)$ she has to pay. For the allocative decision $q = q(V, p, C)$ in stage four to be part of a subgame perfect Nash equilibrium, the buyer has to make an allocative decision such that she solves the following optimization problem:

$$q(V, p, C) \in \arg \max_q (V - p)q - \Gamma(p). \quad (4.7)$$

For every realization of the asset value that exceeds the price as charged by the merging parties, $V > p$, the subgame perfect solution is to decide for the asset transfer, i.e. $q(V, p, C) = 1$. In the case of an asset value below the initially agreed price, $V < p$, the unique solution is $q(V, p, C) = 0$. In the event that the asset value exactly matches the price, the buyer is just indifferent between the acquisition of the assets or rejection. Since we assumed that the buyer can observe the cost of initiating the merger, C , in the case of indifference, the choice of $q = q^*(V, C)$ is a subgame perfect continuation. Thus the buyer's action plan in stage four as part of her strategy is given by following case differentiation:

$$q = q(V, p, V) = \begin{cases} 1 & \text{falls } V > p \\ q^*(V, C) & \text{falls } V = p \\ 0 & \text{falls } V < p \end{cases} \quad (4.8)$$

The merging parties will anticipate the buyer's decision function, and thus integrate the buyer's optimization problem in their own. Hence, they will choose a price $p = p(V, C)$ that solves the following maximization problem:

$$q(V, C) \in \arg \max_p (p - C)q(V, p, C) + \Gamma(p). \quad (4.9)$$

The merging parties consider three possible outcomes of the optimization problem, depending on their choice of the asset price. Firstly, the merging parties could charge a price $p < V$. By consequence, the buyer will choose $q = 1$, the asset will be transferred and the merger will be cleared. The merging parties' profit thus amounts to $p - C + \Gamma(p) - c_M(x_M)$. Since Hermalin and Katz (1993) assume that the merger fee is characterized by

$$\frac{d\Gamma(p)}{dp} + 1 \geq 0 \geq \frac{d\Gamma(p)}{dp},$$

the following modified relationship also holds true:

$$\frac{d[p + \Gamma(p)]}{dp} = 1 + \frac{d\Gamma(p)}{dp} \geq 0.$$

Due to this, the merging parties are incited to choose a price which is as high as possible within the boundary $p < V$. Alternatively the merging parties communicate a price which exceeds the value of the asset, thus inducing the buyer to reject the offer. The merging parties are not allowed to merge in the case that the buyer denies to buy the asset. Therefore, the merging parties walk away with a profit which is equal to $\Gamma(p) - c_M(x_M)$. Obviously, they should choose the participation fee in a way that the initial costs to set up the merger are covered. Here the merging parties are incited to keep the price as low as possible within the interval $p > V$. Eventually, the merging parties could choose to set a price which is equal to the realized asset value. Anticipating the subgame perfect result from the previous stage, the merging parties yield $\Pi_M(V, C) - c_M(x_M)$, where $\Pi_M(V, C) \equiv (V - C)q^*(V, C) + \Gamma(p)$. Integrating the buyer's allocative decision in the merging parties' profit function yields

$$\Pi_M(V, C) \equiv \max\{V - C, 0\} + \Gamma(p).$$

Analyzing the merging parties' profit function with respect to the different alternatives that we depicted above, we find out that for different values of p , the profit function assumes

$$\Pi_M(V, C) \geq \lim_{p \uparrow V} p - C + \Gamma(p)$$

and

$$\Pi_M(V, C) \geq \lim_{p \downarrow V} \Gamma(p).$$

Obviously, for the merging parties it is rational to choose a price which exactly matches the buyer's valuation of the asset, i.e.

$$p(V, C) \equiv p(V) = V.$$

On the first stage, the merging parties and the buyer choose their level of restructuring investments (x_M, x_B) , knowing all about the latter considerations.

Firstly, we address the buyer's anticipation of the subgame perfect continuation. Since nature has not yet revealed the true values of (V, C) , the buyer chooses her restructuring investments in the light of uncertainty. Technically put, she forms the following expectations:

$$\begin{aligned} E[\Pi_B(V, C)] &= E[-\Gamma(V)|x_B] - c_B(x_B) \\ &= E[(V - C)q^*(V, C)|x_M^*, x_B] - c_B(x_B) \\ &= E[\Sigma(V, C)|x_M^*, x_B] - c_M(x_M). \end{aligned}$$

Obviously, the buyer's dominant strategy is to realize first-best restructuring efforts $x_B = x_B^*$ since ex ante she faces a social planner's or a welfare maximizing competition authority's optimization problem. The merging parties are aware of this fact. By integrating the buyer's first-best decision in their optimization program, the merging parties' expected profit assumes the form of following equations:

$$\begin{aligned} E[\Pi_M(V, C)] &= E[(V - C)q^*(V, C) + \Gamma(V)|x_M, x_B^*] - c_M(x_M) \\ &= E[\Sigma(V, C)|x_M, x_B^*] + E[\Gamma(V)|x_B^*] - c_M(x_M). \end{aligned}$$

Since for the merging parties the expression $E[\Gamma(V)|x_B^*]$ is independent of every level of restructuring investments, their investment decision maximizes only the expression $E[\Sigma(V, C)|x_M, x_B^*] - c_M(x_M)$. Due to the buyer's first-best

investments, the merging parties optimize the total value of the transaction by choosing $x_M = x_M^*$, i.e. they engage in first-best efficient restructuring investments themselves.

To sum up, the subgame perfect equilibrium which evolves on the first stage of the divestiture game is characterized by the following actions of the players. The buyer chooses her dominant strategy, thus ensuring ex ante first-best efficient restructuring investments. The merging parties' best response is the choice of first-best restructuring investments as well. Until now, Hermalin and Katz (1993) only ensure first-best investments via a dominant strategy implementation. In order to achieve the reference solution, we have to make sure that first-best efficient investments also trigger ex post efficient allocative decisions at the end of the divestiture process.

We have shown by backwards induction, that the buyer actually decides on the basis of an efficient allocation. Thus, the subgame perfect equilibrium establishes the reference solution. Hermalin and Katz (1993) hence found a way to implement a dominant strategy which yields the reference solution on the basis of a verifiable decision mechanism.

We already addressed in the introduction of this section that the reference solution is only attainable due to the assumption that renegotiations are not admitted. For example, the merging parties could charge a price for the asset, which induces the buyer to an inefficient allocation. If the players find room for individual value improvement, they could agree to abolish the original decision scheme in order to replace it by another restructuring agenda that increases value. In this case we would observe renegotiations that are anticipated by players with rational foresight. It is obvious that anticipated renegotiations alter restructuring incentives. Hence, at this point in the contract-theoretical analysis, the reference solution is only implementable according to Hermalin and Katz (1993) if renegotiations are excluded by assumption.

The previous explanations show that under certain conditions optimal divestiture contracts are implementable. One of the key assumptions for first-best divestiture contracts to be feasible is the exclusion of the possibility of renegotiations. Another important assumption concerns the character of information in the divestiture model. Up to now we assumed that the information parameters influencing the level of willingness to pay for the asset as well as costs on the side of the merging parties, are observable. Concretely, both players, the buyer and the merging parties are able to observe both variables.

In order to prepare for our divestiture model, we give a short introduction into more sophisticated contract-theoretical issues and discuss the relevance of assumptions that are of major importance for our results.

The major research question of my thesis intends to find an answer on how to implement first-best restructuring investments taking into account important side conditions that manifest in practical divestiture processes. As can be retraced from the EC Merger Remedies Study, the following set of assumptions is in line with empirically verifiable behaviour and legislation.

Assumption (1) *The information parameter V and C , i.e. value of the asset and cost of merger initiation are observable for merging parties and the buyer but not verifiable in court.*

It is not unrealistic to assume that the buyer's willingness to pay for the asset or differently put, the value of the asset to the buyer, is private knowledge of both players. One could think that it is trivial assuming that the buyer knows her own valuation of the asset. This is true in the case of restructuring investments that directly affect her own willingness to pay. This changes when making the buyer's valuation dependent on her own restructuring investments as well as on those of the merging parties, i.e. $V(x_M, x_B)$. The merging parties are assumed to know the value of the asset as well. This is a rather plausible assumption since at the moment when nature reveals uncertainty, they are still in possession of the latter. A surely discussable

assumption is to say that the buyer knows the merger initiation costs that exclusively amount to the merging parties. Why should the competitor have advanced knowledge about costs than the competition authority? The reason is that the competitor is systematically better informed concerning industry specific cost structures than any outside institution.

Assumption (2) *The value of the asset to be divested (the buyer's willingness to pay) is a function of two-sided restructuring investments with direct extrinsic and direct intrinsic impact on the value of the assets, i.e $V(x_M, x_B)$.* This assumption derives from observations of real divestiture remedies. All of the merging parties' actions necessary to maintain functionality, marketability and competitiveness of the asset as required by EC competition law, have a positive impact on the buyer's willingness to pay and thus on the value of the whole transaction. Hence, the merging parties' restructuring investments have direct extrinsic impact on the value of the asset to be divested. Accordingly, all measures undertaken by the buyer in order to prepare for the transfer increase the value of the transaction, thereby exercising a positive direct intrinsic effect on her own willingness to pay.

Assumption (3) *Following nature's revelation of information parameters, the merging parties and the buyer do not enter in renegotiations.*

This assumption is far-reaching, technically important but also totally detached from real divestiture processes. We have seen that through the exclusion of renegotiations, efficient allocations are attainable and first-best restructuring efforts become implementable. Thus, both criteria for a reference solution are fulfilled. In the following section of the thesis, we want to relax this assumption and check under which conditions socially optimal divestiture processes are feasible.

The central question is, whether under the assumptions (1) - (3) as presented above, Pareto optimal asset allocations are possible. Up to this point we know that for the reference solution to be attainable, we have to exclude renegotiations. We have seen, that first-best investments in restructuring

are feasible in the case of two-sided investments. Additionally, the reference solution can be established in the presence of information parameters that are exclusively observable for the merging parties and the buyer but not for the competition authority. Since the authority is not able to observe the true values of the asset and the merger initiation costs, these parameters remain non-verifiable. It remains to check whether the assumption of restructuring investments having a direct extrinsic impact, could imply that the reference solution is not attainable by divestiture contracts that exclude renegotiation.

Basically, the question of contractual attainability in the presence of observable information parameters, given some allocation, is closely related to the implementation of Nash equilibria. In what follows, we make use of results by Moore (1992) in order to show that the reference solution in general is not attainable in the presence of investments that have an extrinsic impact on the value of the asset. For this purpose we reproduce Moore's (1992) theorem in order to show that the models developed up to this point are not able to implement first-best restructuring investments in real life divestiture processes, where direct extrinsic impacts are prevalent.³⁷

Theorem (Moore (1992)) *If the information parameters are observable but non-verifiable for the competition authority, the reference solution is attainable in the presence of two-sided restructuring investments. This holds true only if investments have a direct intrinsic impact on the value of the assets.*

Proof Compare for Moore (1992).

We restate Moore (1992) in the following way. We omit a proof since it follows straightforward.

Theorem (Moore (1992) revisited) *If the information parameters are*

³⁷Moore (1992) originally has shown in his proof that in the presence of direct intrinsic investments the reference solution is attainable. We modify Moore's (1992) theorem in order to express the contrary.

observable but non-verifiable for the competition authority, the reference solution is attainable in the presence of two-sided restructuring investments. This holds not true as soon as we admit for direct extrinsic restructuring investments. Thus, the reference solution is not attainable anymore.

Since in practice we observe restructuring investments that have positive impact on the value of the transaction independent of the player who undertakes the investment, we have to deploy contract-theoretical tools that provide solutions which give a more realistic picture of real world divestiture processes.

From the explanations above we know that assumptions (1)-(2) have to be met if we aim to approximatively apply contract-theoretical models to reality. All assumptions derive from divestiture requirements. In what follows, we relax the assumption of strict exclusion of renegotiations, which is an important step since renegotiations are fundamental part of divestiture processes.

4.3 Divestiture contracts and renegotiations

In the preceding section we restricted our attention to cases where restructuring investments were undertaken in a simultaneous way. Our previous modeling and the results would still be valid in the case of sequential restructuring investments involving short time intervals. If the timely distance between restructuring investments becomes too large or the impact of restructuring investments on the value of the asset is characterized by a significant time lag and market conditions are likely to change.

For the merging parties and the buyer, these events are exogenous, having an impact on their originally signed divestiture contract. Independent of the effect of such exogenous shocks, within a contractual relationship, the parties are incited to alter previously contracted conditions in order to adapt the agreement to actual conditions.

In the following we assume that, after the players have signed a divestiture contract, some exogenous event alters conditions in a way that merging parties and purchaser can make additional profits if both are willing to change the original divestiture agreement. In such cases, the competition authority can neither merging parties nor buyer to remain with the initial contract.

Favorable market developments do not have purely beneficial effects on relationship-specific restructuring investments although post-merger competition may not be affected at all. The reason for negative impacts derives from the sequentiality of restructuring investments, that is the timely inconsistency of the investments. Since restructuring investments are naturally sequential investments, we have to make following model assumption which is totally in line with real divestiture processes and international rules of remedy implementation.

Assumption (4) *Restructuring investments are characterized by sequentiality. Firstly, merging parties restructure firm processes and maintain functionality, marketability as well as competitiveness. Following the merging parties' investments, the purchaser restructures her firm processes in order to integrate the asset.*

Departing from this assumption, we are opposed to all issues that come along with renegotiations in the case of favorable market developments. As we have seen in the previous section, from an ex ante point of view it may be beneficial to be able to exclude renegotiations because the reference solution becomes implementable. In the light of ex post realizable additional surplus, the players are incited to resolve their initial divestiture contract and to enter in renegotiations. Hence, in what follows we base our modeling on the following additional assumption.

Assumption (5) *Merging parties as well as potential buyers will renegotiate the initial divestiture contract as soon as ex post additional surplus is realizable.*

This assumption has far reaching effects on the contract-theoretical modeling

of the strategic interaction in renegotiations between the players.

Contract theory assumes two possible ways of modeling renegotiations. One way of designing renegotiations draws back on cooperative game-theoretical models, the other has its origins in non-cooperative game theory. In the following sections we will show that the kind of modeling renegotiations is of decisive importance for the outcome of the divestiture game. Depending on the contractual agreement and the way of dividing additional surplus among the players deriving from successful renegotiations essentially determines whether the reference solution is attainable or not.

In the following, we start with a discussion of cooperative solutions of renegotiation arising in divestiture processes. Here we intend to give a short insight in the background of cooperative game theory in so far as it is important for the understanding. We do not intend to give an exhaustive picture of cooperative game theory.³⁸ We renounce to start modeling structural merger remedies in the presence of renegotiations, where surplus is allocated among the players along cooperative game theory since our newly developed divestiture model makes extensive use of this theory. Subsequently, we introduce to non-cooperative methods of dividing gains from renegotiations in more detail.

4.3.1 Cooperative division of renegotiation surplus

In most contract-theoretical articles involving cooperative divisions of renegotiation surplus, the authors assume that additional profits are shared among the parties in fixed proportions. Often, they assume a fair division of surplus, i.e. each party receives half of the gains from renegotiations. The reason behind the applicability of such an obviously simple rule derives from a not so simple theory developed by Nash (1950).

³⁸There are excellent introductions to the field of cooperative game theory such as Binore (1992), Fudenberg and Tirole (1991), Gibbons (1992), Moulin (1988), Myerson (1991) or Osborne and Rubinstein (1994).

The major difference between non-cooperative game theory and cooperative game theory is that in the setup of non-cooperative games the players choose their strategies independently from each other, then the game is played delivering some output which is measured in utility. In the setup of cooperative games, the players are allowed to communicate before choosing their strategies and playing the game subsequently.

Since in our divestiture game in chapter 5, gains from renegotiations will be shared cooperatively between merging parties and the purchaser, we sketch the theoretical background of cooperative bargaining in short. In many models where renegotiations are admitted, the resulting gains are often allocated among the players according to the Nash bargaining solution.

The Nash bargaining solution

Every bargaining situation can be characterized by the fact that there is a set of possible solutions, i.e. different combinations of payoffs to the players. Nash postulates that rational players do not only agree on some bargaining set but on a certain pair of payoffs. This unique payoff pair is called *Nash bargaining solution*. The Nash bargaining solution builds upon a list of axioms a payoff pair should satisfy for any bargaining solution.³⁹

A Nash bargaining problem is a combination of (X, d) , where X is the set of feasible payoff combinations and d represents a point in the set, which stands for the consequences of disagreement. A payoff pair is called to be attainable, if and only if

1. the bargaining set is convex,
2. X is closed and includes the upper bound,
3. free disposal is admitted.

Definition Bargaining Solution

In general a bargaining solution is a function mapping to all possible possible

³⁹The following exposition follows Binmore (1992), p. 180 ff.

pairs of payoffs and default points a unique real value, i.e. $F : B \rightarrow \mathbf{R}^2$, where $F(X, d)$ is in the bargaining set. Thus, $F(X, d)$ is the solution to some bargaining problem (X, d) , which uniquely determines the payoff combination on which rational players agree.

The Nash bargaining solutions suggests that bargaining gains from renegotiations will be shared among the players according to their bargaining power.

In the following explanations we will address a non-cooperative division of surplus deriving from renegotiations.

4.3.2 Non-cooperative division of renegotiation surplus

In our following analysis we return to the famous model of Hart and Moore (1988) which will now be extended by the possibility of renegotiations. In the event that altered contractual conditions give prospect to ex post additional surplus, the division of those gains will be modeled in a non-cooperative manner.

As a short refresher, we recapitulate the basics of the model. Two firms intend to merge and thus initiate a merger. The merging parties invest in restructuring for the asset transfer to be successful. Those restructuring investments x_M positively influence the total cost of the merger C in the sense that higher investment levels make lower "merger production" costs more likely, i.e. formally $\partial F/\partial x_M > 0$. Merging parties are thus assumed to be able to have an impact on the total cost of merging via restructuring investments.

The buyer of the assets is also able to influence her own willingness to pay for the asset within a certain range. Higher restructuring investments x_B make higher valuations for the transaction, V , more likely. Formally expressed $\partial G/\partial x_B < 0$.⁴⁰

⁴⁰We assume convexity of distribution functions F and G .

A divestiture contract

A *divestiture contract* Φ is an agreement between merging parties and a pre-determined buyer that includes two payment components: a basic fee Γ and some variable price for the asset, p , i.e. $\Phi = (p, \Gamma)$. In the presence of such divestiture contracts, the merging parties' profit function assume the following, neglecting restructuring investments:

$$\pi_M = \pi_M(q, \Phi) = (p - C)q + \Gamma \quad (4.10)$$

In reality, of course a divestiture contract contains much more information than just two parameters. For instance, it contains the subject of the contract, the asset that changes hands and the timing of actions that have to be undertaken by the players. Here it suffices to assume these basic two parameters since we assume that the choice of the asset itself is not part of the divestiture contract. In contrast, we assume that this decision is not subject to a decision by the players but by the competition authority.

Since now we explicitly admit for renegotiations, we have to give up the existence of a unique divestiture contract. We assume that initially, the parties sign ex ante a contract $\Phi^0 = (p^0, \Gamma^0)$. Furthermore, several important decisions are assumed to be made ex ante before the strategic interaction between merging parties and buyer actually starts.

The timing of our divestiture game based on Hart and Moore (1988) has the following structure:

t=1 *Simultaneous restructuring investments*

Both parties undertake restructuring investments simultaneously $x = (x_M, x_B)$. Since there is no sequentially in investments, we assume a time lag between the moment of investing and the impact that derives from restructuring on the value of the asset to be divested and on the cost of setting up the merger in order to give room for renegotiations.

t=2 *Nature's move*

In the second stage of the divestiture game, nature draws both information parameters C and V based on their statistical distribution as assumed by the distribution functions $F(C|x_M)$ and $G(V|x_B)$.

t=3 *Renegotiations*

At this point in time, merging parties and buyer have to reconsider their initial divestiture contract in the light of the parameter C and V that have taken concrete values and possibly replace the initial agreement $\Phi^0 = (p^0, \Gamma^0)$ by a new one which controls for the new situation. We assume that both parties are allowed to propose a new divestiture contract. The merging parties offer is called $\Phi^M = (p^M, \Gamma^M)$ whereas the buyer could offer a contract $\Phi^B = (p^B, \Gamma^B)$. In both cases, the new divestiture contract contains a paragraph which requires that both parties agree on an abolishment of the initial divestiture contract. Since another divestiture contract is not obligatory, the parties can also agree to remain with the initial agreement.

t=4 *Allocative decision*

Due to the introduction of renegotiations, the allocative decision of merging parties and buyer becomes more complex. In order to picture the fact that both parties are now endowed with the right to reject an alternative divestiture contract, in reference to Hart and Moore (1988) we assume that both players can choose from the set $\{0, 1\}$. For the merging parties' allocative decision function this means $q_M \in \{0, 1\}$ and analogous for the buyer's $q_B \in \{0, 1\}$. Thus, the asset will only be transferred to the buyer in the case that both choose simultaneously $q = q_M q_B = 1$. For the competition authority it is observable that the asset will be transferred. In the case of $q = 0$ the authority cannot verify, whether merging parties or buyer rejected the offer. The divestiture contract Φ itself remains verifiable.

t=5 *Payoffs*

In the last phase of the divestiture game, payoffs to merging parties and buyer are realized. Depending on whether in the third stage one of the players made alternative contractual offers or not, the original divestiture contract remains

active or will be replaced by a new one. At this point in time, player j can propose another contract $\Phi^j \neq \Phi^0$ leaving it to player i 's decision whether to sign the contract, thus replacing the old one or rejecting and keeping the original one.

Again we solve this game by backwards induction in order to determine the players' rational decisions.

t=5

At the final stage of the game, nature has revealed the true values for information parameters $\theta = (V, C)$. Merging parties and buyer may each have offered alternative divestiture contracts Φ^M and Φ^B . Consecutively, the players made their allocative decision q . The final payoff to the merging parties is thus a function of alternative divestiture contracts, information parameters as well as of an allocative decision, i.e. $\Pi_M(q; \Phi^M, \Phi^B; \theta)$, still neglecting restructuring investments.

The merging parties' payoff function depends on whose divestiture contract has finally been accepted. Formally expressed,

$$\Pi_M(q; \Phi^0, \Phi^B; \theta) = \max\{\pi_M(q, \Phi^0), \pi_M(q, \Phi^B)\} \quad (4.11)$$

$$\Pi_M(q; \Phi^M, \Phi^0; \theta) = \min\{\pi_M(q, \Phi^0), \pi_M(q, \Phi^M)\} \quad (4.12)$$

$$\min\{\pi_M(q, \Phi^0), \pi_M(q, \Phi^M)\} \leq \Pi_M(q; \Phi^M, \Phi^B; \theta) \leq \max\{\pi_M(q, \Phi^0), \pi_M(q, \Phi^B)\}. \quad (4.13)$$

The first two equations imply that only one of the two players has actually made an alternative offer for a new divestiture contract. If the buyer proposed another contract than initially agreed, the merging parties only sign it if they are better off. Equivalently, this argument holds true for the buyer in the light of an alternative divestiture contract.⁴¹ In the event that both

⁴¹Obviously, the strategic interaction on the last stage of the divestiture game can be characterized as a constant sum game. The share of profit the one gains from having a new contract signed, the other loses accordingly and vice versa.

players suggest to resolve the initial divestiture contract, either the original contract Φ^0 or one of the suggested Φ^M or Φ^B will be enforced. In the cases that the players cannot agree, the competition authority decides to implement some divestiture contract Φ .

t=4

There are two subgame perfect equilibria thinkable when it comes to the allocative decision of the parties. In the case the players choose $q_M = q_B = 0$, ex post the buyer rejects the asset from being transferred and integrated in her operations. Thus, the merger will not be approved by the competition authority. This leaves synergy potential uncovered and should not be considered as a desirable outcome. Hence, we concentrate on the non-trivial solution of a subgame perfect equilibrium which actually establishes a divestiture relationship. i.e. $q_M = q_B = 1$.

A necessary condition for the non-trivial solution to be implementable is formally expressed by following inequality:

$$\Pi_M(0; \Phi^M, \Phi^B; \theta) \leq \Pi_M(1; \Phi^M), \Phi_B; \theta) \leq V - C + \Pi_M(0; \Phi^M, \Phi^B; \theta) \quad (4.14)$$

In the case that the upper condition holds true, the value of the assets as perceived by the buyer, V actually exceeds the cost of producing the merger C , i.e. $V \geq C$. We suppose that under this condition the players decide ex post efficiently, i.e. $q_M = q_B = q^* = 1$.

The reason for this affirmation is the following. The players make an allocative decision $q = q_M q_B$ at the fourth stage of the game. At this point in time both anticipate the subgame perfect outcome of the fifth stage which is incorporated in both players profit functions. Thus, in the case of the allocative decision function $q = q_M q_B$, the merging parties' profit function amounts to $\Pi_M(q_M q_B; \Phi^M, \Phi^B; \theta)$. The buyers profit function assumes the following form: $(V_C)q - \Pi_M(q_M q_B; \Phi^M, \Phi^B; \theta)$. In the case that one player chooses against the asset transfer, that is either $q^M = 0$ or $q^B = 0$, the other party's

best response is to deny the asset transfer as well. Hence, $q_M = q_B = 0$ actually forms a subgame perfect equilibrium.

In contrast, if ex post the buyer is willing to buy the asset, i.e. $q^B = 1$, for the merging parties it is optimal to also choose $q^M = 1$ if $\Pi_M(0; \Phi^M, \Phi^B; \theta) \leq \Pi_M(1; \Phi^M, \Phi^B; \theta)$ holds true. Conversely, $q^B = 1$ is a best response to $q^M = 1$ if $V - C - \Pi_M(1; \Phi^M, \Phi^B; \theta) \geq -\Pi_M(0; \Phi^M, \Phi^B; \theta)$. Therefore, if the upper inequality holds true, $q_M = q_B = 1$ is part of the equilibrium path making an asset transfer and consequently merger clearance implementable.

t=3

We now arrive at the stage where renegotiations are allowed. Either merging parties or buyer will suggest alternative divestiture contracts which should replace the initial contract in dependence on the information parameters that have realized in $t = 2$. We have to differentiate four possible payoff constellations which integrate subgame perfect continuations from stage four and five.

(i) $V < C$:

In this case neither merging parties nor buyer are incited to offer another divestiture contract since merger costs exceed the value of the asset. There will be no additional gains from an ex post perspective that could be distributed among the players through a new divestiture contract. Thus, the initial agreement remains unchanged, i.e. $\Phi^M = \Phi^B = \Phi^0$.

In the case of $V < C$, the equilibrium condition (4.14) is not satisfied. Whatever one of the players may offer, the allocative decision will be $q = 0$, i.e. there will be no asset transfer. Suppose merging parties propose $\hat{\Phi}^M \neq \Phi^0$, then due to (4.12) we know that $\Pi_M(0; \hat{\Phi}^M, \Phi^0; \theta) \leq \pi_M(0, \Phi^0)$. Thus, unilaterally deviating from the original contract does not pay off to the merging parties. Accordingly, this holds true for the buyer. Eventually, the original divestiture contract remains in place as part of the equilibrium path. As a subgame perfect continuation, the asset transfer will not be realized which is in line with the ex post efficient decision.

$$(ii) \quad V - C + \pi_M(0, \Phi^0) \geq \pi_M(1, \Phi^0) \geq \pi_M(0, \Phi^0)$$

Both parties do not offer new divestiture contracts deviating from the original one, i.e. $\Phi^M = \Phi^B = \Phi^0$.

In this case, obviously the buyer's willingness to pay exceeds or is equal to the merger costs, $V \geq C$. By consequence, the ex post efficient allocative decision implies $q^* = 1$, being established by the original divestiture contract. Unilateral deviations by one of the players is not a best response, given the other player remains with the initial contract. With reference to the condition of subgame perfectness (4.12), we know that $\Pi_M(1; \hat{\Phi}^M, \Phi^0; \theta) \leq \pi_M(1, \Phi^0)$ and $\Pi_M(0; \hat{\Phi}^M, \Phi^0; \theta) \leq \pi_M(0, \Phi^0)$. It follows straightforward that $\Pi_M(0; \hat{\Phi}^M, \Phi^0; \theta) \leq \pi_M(1, \Phi^0)$. Similar considerations hold true for the buyer. Hence, in this case we observe an asset transfer as part of the equilibrium path with an ex post efficient allocation of $q^* = 1$ and the initial divestiture contract not being renegotiated.

$$(iii) \quad V - C + \pi_M(0, \Phi^0) \geq \pi_M(0, \Phi^0) \geq \pi_M(1, \Phi^0)$$

In this case the buyer is incited to propose a new divestiture contract $\Phi^B \neq \Phi^0$. She writes a contract which stipulates

$$\pi(1, \Phi^B) = \pi(0, \Phi^0) \geq \max\{\pi(0, \Phi^B), \pi(1, \Phi^0)\}.$$

Nature has drawn a parameter constellation $V \geq C$ which would render an ex post efficient allocation $q^* = 1$ desirable. Actually it is implementable but it strongly depends on the contractual design. Initially under the upper condition, only the buyer is willing to buy the asset under the divestiture contract Φ^0 . Knowing about the merging parties' profit functions, the buyer can choose an alternative divestiture contract Φ^B , which alters the merging parties' profit function in the following way. In the case of rejecting the asset transfer, the merging parties earn as much as

$$\Pi(0; \Phi^0, \Phi^B; \theta) = \max\{\pi(0, \Phi^0), \pi(0, \Phi^B)\} = \pi(0, \Phi^0)$$

due to the divestiture offer proposed by the buyer. In the case of admitting for the asset transfer the merging parties earn

$$\Pi(1; \Phi^0, \Phi^B; \theta) = \max\{\pi(1, \Phi^0), \pi(1, \Phi^B) = \pi(0, \Phi^0)\}.$$

It follows straightforward that

$$\Pi(0; \Phi^0, \Phi^B; \theta) = \Pi(1; \Phi^0, \Phi^B) \leq \Pi(0; \Phi^0, \Phi^B) + V - C.$$

Thus, equilibrium condition (4.14) is satisfied. Therefore, if the buyer suggests $\hat{\Phi}^B \neq \Phi^0$, and merging parties play according to the strategies as exposed above, the new divestiture contract is able to implement an ex post efficient allocation on the fourth stage. The individual profits that arise to each player are as follows. Merging parties earn $\pi_M(1, \Phi^B) = \pi_M(0, \Phi^0)$. Obviously, the buyer implements a new divestiture contract which holds merging parties exactly indifferent between accepting the asset transfer as part of an ex post efficient allocation or rejecting it on the basis of the initial restructuring contract. Both decisions are part of the subgame perfect equilibrium path. We decide for the equilibrium which actually triggers the asset transfer. Finally, the buyer receives $V - C - \pi(0, \Phi^0)$.

$$(iv) \quad \pi_M(1, \Phi^0) > V - C + \pi_M(0, \Phi^0) \geq \pi_M(0, \Phi^0)$$

In this case the merging parties are incited to propose a new divestiture contract $\Phi^M \neq \Phi^0$. They offer a contract stipulating

$$\min\{\pi(0, \Phi^B), \pi(1, \Phi^0) - (V - C)\} \geq \pi(0, \Phi^0) = \pi(1, \Phi^1).$$

In analogy to the reasoning in case (iii), here the merging parties write a new contract which is designed just to keep the buyer indifferent between deciding for or against the asset transfer based on the ex post realized information parameters. Due to indifference, we assume that the parties agree on a new divestiture contract which triggers the asset transfer.

Thus, we have shown, that under all thinkable parameter realizations (V, C)

the asset transfer is implementable either via the existing contract or by an apt design of new divestiture contracts that take subgame perfect continuations from stage four and five into consideration.

As an important interim result, we could show with the help of Hart and Moore (1988) and Schweizer (1999) that renegotiations are able to implement efficient allocation decisions.

Reviewing our previous case differentiations, we end up with the following insight. In every case (i) - (iv), the ex post efficient asset allocation $q^* = q^*(V, C)$ is implementable. Neglecting restructuring investments, merging parties make following profits as a result of different divestiture contracts:

$$\Pi_M(V, C) = \begin{cases} \pi(0, \Phi^0) & \text{if (i)} \\ \pi(1, \Phi^0) & \text{if (ii)} \\ \pi(0, \Phi^0) & \text{if (iii)} \\ V - C + \pi(0, \Phi^0) & \text{if (iv)} \end{cases} \quad (4.15)$$

Accordingly, the buyer's profits assume the following expression:

$$\Pi_B(V, C) = (V - C)q^*(V, C) - \Pi_M(V, C). \quad (4.16)$$

Before analyzing the impact deriving from alternative divestiture contracts on restructuring incentives, we highlight the importance of renegotiations in establishing first-best efficient divestiture processes.

In cases (i) and (ii) merging parties and buyer agree on the asset transfer thus establishing an ex post efficient allocation under the initial divestiture contract. No additional gains can be realized such that the parties are not incited to replace the initial contract by a new one. In cases (iii) and (iv) it is either the merging parties or the buyer who are willing to transfer the asset under the original divestiture contract. As we have seen from the analysis above, the party which is able to appropriate all additional gains from

renegotiations will offer another divestiture contract. This player offers a contract which induces the other player to respond with an ex post efficient allocative decision. Although one of the players will not participate from additional gains, this players will not offer another divestiture contract which makes him better off since the counter-party will not sign it.

t=2

There is no strategic interaction between the players on this stage of the divestiture game. Nature reveals the information parameter (V, C) .

t=1

At this point in time, merging parties and buyer decide on the scale of their restructuring investments while anticipating the subgame perfect continuation of the rest of the divestiture game. We denote

$$\vartheta_M(x_M, x_B) \equiv E[\Pi_M(V, C)|x_M, x_B] \quad (4.17)$$

the merging parties' expected profit. Accordingly, we define the buyer's expected profit to be

$$\vartheta_B(x_M, x_B) \equiv E[\Pi_B(V, C)|x_M, x_B]. \quad (4.18)$$

Up to now, we neglected restructuring investments. In order to determine the players incentive to invest in restructuring, we form the following first order conditions:

$$\frac{\partial \vartheta_M(x_M, x_B)}{\partial x_M} = c'_M(x_M) \quad (4.19)$$

$$\frac{\partial \vartheta_B(x_M, x_B)}{\partial x_M} = c'_B(x_B). \quad (4.20)$$

In the following, we compare the players' incentives to invest with the case where an omniscient competition authority would implement the reference solution, i.e. ex ante efficient restructuring decisions $x^* = (x_M^*, x_B^*)$. In the case of ex ante first-best efficient restructuring investments, the first order

conditions for both players amount to:

$$\frac{\partial \Sigma(x_M, x_B)}{\partial x_M} = c'_M(x_M) \quad (4.21)$$

$$\frac{\partial \Sigma(x_M, x_B)}{\partial x_B} = c'_B(x_B), \quad (4.22)$$

where

$$\Sigma(x_M, x_B) = E[(V - C)q^*(V, C)|x_M, x_B] \quad (4.23)$$

denotes the total ex ante expected value that accrues to the players and thus to society due to the divestiture relationship.⁴²

For the determination of restructuring incentives that arise under different divestiture contracts in comparison with those under the reference solution, we define the following delta-function, consisting of firm-individual profits and total welfare deriving from an ex ante efficient divestiture process. In sum, we define:

$$\Delta_M(x_M, x_B) \equiv \vartheta_M(x_M, x_B) - \Sigma(x_M, x_B) \quad (4.24)$$

$$\Delta_B(x_M, x_B) \equiv \vartheta_B(x_M, x_B) - \Sigma(x_M, x_B). \quad (4.25)$$

We now approach the central insight which comes along with the analysis of divestiture contracts in the presence of non-cooperative modeling of renegotiations. Therefore we analyze restructuring investments that result from our previous modeling. We state the following proposition which is in line with Hart and Moore (1988) as well conveniently applied in contract theoretical treatments such as Schweitzer (1999).

Proposition (A): *Marginal incentives to invest in restructuring activities*

Let $\Phi^0 = (p^0, \Gamma^0)$ be the initial divestiture contract as signed by merging parties and buyer. In the presence of this contract the merging parties and

⁴²At this point we still renounce to take relationship-specific investments into consideration, since in the present analysis they are not relevant.

the buyer choose restructuring investments such that

$$\frac{\partial \Delta_M(x_M, x_B)}{\partial x_M} \leq 0 \quad (4.26)$$

$$\frac{\partial \Delta_B(x_M, x_B)}{\partial x_M} \leq 0. \quad (4.27)$$

The merging parties' marginal incentives to invest in restructuring are sub-optimal, i.e. $\frac{\partial \Delta_M(x_M, x_B)}{\partial x_M} < 0$ iff and only iff

$$\max\{p^0, C_L\} < \min\{V_H, C_H\}. \quad (4.28)$$

The buyer's restructuring investments are lower than optimal, i.e. compared to the level of a perfectly informed competition authority, i.e. $\frac{\partial \Delta_B(x_M, x_B)}{\partial x_B} < 0$ iff and only iff

$$\max\{V_L, C_L\} < \min\{p^0, V_H\}. \quad (4.29)$$

Proof *Compare for Appendix*

In order to avoid the subgame perfect equilibrium where the ex ante efficient restructuring investment choice $x^* = 0$ is realized, we assume

$$V_L < C_H \text{ and } C_L < V_H.$$

Since $C_L < V_H$, we know that $C_L < \min\{V_H, C_H\}$. Thus, we can rewrite (4.28) in the following way:

$$p^0 < \min\{V_H, C_H\}. \quad (4.30)$$

Based on our assumption to not admit for the non-transfer solution $q^* = 0$, we focus on cases where $C_L < V_H$, i.e. $V_H > \max\{V_L, C_L\}$. Hence, inequality (4.29) can be restated as follows:

$$\max\{V_L, C_L\} < p^0. \quad (4.31)$$

Excluding the non-transfer solution, the decision problem collapses to

$$\max\{V_L, C_L\} < \min\{V_H, C_H\}.$$

By consequence, either condition (4.30) or (4.31) holds true but there is no possibility for both to be valid at one and the same time. For any initial divestiture contract Φ^0 , either the merging parties' or the buyer's restructuring investments have a negative impact on the delta-function, i.e. $\partial\Delta_M/\partial x_M < 0$ or $\partial\Delta_B/\partial x_B < 0$. This implies that the first order conditions (4.19)-(4.22) cannot be simultaneously satisfied.

As major result we deduce that there is no initial divestiture contract which is able to implement restructuring investments that establish the reference solution. Failing the reference solution can be traced back to the admission of non-cooperative renegotiations.

To give a résumé of our findings, it became evident that divestiture contracts necessarily involving relationship-specific restructuring investments and giving rise to renegotiations, systematically fail to implement the reference solution if the ex post "no-transaction-condition" is excluded from the set of possible outcomes. This holds true for all divestiture contracts that are similar to the contract-theoretical environment as designed by Hart and Moore (1988). The reason for the non-attainability of first best restructuring investments is the non-cooperative modeling of renegotiations.

One of the main contributions of our divestiture model will be, to show that the reference solution is implementable in the presence of renegotiations although there is sequentiality of restructuring investments. A necessary condition for first-best efficient restructuring investments to be realizable, is to alter the design of renegotiations, i.e. to switch from a non-cooperative modeling to a cooperative renegotiation mode. We will see that just altering the renegotiation design will not establish first-best restructuring investments per se but changes in ex ante allocation of ownership rights have to be im-

plemented by the competition authority.

At the end of this chapter, we address the following question: What is the difference between a non-cooperative and a cooperative renegotiation design?

The question can be easily answered with the help of the preceding analysis. Within the non-cooperative renegotiation modeling by Hart and Moore (1988), there is an ultimatum until which both parties can make an alternative offer for a divestiture contract. If both parties miss out to offer a new contract, they run the risk of ending up with an ex post inefficient allocative decision. Within a cooperative modeling of renegotiations there is no such risk of not renegotiating the initial divestiture contract in the presence of gains from renegotiations. The reason is that under cooperative renegotiations, every inefficient decision will be renegotiated.

Up to now the divestiture parties were able to write an ex ante contract which controls for every action the merging parties and the buyer have to undertake in order to complete the asset transfer and thus trigger merger clearance. We started with the case of renegotiation proof ex ante divestiture contracts. Whenever the players involved in the asset transfer are able to commit not to renegotiate the ex ante divestiture contract, the reference solution evolves. Since in general divestiture contracts are subject to changing conditions and rather long term oriented, excluding renegotiations from the set of possible events and not analyzing their impact on ex post allocative decisions as well as on ex ante restructuring investments, appears to be short-sighted and will not picture merger negotiations as observed in practice. Thus, we admitted for renegotiations to appear within the divestiture process. We showed that renegotiations will be anticipated by rational divestiture parties and consequently they alter ex ante incentives for restructuring investments on both sides of the transaction. We developed an important result showing that the question of first-best restructuring investments to be implementable essentially depends on the character of renegotiations. Expressed in game-theoretical terms, whenever divestiture renegotiations are

modeled in a non-cooperative way, the reference solution is not realizable. Hence, we made the important contract-theoretical finding of the impossibility of ex ante agreements in the presence of renegotiations applicable to the case of structural merger remedies.

In the following, we not only address the impact of cooperative renegotiation designs on ex ante divestiture contracts, we will bring structural merger remedies in the context of another theoretical field, the economics of institutions in general, and the theory of the firm as an essential part of it. The analysis thus becomes more complex but gives a better picture of real word divestiture processes. The new institutional economics departs from the posit that detailed ex ante contracts are not possible, i.e. there is no way to ex ante agree on a divestiture contract that regulates all future actions of the players until the asset transfer is completed. In contrast, institutional economics assumes that an institution such as the competition authority is only able to set a rather general frame in which divestiture contracts emerge since she is not able to observe and verify most of the actions and communications among the parties.

Since the assumption of only very general aspects to be contractually agreeable, can not be justified with the help of a certain contractual environment or anticipated renegotiations, we follow the prominent model by of Grossman and Hart (1986) and assume that ex ante detailed divestiture contracts are impossible. Contracts that are signed but not on a detailed information basis of who undertakes what action at what point in time, are called incomplete contracts.

The analysis of structural merger remedies and restructuring investments in the presence of incomplete contracts will be at the core of the consecutive remaining part of this thesis.

4.4 Merger remedies and incomplete contracts

Incomplete contracts as firstly addressed by Grossman and Hart (1986) depart from the assumption that detailed ex ante contracts in general are not possible. The theory postulates that only very general aspects of ownership rights or governance structure are ex ante contractually compatible.

The aim of this section is to demonstrate the impact deriving from divestiture contracts that are written under the assumption that only an ex ante distributions of ownership rights in an divestiture object are feasible.

In this section we analyze the effects of incentives to invest in restructuring under different asset ownership structures and thereby prepare for our richer divestiture model in chapter 5 which builds on the pillars of Grossman and Hart (1986) and Nöldeke and Schmidt (1998). Independent of the underlying question, incomplete contracts are able to analyze existing institutions concerning their efficiency and thus explain whether an asset should be in shared ownership or fully integrated in one firm's business.⁴³

In the following, we depart from the modeling of Hart and Moore (1988), which has proven to be meaningful for an analysis of structural merger remedies when it comes to interpreting restructuring investments as relationship-specific. In this context we analyze the impact of different asset ownership structures on the players' incentives to invest in restructuring. This is when Grossman and Hart (1986) come into play who were the first who interpreted a firm as accumulations of assets, thereby founding a totally new perception of institutions as bundles of ownership rights. According to the distribution of the control rights among a set of owners, different incentive schemes evolve. The decisive question of models of incomplete contracts is under which ownership structure first-best efficient investments are implementable.

⁴³Initially, these models were meant as a theoretically valid answer on the question of the boundaries of the firm. Although explaining the holdup problem in a large variety of situations, there is a lot of criticism concerning the ad-hoc assumption of complete contracts ex ante not to be existent.

4.4.1 Asset divestiture, ownership structure and investment incentives

In the present section we will apply the idea of Grossman and Hart (1986) to structural merger remedies whose implementation requires relationship-specific investments.

We assume that following the merger transaction, the merging parties are in sole control of two assets that almost supply the whole quantity of a good consumed in the relevant market. Since without any further intervention by the competition authority, the merging parties would significantly impede effective competition on the relevant market, at least one part of the assets has to be sold to some viable competitor as a structural merger remedy. We continue to assume that relationship-specific restructuring investments are obligatory for the merging parties as well as for the buyer of the assets.

Following the players' restructuring investments, they make an allocative decision $q = (q_M, q_B)$. The owner of divestiture d is independent with respect to the allocative decision, i.e. to choose the level of q_M or q_B since she is sole owner of the asset.

At the point in time when merging parties and purchaser write the divestiture contract, the players can only agree on an ex ante enforceable allocation of ownership rights at the asset to be divested.⁴⁴ The set of all divestitures available on the market is given by $\{d_1, d_2\} = D_1 \cup D_2$. Various ownership structures are thinkable.

Let D_i be the set of divestitures which are ex ante in exclusive ownership of party i at the beginning of the divestiture process, where i either represents the merging parties or the potential buyer. In general, the following two ownership structures are possible.

⁴⁴Later we restrict this assumption further in order to admit only for those ownership structures which are prescribed by the competition authority.

Both assets can either belong to one player i , i.e. $D_i = \{d_1, d_2\}$ and $D_i = \emptyset$ or each player owns one part of the divestiture objects, i.e. merging parties as well as buyer share the assets, i.e. $D_i = \{d_i\}$, where $i = M, B$.

Whenever the competition authority decides to clear the merger under a structural merger remedy, ex ante the merging parties enter into the divestiture being exclusive owner of the assets to be divested. Thus, there is only one ownership structure that has to be analyzed with respect to incentives for restructuring investments, i.e. $D_M = \{d_1, d_2\}$.

An incomplete contract model which bases on this assumption would not satisfy to explore the potential of such an analysis. Especially with regard to policy recommendations, it may be worthwhile to disengage from such a single-sided analysis. Besides these pure model-theoretic considerations in most European merger cases involving structural merger remedies, the divestiture process starts after the merger has been cleared. That is restructuring activities and implementation phase may take place after the buyer already became legal owner of the assets but physically the divestiture object has not yet changed hands. It is exactly this timely inconsistency between becoming legal owner of the assets and being able to fully exercise power over the assets that makes suboptimal restructuring investments to occur in reality. We intend to integrate this important feature in our following analysis.

In Grossman and Hart (1986), ex ante the players agree on some allocation of ownership rights. Given a certain distribution of control rights, both player invest in the completion of some transaction.

In our divestiture game, we assume that the competition authority is free to choose the ex ante ownership structure under which the divestiture process should start. Concretely, the EC can either allow for the merger and simultaneously transfer all legal ownership rights of the asset to be divested

to the buyer and then allow for the divestiture process to start. Alternatively, the EC could make merger clearance conditional on a successful asset transfer. The analysis of different ownership structures at different points in time of the divestiture process will help to answer this question.

We already mentioned that the competition authority decides on the distribution of legal ownership of the assets that have to be divested. Given this ex ante ownership structure, merging parties and buyer decide on the level of restructuring investments x_M and x_B , respectively. Both parties are forced by the EC Merger Regulation to undertake restructuring investments independent of the ownership structure, DG Competition has installed ex ante as part of the incomplete divestiture contract.

Whatever ownership structure is agreed upon at the beginning of the divestiture game, the merging parties as well as the buyer are necessary for the transaction. In the present context, the ownership structure is assumed to be at the choice of the competition authority. Missing investments in the transaction by one party induce the competition authority to immediately prohibit the merger.

We assume that the level of restructuring investments $x = (x_M, x_B)$ stochastically influences some information parameter $\theta = (\theta_M, \theta_B)$. The merging parties' profit from merging and divestiture amounts to $\pi_M(q, \theta_M)$, which is a function of the information parameter θ as well as the allocative decision q . The buyer's profit accordingly is represented by $\pi_B(q, \theta_B)$.

Following nature's revelation of the true values for the information parameter θ , the players enter into ex post negotiations. Within renegotiations, the players will make use of their disposal rights with respect to the asset as determined by the ex ante distribution of ownership rights as a threat. In the case that the divestiture process starts either with merging parties being sole owner of the assets $D_M = \{d_1, d_2\}$ or with the buyer being exclusive owner of the assets, i.e. $D_B = \{d_1, d_2\}$, one of them will make the allocative

decision independent of the other, i.e.

$$q^{NE}(\theta) = \arg \max_{(x_M, x_B)} \pi_M(x_M, x_B, \theta_M) \quad (4.32)$$

$$q^{NE}(\theta) = \arg \max_{(x_M, x_B)} \pi_B(x_M, x_B, \theta_B). \quad (4.33)$$

Thus, either merging parties or buyer are completely independent of the other player. The allocative decision can be implemented as dominant strategy in the case of exclusive ownership.

Possibly, the competition authority decides to let merging parties and buyer ex ante to enter into a divestiture contract which foresees shared ownership, i.e. merging parties and buyer each of them are in possession of an asset. Formally, the ownership structure assumes $D_M = \{d_1\}$ and $D_B = \{d_2\}$.⁴⁵ In this case the competition authority is exposed to strategic interaction among the players in the case of failing renegotiations.

The ex post subgame perfect Nash equilibrium is characterized by the following conditions:

$$q_M^{NE}(\theta) = \arg \max \pi_M(x_M, x_B^{NE}(\theta), \theta_M) \quad (4.34)$$

$$q_B^{NE}(\theta) = \arg \max \pi_B(x_M^{NE}(\theta), x_B, \theta_B). \quad (4.35)$$

Thus, in the case of shared asset ownership and failing renegotiations, both players can ensure at minimum $q^{NE}(\theta) = (q_M^{NE}, q_B^{NE})$. Given the allocative decision of the players and the information parameter θ , the merging parties profit is equal to

$$\pi^{NE}(\theta) \equiv \pi_M(q^{NE}(\theta), \theta_M). \quad (4.36)$$

The buyer's profit accordingly is defined as

$$\pi^{NE}(\theta) \equiv \pi_B(q^{NE}(\theta), \theta_B). \quad (4.37)$$

⁴⁵We assume the divestiture objects to be identical, i.e. $d_1 = d_2$.

In the case of successful renegotiations, merging parties and buyer can realize additional gains, i.e. a mark-up over the point of threat, where both players fall back to the non-cooperative solution. We measure the gains from renegotiations with the following expression:

$$G(q, \theta) = \Sigma(\theta) - (\pi_M^{NE}(q, \theta_M) + \pi_B^{NE}(q, \theta_B)). \quad (4.38)$$

In the unlikely event of being perfectly informed, the competition authority could solve the optimization problem herself in a socially optimal way. This means that the authority would choose to maximize synergy gains from merging:

$$\Sigma(\theta) = \max_q \pi_M(q, \theta_M) + \pi_B(q, \theta_B). \quad (4.39)$$

A necessary condition for the total profit of the transaction to be socially optimal is that first-best efficient allocative decisions are made with respect to both assets, i.e. $q^*(\theta) = \arg \max_q \pi_M(q, \theta_M) + \pi_B(q, \theta_B)$. We assume that the surplus from renegotiations will be equally shared among the players according to the Nash bargaining solution. Thus, the total profit of the players will increase in the case of successful cooperative renegotiations to

$$\pi_M(q_M, q_B, \theta_M) + \frac{1}{2}G(q_M, q_B, \theta) \quad (4.40)$$

$$\pi_B(q_M, q_B, \theta_B) + \frac{1}{2}G(q_M, q_B, \theta). \quad (4.41)$$

For these profits to be realizable, the parties have to decide for the ex post efficient allocative decision $q^*(\theta)$. Since without additional renegotiation surplus, neither merging parties nor buyer would allocate ex post efficiently, i.e. $q \neq q^*$, both players have to commit to the ex post efficient allocation. This is only a best response if the other chooses the an allocative decision, too. For example, if the merging parties choose $q_M = q_M^*$, then she has to be rewarded for choosing an allocation which is suboptimal from a non-cooperative perspective. Hence, the buyer, willing to share the gains from renegotiations evenly, will make a payment Γ_M to the merging parties such that their aggregated profit $\pi_M(q^*(\theta), \theta_M) + \Gamma_M$ exactly matches (4.40). The payment,

the buyer has to transfer to the merging parties for renegotiations gains to be feasible, assumes:

$$\Gamma_M = \pi_M(q_M, q_B, \theta_M) - \pi_M(q^*(\theta), \theta_M) + \frac{1}{2}G(q_M, q_B, \theta).$$

Hence, payments are perfectly balanced out, i.e. $\Gamma_M = \Gamma_B$.⁴⁶ In the presence of an ex post efficient allocative decision, the merging parties' and the buyer's profit function consists of two components. The first is the Nash equilibrium payoff π^{NE} which represents failing renegotiations and fall-back to the non-cooperative threat point of the divestiture relationship. The second component is represented by the cooperative division of renegotiation surplus. For the merging parties the profit function assumes

$$\pi_M^*(\theta) \equiv \pi_M^{NE}(\theta) + \frac{1}{2}G(q_M^*(\theta), \theta). \quad (4.42)$$

Accordingly, the buyer's profit function is given by

$$\pi_B^*(\theta) \equiv \pi_B^{NE}(\theta) + \frac{1}{2}G(q_B^*(\theta), \theta). \quad (4.43)$$

Now we arrive at the essential stage of the incomplete divestiture contract model where it comes to the players' incentives for restructuring investments. Since at this stage in the divestiture game, the information parameters are still unknown, restructuring investment decision are made under uncertainty, i.e. merging parties and buyer choose restructuring investments to maximize their expected total profit. Formally, merging parties optimize

$$E[\pi_M^*(\theta)|x_M, x_B] - x_M \quad (4.44)$$

and the buyer chooses x_B to find the optimal value for the expected profit from the divestiture relationship

$$E[\pi_B^*(\theta)|x_M, x_B] - x_B. \quad (4.45)$$

⁴⁶The same holds true for the case that the buyer has to pay over some fixed amount of money in order to realize gains from renegotiations.

Here too, the choice of restructuring investments has a non-cooperative character. Each player is incited to free-ride on the other parties' restructuring investments at least to some extent.⁴⁷ Thus, we determine the subgame perfect Nash equilibrium for restructuring investments, $x^{NE} = x_M^{NE}, x_B^{NE}$. In order to analyze restructuring incentives, on one hand we consider the following reduced form optimization problem of a welfare-oriented competition authority:

$$\sigma(x_M, x_B) \equiv E[\Sigma(\theta)|x_M, x_B], \quad (4.46)$$

on the other hand, we focus on the firm-individual ex ante profit functions of merging parties and buyer in the case of failing renegotiations, i.e. under the non-cooperative Nash equilibrium:

$$\vartheta_M(x_M, x_B) \equiv E[\pi_M^{NE}(\theta)|x_M, x_B] \quad (4.47)$$

$$\vartheta_B(x_M, x_B) \equiv E[\pi_B^{NE}(\theta)|x_M, x_B]. \quad (4.48)$$

Putting both results together yields the following expected profit for merging parties and buyer respectively:

$$E[\pi_M^*(\theta)|x_M, x_B] = \frac{1}{2}\sigma(x_M, x_B) + \frac{1}{2}\vartheta_M(x_M, x_B) - \frac{1}{2}\vartheta_B(x_M, x_B) \quad (4.49)$$

$$E[\pi_B^*(\theta)|x_M, x_B] = \frac{1}{2}\sigma(x_M, x_B) + \frac{1}{2}\vartheta_B(x_M, x_B) - \frac{1}{2}\vartheta_M(x_M, x_B). \quad (4.50)$$

The competition authority is aware of the fact that different ex ante asset ownership structures imply different threat points. Firm-individual non-cooperative profits $\pi_M^{NE}(\theta)$ and $\pi_B^{NE}(\theta)$ are a function of the ex ante distribution of assets and result from threat strategies. Not only firm-individual profit depend on the ex ante governance structure but also individual-firm profits $\pi_M^*(\theta)$ and $\pi_B^*(\theta)$ in the case of successful cooperative renegotiations. The reduced form representations of profit functions in both cases (4.46)-(4.48) are a function of the ex ante distribution of assets as required by the

⁴⁷Free-riding on restructuring investments in general is not assumed to be possible in a large scale since restructuring investments require rather firm-specific actions, one firm cannot accomplish for the other.

competition authority, $\vartheta_M = \vartheta_M(x_M, x_B, D_M)$ and $\vartheta_B = \vartheta_B(x_M, x_B, D_B)$. More importantly, the incentives for restructuring incentives as well are directly dependent on the assets that are allocated to a player by the competition authority as structural merger remedy. We make the the functional relationship explicit:

$$x^{NE} = x^{NE}(D_M, D_B).$$

If restructuring investments and individual non-cooperative profits are dependent on the asset allocation as prescribed by the EC, the ex ante total surplus is a function of the ownership structure $D = D_M \cup D_B$, too. Formally expressed

$$\sigma(x^{NE}(D_M, D_B)) - (x_M^{NE}(D_M, D_B) + x_B^{NE}(D_M, D_B)). \quad (4.51)$$

We suppose that the competition authority chooses an ex ante distribution of asset ownership that maximizes the expected profit and thus the value of the asset transfer.

What are the key insights from transferring Grossman and Hart (1986) to structural merger remedies?

Incomplete contracts are characterized by the assumption that ex ante agreements are not enforceable. This holds also true if we introduce DG Competition as competition authority which is in charge of monitoring ex ante divestiture contracts. Due to the parties' anticipations, the reference solution is not attainable even though the optimal asset ownership structure may be initially installed.

Merging parties and buyer invest in relationship-specific restructuring independent of the ex ante ownership structure. They both anticipate that ex post gains from renegotiations have to be shared with the competitor. Ex ante this alters restructuring incentives since the parties are not able to fully appropriate the return on their own investments. A part of the restructuring investments will increase total welfare, i.e. profits for the competitor as well. From an ex ante perspective this creates holdup within the structural merger remedy process.

Now, if the incomplete contracts approach cannot solve the holdup problem involved in the implementation of structural merger remedies, due to the impossibility to write contracts that will not be renegotiated, what is the added value of introducing structural merger remedies to the theory of incomplete contracts if the reference solution is still unattainable?

There are two reasons for the incomplete contracts approach to be theoretically valid and practically meaningful.

Firstly, the interpretation of firms as bundles of assets that can be increased via merger or decreased through divestitures is intuitive when it comes to analyzing the resulting effects on incentives to restructure under different ownership scenarios.

Secondly, the theory of incomplete contracts is powerful in the sense that optimal governance structures are determined in an endogenous way. Assume that a competition authority concludes that two assets have to be sold to a competitor for a merger to be cleared. Neglecting incentives for restructuring investments under different ownerships structures of both assets would lead to a suboptimal transfer of the assets to the last remaining competitor on the market. The application of incomplete contracts to divestitures endogenously determines an optimal distribution of assets at the point in time when the parties enter into ex ante negotiations. Possibly, taking restructuring incentives into account, it may be more efficient to transfer only a fraction of an asset to the competitor.

4.4.2 Contingent ownership structures and restructuring incentives

In this section we allow the competition authority to manipulate the ex ante distribution of ownership rights at the point in time when the merging parties and the purchaser sign a divestiture contract, thus inducing altered incen-

tives in restructuring investments.

Real world divestiture processes regularly start with the following fixed distribution of property rights over the asset to be divested: at the beginning of the divestiture process, the merging parties are exclusive owner of the asset. In the run of the process, the purchaser acquires full ownership at the asset. As a consequence of the reversion of exclusive ownership structures, incentives to invest in restructuring are completely neglected and thus prove to be suboptimal.

The theory of incomplete contracts departs from the central assumption that only ex ante different structures of property rights are legally enforceable. As will be shown in this section, this is a remarkable and powerful feature of incomplete contracts which is sufficient to improve the efficiency of restructuring investments.

Due to the fact that ex ante agreed asset ownership structures determine incentives to invest in restructuring, there may be ex ante allocations of property rights at the asset to be divested which improve on the implementation efficiency involved in divestiture processes or even establishes first-best efficient restructuring investments.

Demski and Sappington (1991) as well as Nöldeke and Schmidt (1998) have shown that contingent ownership structures involving options on asset are able to implement the reference solution in cases where rigid asset ownership distributions fail. Thus, the application of these models to divestiture processes, departing from the merging parties' exclusive ownership at the asset to be divested, is promising.

In the following we will touch on ownership options in the context of structural merger remedies and give a rough picture of the resulting impact on

restructuring investments.⁴⁸

According to Nöldeke and Schmidt (1998) and in line with the timing of divestiture processes in practice, the merging parties and the purchaser of the asset decide on the level of restructuring investments sequentially. As an important part of the model assumptions, the purchaser is able to observe the level of investments chosen by the merging parties at an earlier stage in the divestiture process.

The sequentiality of restructuring investments allows the Commission to force the parties to sign a divestiture contract which foresees an option on asset ownership for the purchaser. At the beginning of the divestiture procedure, still the merging parties are exclusive owner of the assets. At the same time, the Commission provides the purchaser with an option on asset ownership who is thus endowed with the right to buy the asset from the merging parties by paying some strike price. According to Nöldeke and Schmidt (1998), the option has to be exercised timely after the merging parties' restructuring investments and before the purchaser engages in measure that integrate the asset in her business. Under this setting, the authors have shown that the strike price can be chosen in such a way that the option induces both players to invest first-best efficiently, thereby establishing the reference solution.

We transfer this knowledge about the existence of optimal option contract inducing efficient investments to divestiture processes. The competition authority has to choose the strike price of the divestiture option such that the purchaser's option execution induces first-best efficient investments in restructuring.

Thus, contingent ownership structures involving options on asset ownership are able to solve the problem of suboptimality which is part of relationship-specific restructuring investments under rigid ex ante allocations of property

⁴⁸The exposition will be intentionally superficial, since we make extensive use of the insights of Nöldeke and Schmidt (1998) in chapter 5 of this thesis.

rights. Optimal divestiture contracts, that is binding agreements governing the implementing phase of structural merger remedies, contain ownership options where the Commission has chosen an exercise price such that execution only happens in the case of first-best restructuring investments.

Finding such an optimal divestiture contract is the result of the following backwards induction argument:

At the point in the divestiture process when the purchaser has to undertake restructuring investments, she decides on their level depending on whether she became owner of the assets via option exercise or not. If the purchaser has exercised her option earlier in the divestiture process, she will invest efficiently since in that case she is residual claimant of the returns on her restructuring investments. In the case she did not exercise the option, she is not incited to invest in restructuring at all. Option exercise implies that the purchaser has to pay the strike price over to the merging parties. Whether it is profitable to execute the option on asset ownership or not, depends on the level of the strike price ex ante chosen by the Commission, as well as on the level of restructuring investments chosen by the merging parties. The larger the merging parties' investments, the more profitable becomes the execution of the ownership option. Relating the purchaser's profit to the strike price, the Commission chooses the former in such a way that exercise is profitable for the purchaser if the merging parties have chosen the first-best efficient level of restructuring investments.

The merging parties know about the purchaser's decision problem and anticipate whether she will exercise the option on asset ownership depending on their own restructuring investments. Thus, the merging parties can either invest optimally, therefore inducing the purchaser to exercise the option, eventually choosing first-best efficient investments or they underinvest, which incites the purchaser to let the option expire and not to invest at all. Nöldeke and Schmidt (1998) have shown that under such a contingent ownership structure, the merging parties invest efficiently, thereby inducing option exercise and efficient restructuring investments by the purchaser.

To sum up, the incomplete contracts approach involving contingent ownership structures not only models investment incentives as a function of the ex ante determined distribution of ownership rights but also provides a solution to contractual relationships that require sequential and relationship-specific investments. Therefore, this modeling approach can be considered as to provide a potential solution to holdup problems in real word divestiture processes. Structural merger remedies foreseeing the transfer of assets between firms to our mind suggest the application of the theory of incomplete contracts where firms are interpreted as bundles of assets. The distribution of ownership rights determines incentives of the players at a later point in time.

We are not only convinced that the modeling comes very close to divestiture processes in practice, we believe that the solution of the empirically observed double moral hazard problem involved with restructuring investments actually can be implemented by divestiture option contracts. Apart from the fact that they theoretically implement the reference solution, divestiture options have other positive properties. Without any contingent ownership structure, a competition authority cannot influence the incentives which are involved in the asset transfer. By the integration of an ownership option, the Commission is able to determine the level of restructuring investments through the choice of a certain exercise price. Since the asset to be divested is not a traded one, it may be difficult to determine its market price, that is a fair price the purchaser has to pay for the asset. Since in the case of merger transactions divestiture objects most often have a strategic value, the price may not correspond to its value. By the implementation of a divestiture option contract, the Commission solves the problem of finding a fair price for the asset, since the price corresponds to the strike price which, chosen in an appropriate way, induces two-sided efficient restructuring investments.

Besides this, option contracts solve another very important problem which is prevalent in structural merger remedies processes: The fact that restructuring investments are unobservable. Through the implementation of option

contracts, the investments do not become observable but observability becomes irrelevant since the competition authority can observe the asset transfer. Whenever the authority finds out that the asset has been transferred, she knows that the option on asset ownership has been exercised. Since the strike price of the option has been chosen such that execution only happens if two-sided first-best restructuring investments have been undertaken, the authority deduces, whenever she observes asset transfer, that the implementation of the structural merger remedy is efficient.

The option mechanism not only has positive aspects. In order to be able to write an optimal strike price in the divestiture option contract, the authority has to know the profit functions of the players. Thus, such an implementation mechanism requires a lot of information, the competition authority might not have in practice. A mitigating factor may be that, competition authorities are endowed with the right to require the disclosure of all relevant information.

Chapter 5

A new contract-theoretical approach to divestiture remedies

Whilst chapter four intended to bring contract-theoretical models in the context of structural merger remedies, in this chapter we create the first contract-theoretical model on the efficient implementation of structural merger remedies in the literature on competition policy.

From the preceding chapter we know that interpreting firms as bundles of assets is an intuitive approach to merger remedies, where parts of assets are legally and physically transferred to the competitor. Hence, our divestiture process will be modeled under an incomplete divestiture contract. Thus, a structural merger remedy equals a transfer of ownership rights that in turn alter the incentive structure in the divestiture relationship. As we have pointed out in chapter four, the incomplete contracts approach departs from a small set of assumptions. The key assumption is that all that merging parties and purchaser can ex ante write in a binding divestiture agreement, is the ex ante distribution of ownership rights with respect to the asset to be divested.

Our analysis begins with merging parties being in exclusive ownership of the assets as is the case in real word divestiture processes. We show that the incomplete contracts approach not only finds an intuitive application with

regard to merger remedies, it also draws a detailed picture of how the asset transfer is accomplished under the Commission's implementation practice. We will show that the incomplete contracts analysis is able to reveal suboptimal incentives, i.e. double moral hazard issues, involved in restructuring investments as highlighted by the Commission's Merger Remedies Study. Since a model is always just a rough picture of reality, we focus exclusively on the divestiture process, a certain set of players and their restructuring investments.¹

Chapter 5 is organized as follows. In section (5.1) we address the legal background of our divestiture game to the extent to which it is necessary to understand the strategic interaction of the players which evolves due to standardized structural merger remedies process. We explain roughly, which players are part of the divestiture process and which are assumed to be irrelevant for our modeling purposes. Thereafter, in section (5.2) we present our divestiture game, an extensive discussion of model assumptions as well as a detailed timely structure of actions that can be undertaken by the players in the run of the divestiture process. In section (5.3) we develop the reference solution for our model which represents the benchmark for the following analysis of incentives to invest in restructuring under prevalent EC jurisdiction. Additionally, the first-best solution helps to measure the delta in restructuring investments deriving from an altered legislation which admits for more flexible solutions than under current merger law. The consecutive sections constitute important contributions of this thesis. Section (5.4) gives proof of inefficient restructuring investments which necessarily evolve under prevalent merger remedies policy. Here, we assume an incomplete contracts perspective in that merging parties and purchaser enter into the divestiture relationship with the merging parties being exclusive owner of the assets. We will show that under this distribution of equity shares in the asset to be divested, inefficient restructuring investments evolve. Based on this insight, in section (5.5) we suggest a first efficiency improvement in making further use of the theory of incomplete contracts which allows to ex ante enter into

¹Detailed model assumptions will be discussed extensively in the following sections.

divestiture contracts that exclusively determine the ex ante allocation of ownership rights with respect to the assets that have to be divested. Here, merging parties and purchaser enter a kind of joint ownership in the assets, where initially both players hold equity shares in the asset. As an interim result we find that, by implementing more flexible initial divestiture agreements compared to the case of exclusive ownership, the Commission achieves more efficient restructuring investments. In the final and most important part of our divestiture model, in section (5.6), we consider divestiture contracts where the Commission endows the purchaser with the right to acquire all equity shares outstanding via exercising an option on ownership, thus becoming exclusive owner of the asset at the closing of the divestiture process. As an important result we prove that those divestiture option contracts are able to implement first-best efficient restructuring investments. Building on the insights of section (5.5), we show that restructuring investments under shared ownership structure will be dominated by investments under remedy option contracts. As another important feature of our incomplete contracts modeling approach, we give proof that every initially chosen distribution of asset ownership rights will be renegotiated in equilibrium.

5.1 EC jurisdiction as institutional background for the divestiture game

In the following, we give proof of the inefficiency which is involved in structural merger remedies processes due to sub-optimal investments in restructuring. We postulate that the reason for underinvestments in restructuring can be traced back to the merger remedies policy as exercised by DG Competition. For this rather strong institutional criticism to be valid, we have to design a basic divestiture model which at least roughly pictures the standard divestiture process and consecutively analyze restructuring incentives within this model.

Nevertheless a model never claims to be completely realistic. Still there are

reasonable abstractions that make a divestiture model tractable. The present section intends to present the institutional background which underlies of following divestiture game. A deeper discussion of our model assumptions is part of the divestiture game in the following section (5.2).

For the purpose of being able to state policy implications based on the findings in this thesis, it is highly important to set out a divestiture game that is indeed a close image of what the EC jurisdiction dictates.

In order to build a model of the divestiture process, we need to discuss the actors and institutions that are involved as well as the assumptions made concerning the actions they can undertake at different stages of the divestiture game.²

5.1.1 The divestiture process under EC law

All divestiture decisions are based on EC jurisdiction that materializes in two main legal documents: the Merger Regulation (EC) No 139/2004 and the Commission Regulation (EC) No 802/2004 which is also called the "Implementing Regulation" and is thus of great importance for the design of the structural divestiture process.

Since the level of restructuring investments refers to issues of implementing commitments, we lay out the standard divestiture process as required by the EC.³

In most merger cases involving divestitures, commitments are offered by the parties in order to trigger a clearance decision. Normally, the implementation phase follows the clearance decision since most often those implementing

²We only focus on those actors which are relevant for our divestiture model since a more complete discussion of the whole process can be found in chapter 2.

³The following presentation refers to Commission Notice on remedies acceptable under Council Regulation (EEC) No 139/2004 and under Commission Regulation (EC) No 802/2004 published in 2007.

provisions are part of the Commission's divestiture requirements.

The Commission requires a divestiture to be completed within a previously determined time frame which is part of the divestiture agreement among the Commission and the merging parties as well as the buyer. In practice, the divestiture process has two phases:

In a first phase, the merging parties are allowed to enter into a binding agreement with some potential competitor. Here, the merging parties firstly try to find a suitable purchaser of the asset. In the case that the merging parties fail to properly sell the asset to a competitor, a divestiture trustee will be appointed who obtains the mandate to divest the assets at the lowest price possible.⁴

In a second phase, the business will actually be transferred to some suitable buyer. We call this phase "the transaction" or the transfer of the legal title from merging parties to the buyer.

This dichotomy of the divestiture process will find explicit consideration in our divestiture game since in the first phase the parties enter into a binding divestiture agreement and in the following they undertake sequential restructuring investments to prepare for the asset transfer.

In general, the Commission is incited to keep divestiture periods as short as possible since the assets to be divested are otherwise exposed to an extended period of uncertainty which gives the parties room for opportunistic behaviour. The Commission regularly allows for a six month lasting first divestiture period with additional three months in the case that a divestiture trustee has to take care of the assets. In total nine months pass by until closing of the transaction. This is a rather long time frame which gives rise

⁴One can imagine that merging parties are interested in finding a buyer who is willing to buy the assets and to engage in restructuring investments since otherwise the assets will be sold at a too low price.

to changing market conditions and unplanned actions of the players that may induce the parties to renegotiate their initial divestiture contract. The Commission is especially aware of the fact that the risk of moral hazard increases with the duration of the first divestiture period. Concretely, the Commission states: "These periods may be modified on a case- by-case basis. In particular, they may have to be shortened if there is a high risk of degradation of the business' viability in the interim period."⁵

Regularly, the divestiture period starts right after the adoption of the Commission's clearance decision under commitments. The parties sign a binding divestiture contract in the run of the merger procedure. Following the Commission's final decision, the players undertake restructuring investments and prepare for the closing of the transaction. If the merging parties and the buyer did not sign an ex ante divestiture contract before the Commission's decision but only entered in first divestiture negotiations, the Commission decides on the duration of the period for entering into a contract and final closing on a case-by-case basis.

The right choice of a purchaser is an important aspect for a structural merger remedy to be effective. Thus, independent of the merging parties' choice of a buyer, the latter is subject to the Commission's approval. If the Commission considers a purchaser to be suitable under the proposed remedies, and the divestiture contract signed between merging parties and purchaser is in line with the commitments requested, the Commission approves the divestiture to the suggested buyer. For instance, the parties have to make sure via appropriate precautions in the divestiture contract, that the purchaser herself will maintain the divested asset as a competitive force in the post-merger market. This in turn requires the purchaser to undertake restructuring investments that, by the way, hinder her to resell the assets after a short time which would not be in the sense of the Commission's decision.⁶

⁵C.f. EC Notice (2007). Commission Notice on remedies acceptable under Council Regulation No 139/2004 and under Commission Regulation No 802/2004, p. 27.

⁶A package of assets could possibly be sold to several competitors. In what follows we assume that merging parties or equivalently the divestiture trustee identify only one

Since our model focuses on the divestiture process itself, i.e. the period when the asset legally and physically will be transferred to a suitable purchaser, we lay out three alternative ways, in which assets can be transferred in accordance with the Commission and discuss which of the transaction modes comes our own modeling approach closest.

The first way of transferring a business unit or an asset to some suitable purchaser foresees that the transaction starts after the Commission's decision and will be completed within a fixed time frame.

This mode of transaction is an appropriate one in the case that several buyers meet the purchaser requirements for the business to be viable after the transaction.

In addition to the mode of transaction as just presented, the Commission could require not to complete the merger before merging parties have entered into a binding agreement with a purchaser for the assets, that has been approved by the Commission. This mode of transferring the assets is called "Up-front buyer"-remedy.

In general, the Commission applies an up-front buyer-remedy in cases that involve significant risks of asset degradation and risk of losing key personnel. The intention of requesting an up-front buyer is to make sure that commitments will be implemented in a shorter time frame. In that way, merging parties are incited to close the divestiture in order to complete their own merger.

Finally, the last category of transaction modes is the "fix-it-first"-obligation. This implies that the merging parties identify a suitable purchaser for the assets during the Commission's investigations and enter into a binding divestiture contract before the Commission adopted a decision.⁷

suitable purchaser for the assets fulfilling the Commission's requirements.

⁷In such cases, the validity of the divestiture contract is still dependent on the final decision of the Commission.

This way of transferring the asset to a suitable purchaser has certain advantages. Thus, the Commission can integrate the proposed merger remedies into her final decision on the merger.⁸ By authorizing the merger, the Commission also approves merger remedies. The closing of the transaction will thus follow shortly after the clearance decision.

As can easily be retraced, this approach will be vital in merger cases where the identity of the buyer is of paramount importance for a successful implementation of the assets as well as for effective post-merger competition.

To sum up, what is the main difference between the approaches and which one is appropriate for a sufficiently general modeling of divestiture processes? The major difference between an up-front buyer solution and the fix-it-first approach is that in the case of an up-front buyer, the identity of the purchaser is not known prior to the Commission's clearance decision. As can be imagined, in many cases, the authorization of a merger essentially depends on the purchaser of the assets. Assume the case of four firms on a market where two out of these intend to merge. Among the remaining two firms we suppose a strong asymmetry in market shares. Suppose the assets would be transferred to the firm with the greater market share. Thus, the Commission would trigger another notification since effective competition would possibly be in danger.

Hence, the mode of transaction is highly dependent on the market under consideration and the distribution of market shares. In our model we admit for two ways of divesting the assets:

- the assets will be transferred within a fixed time-frame following the Commission's decision, based on some purchaser requirements,
- the merging parties suggest some suitable purchaser in the run of merger in-

⁸A suitable purchaser is not necessarily an existing competitor. If a structural merger remedy involves a carve-out, most often, the business unit forms a stand-alone firm. Thus, through the merger a new competitor is created.

investigation entering into a binding agreement before the Commission adopts a decision.

In the following sections we will show that these divestiture processes are not able to implement first-best restructuring investments. As major contribution of this thesis we will show that this process has to be altered.

After having laid out the basic legal traits of character of a divestiture process as applied by the Commission, in the next section we focus on the actors and institutions which are involved as well as on their obligations and tasks.

5.1.2 Actors and institutions

In the Commission's merger remedies practice, a couple of institutions are involved in the process of a merger notification, investigation and implementation. Eventually, the aim of the Commission is to restore effective competition post-merger. For this to be ensured, the Commission engages third parties which ensure that the divestiture process will be completed successfully. In our model we will show that is only partially true.

Let us begin the discussion with the merging parties as initiators of the merger and the subsequent implementation phase. In the run of the divestiture process, the merging parties have to fulfill obligations that are vital for the post-merger competition to be effective. The merging parties have to prove that the assets are viable and competitive or, in the case of carve-outs, operating on a stand alone basis at the point in time when the assets are transferred to the buyer. The divestiture has to start in the interim period which means the period between the Commission's decision and the closing of the transaction, i.e. legal and physical transfer of ownership rights to the purchaser.

The Commission requires the fulfillment of the following three obligations:⁹

- (i) safeguards for the interim preservation of the viability of the assets,
- (ii) necessary steps for a carve-out process,
- (iii) necessary steps to prepare the divestiture of the business.

The interim preservation of divested assets is of paramount importance for our model since this phase often gives room for opportunistic behaviour deriving initially from merging parties.

Although it is the parties' duty to maintain the competitive potential of the assets to be divested, their incentives are exactly opposed to this requirement since it is in their best interest to hinder the future competitor. Uncertainties are inherent in the asset transfer, we therefore include stochastic in the sense of a move of nature determining the value of the business which has to be divested.

In order to reduce uncertainty, the Commission requires that the parties offer commitments that guarantee "[...] independence, economic viability, marketability and competitiveness of the business."¹⁰

Concretely, merging parties are obliged to ensure that all assets to be divested will be maintained according to common business practice. Furthermore, they have to make obvious that they will not undertake actions having negative effects on the assets to be transferred. Post-merger, the assets must be in the same condition as pre-merger, i.e. maintenance must be continued, sufficient financial resources have to be provided on the basis of ongoing business plans as well as key personnel functions in administration and management of the assets must not be altered in a significant way.¹¹

In our model we subsume these concrete actions under the rather abstract

⁹C.f. EC Notice (2007). Commission Notice on remedies acceptable under Council Regulation No 139/2004 and under Commission Regulation No 802/2004, p.29.

¹⁰C.f. EC Notice (2007). Commission Notice on remedies acceptable under Council Regulation No 139/2004 and under Commission Regulation No 802/2004, p.30.

¹¹The Commission does not accept a seller-financed asset acquisition of the buyer. This would not guarantee effective post-merger competition due to restricted independence in decision making. In our divestiture model we abstract from financing issues and assume that the buyer acquires the asset with own financial resources.

notion of restructuring investments.

The most important institution within the merger remedies and divestiture process is the European competition authority, DG Competition. Here the Merger Network is in charge of merger investigations, decision and implementation of merger remedies. The aim and the task of DG Competition is regulated by law, more precisely by the EC Merger Regulation: to only allow for mergers that, possibly under acceptable modifications, do not distort effective competition within the European Community. In cases where structural remedies are considered to be an effective remedy in order to restore effective competition post-merger, the European Commission requires according to the IR (2001/C 68/03), the engagement of an agent that is essential for the implementation of divestiture remedies.¹² The so-called "hold-separate trustee" is in charge of the interim preservation of the business to be divested.

In our model we assume that all actors engaged by the European competition authority have identical objectives and political interests. Furthermore we suppose that all activities such as merger investigation, remedies process and surveillance of implementation are centralized in DG Competition's Merger Network. Via this assumption we can neglect strategic interaction and divergent incentives within the competition authority and their trustees such as law firms, investments banks and consulting firms in charge of monitoring the divestiture process.

Surely, this approach is prone to fundamental criticism. The advantage of such an approach is that there will be a focus on restructuring investments and as will be made obvious, on the double moral hazard problems with respect to the implementation of structural merger remedies.

For the remainder of the thesis we assume risk-neutral actors. This assumption is plausible when thinking of large firms where the transaction itself

¹²C.f. IR (2001/C 68/03), Article 50 ff.

constitutes only a very little fraction of the overall asset values.¹³

The first actor entering our model will be represented by two firms planning to merge. As from now we will refer to the merging parties.¹⁴ Assuming that those two firms act as one can be justified by the fact that both have exactly the same objective function.¹⁵

The other side of the transaction is represented by the so-called potential buyer of the assets to be divested that the competition authority identified as a viable purchaser for post-merger competition.¹⁶

Independent of whether the Commission first adopts her merger decision and the allows for the divestiture process to start or whether DG Competition requires a fix-it-first remedy approach, merging parties and suitable buyer, once they are admitted to enter into a divestiture contract, will play the following divestiture game involving sequential restructuring investments.

5.2 The divestiture game

Basically, our divestiture game starts with the adoption of the Commission's decision on the merger, which is eventually conditional on the outcome of the divestiture process. Following the Commission's decision, merging parties and purchaser enter into a sequential restructuring game.

¹³In the following we treat the notions of "value of the asset" and "value of the transaction" synonymously.

¹⁴In the following modeling of mergers, we only consider horizontal concentrations.

¹⁵At a first glance, this assumption may be a critical one. Treating merging parties as one entity neglects all thinkable strategic interaction among those two firms. Surely, a richer model should account for the incentives that are involved during the period of finding a target firm and restructuring investments that happen among the parties. This kind of approach would in turn distract attention from incentives to engage in restructuring investments. A more detailed discussion of the objective function can be found in chapter 6.

¹⁶In the following, the notion of a viable competitor is considered to be equivalent to the legal notion of a suitable purchaser. See Implementation Regulation (2001/C 68/03) pp.68/5.

We assume that in the pre-divestiture period $t = -1$ some important decisions have already been adopted by the Commission. At that date, DG Competition already decided on the scope and the size of the assets to be divested as well as on the choice of a suitable purchaser of the assets who is assumed to be exclusively able to compete post-merger with the newly acquired assets.¹⁷

The strategic interaction between the players actually starts in $t = 0$. This is the point in time when the Commission adopts the decision for clearing the merger, i.e. the first divestiture period begins with a minimum duration of six months if the merging parties are able to divest the business within this time frame.

There is a very important feature of the Commission's approach to divestiture processes. As soon as the Commission adopts a merger decision which involves structural merger remedies, the merging parties are free to choose a suitable purchaser for the business to be divested within the first period. Once a suitable purchaser is found or possibly determined by the divestiture trustee, merging parties and buyer are locked in the divestiture relationship. Thus, all restructuring investments which are essential part of the transaction period until closing can be considered as to be relationship-specific. As we will show in the following, this fact will have far reaching consequences for the level of implementation efficiency. The EC thus requires a suitable purchaser to be the optimal buyer and most viable competitor after the asset has been effectively integrated in her own business.

The timing of our contract-theoretical divestiture game is as follows:

¹⁷In our model we do not intend to answer the question whether a structural remedy is effective or not nor do we discuss how the merging parties came up with the remedy under consideration. Instead we focus on the players' incentives for restructuring investments once the business to be divested has already been identified and approved by the Commission as being a valid tool to restore post-merger competition. This assumption is certainly a shortcoming of the model which should be addressed in further research.

t=0 *Clearance decision*

The clearance decision in $t = 0$ by Article 19, Implementation Regulation (2001/C 68/03), depends on the question whether a viable business will be transferred to a single suitable buyer within a contractually specified point in time.¹⁸ DG Competition will only clear the merger in the case she observes that the asset transfer actually has successfully taken place. This is the only observable variable in reality and in our divestiture model since restructuring investments can be part of the divestiture agreement but are neither fully observable for the Commission nor for hold-separate- or divestiture trustees.

In line with the European Commission's findings that in some cases the viability of the assets to be divested depends to a large extent on the buyer, we interpret all investments in order to prepare and preserve functionality, viability as well as competitiveness to be completely relationship-specific. Thus, the transaction has no value outside the relationship between the merging parties and the suitable buyer.

Therefore, the Commission requires the merging parties to enter into a binding agreement with a purchaser for the assets.¹⁹

Initially, in $t = 0$, the merging parties and the purchaser write an ex ante divestiture contract that governs their further relationship until the asset transfer is completed. At this point in time, there is a monetary outlay, $C \geq 0$, which accrues exclusively to the merging parties. These costs are fixed and can be interpreted as cost of contract initiation including all the fees being paid to law firms writing the notification which is obligatory for merger investigation as well as search cost to find a suitable purchaser and efforts that are necessary to find remedies that are able to clear competition concerns.

¹⁸See paragraph 49 for purchaser standards.

¹⁹See Article 20, Implementation Regulation (2001/C 68/03) and Commission Decision of 13 December 2000 (COMP/M.2060 - Bosch/Rexroth).

t=1 *Merging parties' restructuring investments*

At date $t = 1$, the merging parties invest in restructuring, i.e. in the preparation of the assets for the transfer.²⁰

The level of restructuring investments is given by $x_M \in \mathbb{R}_0^+$. In general we assume the merging parties' restructuring investments to be non-verifiable for the Commission but to be observable for the purchaser.²¹

t=2 *Renegotiations*

Since we assume restructuring investments to be observable for the potential buyer but not to be verifiable for the competition authority, in $t = 2$ the parties may find it beneficial to renegotiate the originally contracted ownership structure which foresees that the merging parties enter into the divestiture process as legal and physical owner of the assets.

At this point in time, the purchaser can observe the level of restructuring investments chosen by the merging parties. Depending on the level of these investments, the purchaser considers whether to acquire full ownership of the asset to be divested. If the merging parties' investments are sufficient from the purchaser's perspective, as a result of renegotiations she becomes owner of the asset, thus inducing the asset transfer. The change in the allocation of ownership rights is assumed to be observable for the competition authority, which induces her to eventually clear the merger in case the asset has been transferred to the purchaser. For the Commission it is sufficient to be able to observe whether the asset has been transferred or not, since she knows, the purchaser, being made residual claimant of her own restructuring investments, invests in a first-best efficient manner.

In the case of failing renegotiations, the purchaser rejects asset ownership, thus inducing a prohibition decision by the competition authority. Obviously,

²⁰The assets have to be maintained according to previously presented Commission Notice on remedies acceptable under Council Regulation No 139/2004 and under Commission Regulation No 802/2004, until they are finally ready to be transferred to the competitor.

²¹It appears to be quite obvious that the merging parties do not have the right incentives to choose the efficient investment level since they give the asset away to a competitor.

the merging parties' level of investments is critical for the purchaser's decision on restructuring investments. By consequence, the success of the asset transfer and therefore the merger decision is depend on the level of two-sided investments influencing the value of the transaction.

t=3 *Purchaser's restructuring investments*

Depending on preceding renegotiations of the asset ownership structure, the potential buyer invest $x_B \in \mathbf{R}_0^+$ in $t = 3$. Again, we assume that the purchaser's restructuring investments are only observable for the merging parties but not for the Commission.

t=4 *Nature reveals information parameter*

In $t = 4$ nature draws an information parameter θ from a continuous distribution function $F(\theta)$ which is defined on $[\underline{\theta}, \bar{\theta}]$ where $\underline{\theta} < \bar{\theta}$. The random variable θ reflects various market conditions that influence the value and thereby the success of the asset transfer. Besides restructuring investments of the merging parties and the buyer, θ determines the value of the transaction $\tilde{V}(x_M, x_B, \theta)$.

In contrast to our introductory contract-theoretical modeling in chapter 4, where merger initiation costs C were subject to uncertainty, here we depart from the assumption that only the value of the asset is dependent on the information parameter θ . There is another important difference in the modeling of uncertainty. In the preceding chapter we assumed that restructuring investments have purely direct intrinsic impact on the merger initiation cost and value of the transaction. Merging parties could exclusively influence the statistical distribution of merger initiation cost $F(C|x_M)$ by investing in restructuring. The purchaser in contrast could positively alter the statistical distribution of the asset value $F(V|x_B)$ by choosing higher levels of restructuring investments without having impact on the value of merger initiation costs.

In the present modeling we assume that only the distribution of the asset

value can be influenced by both-sided restructuring investments admitting the merging parties' investments to have a direct positive impact on its value, i.e. $F(V|x_M, x_B)$.

t=5 *Closing of the transaction and payoffs*

The stylized divestiture process ends at this point in time. Here, payoffs are realized and the transaction will be closed. Later, we will admit for more flexible divestiture processes that involve options on asset ownership. At this stage, the buyer, in the case she was made owner of an option on asset ownership by the competition authority, she may exercise her right depending on the underlying value of the transaction.

The timing of events in our divestiture model is as depicted in Figure 5.1.

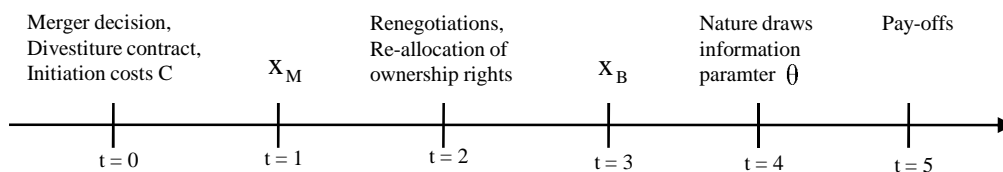


Figure 5.1: The divestiture game

We already mentioned some assumptions concerning the informational structure of the game. Additionally, we assume that the merging parties as well as the potential purchaser have complete information throughout the divestiture process. Since divestiture contracts are incomplete, the Commission cannot enforce the parties to write a contract that enforces first-best restructuring investments. The reason is that x_M and x_B are not verifiable for the Commission. Due to the informational advantage of the parties over the competition authority, the terminal asset value $\tilde{V}(x_M, x_B, \theta)$ is private knowledge of both merging parties and purchaser. Thus, the value of the transaction is not contractible in a binding divestiture agreement.²²

²²Contract Theory teaches us that in general it is not possible to write contracts on variables that are private knowledge. For a detailed discussion of incomplete contracts we

In our divestiture model, we restrict attention to different initial divestiture contracts that are written between merging parties and purchaser under the Commission's observance. Different initial divestiture contracts will have different impacts on the players' incentive for restructuring. Thus, leaving the traditional view that the merging parties have to enter the divestiture process as exclusive legal and physical owner of the assets, gives room to improved restructuring incentives and therefore to much more efficient divestitures than under prevalent EC merger policy.

Initially incomplete divestiture contracts ex ante define a distribution of asset ownership rights among merging parties and purchaser. Under prevalent merger policy, the Commission foresees to start the divestiture process with merging parties being in full ownership of the assets. Admitting for more flexible ownership structures not only may improve restructuring incentives, this interpretation is also completely in line with the incomplete contracts paradigm, which says that only the distribution of ownership structure is ex ante contractually enforceable.

Now, what is meant by the notion of "flexible ownership structures"?

We assume that the Commission admits for the divestiture process to be started with both, merging parties and purchaser being legal owner of the assets, allowing for the ownership rights to be fully transferred to the purchaser within the divestiture process as a result of renegotiations. That is, the purchaser is ex ante made partial owner of the divestiture. Later on, we allow for even more flexible ownership structures, where the Commission endows the purchaser with an option-to-own the assets, where the execution of the option is a function of the underlying asset value, which in turn depends on the stochastic parameter θ as well as on the players' restructuring investments (x_M, x_B) .

recommend Demski and Sappington (1991), Edlin and Hermalin (2000) and Nöldeke and Schmidt (1998).

In order to be precise, we have to discuss the notion of ownership in more detail. Especially in the case of structural merger remedies, there can be a timely inconsistency between the legal acquisition of ownership rights in the sense that the purchaser becomes holder of equity stakes in the assets and the point in time, when the asset factually and physically will be transferred to the purchaser. This inconsistency cannot be overstated, since this is exactly the reason for the prevalence of moral hazard problems in the divestiture process.

For our following divestiture model we assume that, according to the incomplete contracts paradigm, initially the Commission enforces some ownership structure, i.e. the merging parties and the purchaser are endowed with legal positive fractions of equity stakes. Given this ownership distribution, they start with sequential restructuring investments. The ex ante ownership structure is logically decisive for the parties' incentives to invest in restructuring. Restructuring investments in turn influence the value of the transaction. The success of the divestiture and thus of the merger endeavor is fully depending on whether the asset will be physically transferred to the purchaser in a for the Commission observable manner.

In the case that the Commission entitles both, merging parties and purchaser with ownership rights at the divestiture from the beginning of the divestiture process, we admit so-called "joint ownership-structures" where merging parties and purchaser hold positive fractions of equity shares in the asset. This view is not completely new since it traces back to the literature of incomplete contracts and their application to joint ventures.²³ In line with the incomplete contracts approach, we can interpret the transaction as a bundle of physical assets of which ownership rights will be legally divided by the Commission in a way she wants to regulate incentives for restructuring investments.²⁴

²³The assumptions on the distribution of information in our model finds application in Lüllesmann (2004).

²⁴An alternative interpretation would be that nature randomly determines exclusive ownership rights after both parties engaged in restructuring investments.

Ex ante, the expected value of the underlying asset or the transaction amounts to

$$E[\tilde{V}(x_M, x_B, \theta)]$$

for any restructuring investments undertaken by merging parties and purchaser. For the model to be technically tractable, in the following we have to postulate some important assumption with respect to the functional behavior of the asset value. In line with Nöldeke and Schmidt (1998), we depart from the following set of assumptions:

Assumptions (i) - (iii): The value of the asset transaction $\tilde{V}(x_M, x_B, \theta)$ is twice continuously differentiable, strictly increasing in the arguments x_M and x_B strictly quasi-concave, and satisfies the following technical conditions:

(i) $\tilde{V}(x_M, x_B, \theta) = V(x_M, x_B, \theta) + \omega$ and $E[\tilde{V}(x_M, x_B, \theta)] > 0$ for all $(x_M, x_B) \geq 0$.

(ii) $\frac{\partial^2 V(\cdot)}{\partial x^2} < 0$, $\lim_{x \rightarrow 0} \frac{\partial V(\cdot)}{\partial x} = \infty$ and $\lim_{x \rightarrow \infty} \frac{\partial V(\cdot)}{\partial x} = 0$ for $x \in \{x_M, x_B\}$.

(iii) $\frac{\partial V(\cdot)}{\partial x_M \partial x_B} > 0$ for all (x_M, x_B) .

Under assumption (i), the transaction yields a positive expected net value. This assumption is critical since it implies that the merger creates substantial synergies that partially have to be passed on to the purchaser because he could block the asset transfer and therefore render the merger impossible. Later we will discuss the question of how much bargaining power the parties actually have when it comes to the distribution of the realized value of the transaction. The surplus is stochastic and enters the expected net value in an additive way which is a simple and convenient way to model uncertainty.

Assumption (ii) contains the "Inada conditions" meaning that positive but finite restructuring investments maximize surplus from the asset transfer.

The final assumption (iii) is of paramount importance since it addresses the nature of restructuring investments necessary to realize the transaction.

In our model restructuring investments of both parties are assumed to be complementary in a marginal sense. The reason is that the buyer cannot undertake restructuring investments in the place of the merging parties in order to prepare for the asset transfer, and vice-versa. This is not a purely technical assumption but mirrors real divestiture processes since firms are neither able nor allowed to manipulate the competitor's internal processes. If we did not depart from the assumption of complementary restructuring investments, we would have difficulties in defending the proposition that those investments are highly relationship-specific. Thus, both-sided individual restructuring investments are required by the Commission. To be precise, the transaction only adds value if both parties undertake actions on each side.

After having addressed the main model assumptions, in the following section we present the reference solution to our model based on the preceding presentation of a divestiture process under EC law. The reference solution will play a central role for the further analysis since first-best restructuring investments evolve which serve as benchmark for the proof of inefficiency under prevalent EC jurisdiction and for the level of efficiencies attainable under alternative ex ante allocations of ownership rights.

5.3 First-best efficient restructuring investments

For the following proof of inefficient restructuring investments, and as a benchmark for upcoming alternative divestiture contracts that admit for more flexible ownership structures, we first present the reference solution which provides first-best restructuring investments (x_M^*, x_B^*) .

If the divestiture contract was complete and the Commission had perfect information with respect to asset value and the level of restructuring invest-

ments, the authority would implement the socially optimal solution. Concretely, the Commission would require first-best efficient restructuring investments by merging parties and purchaser. Due to perfect information, the Commission could observe any breach of divestiture contract and thus prohibit the merger in the case that either one or both of the players chose a sub-optimal level of restructuring investments.

Hence a perfectly informed Commission chooses the efficient level of restructuring investments thereby maximizing the ex ante surplus resulting from the asset transfer, i.e.

$$\Sigma(x_M, x_B) \equiv E[\tilde{V}(x_M, x_B, \theta)] - x_M - x_B - C.^{25} \quad (5.1)$$

For the model to be meaningful and for the divestiture process to be initiated, we assume that it is economically efficient for the parties to merge in the light of the merger initiation costs C that amount due to notification, contract initiation, engagement of hold-separate- and divestiture trustees i.e. the value of the transaction exceeds the cost of initiating the transaction:

$$V(x_M, x_B) > C.^{26}$$

Therefore, a perfectly informed Commission implements strictly positive efficient restructuring investment levels (x_M^*, x_B^*) which are uniquely defined

²⁵Please note the difference to the model from section 4.3, where the gains deriving from the asset transfer are described by $\Sigma(x_M, x_B) \equiv E[(\tilde{V} - C)q^*(V, C) - x_M - x_B]$. In our divestiture model, we do not explicitly model the allocative decision as a separate stage in the divestiture game, i.e. the social surplus function collapses to $\Sigma(x_M, x_B) \equiv E[(\tilde{V} - C)(x_M, x_B, \theta)] - x_M - x_B$. Nevertheless, in our model the Commission will decide against or for merger clearance depending on whether the asset will be transferred to the purchaser in the run of the divestiture process. The asset transfer in turn depends on restructuring investments. Thus, the allocative decision is indirectly endogenous in our model. Since C is independent of the nature's draw θ , we can treat merger initiation costs as a constant, i.e. $\Sigma(x_M, x_B) \equiv E[\tilde{V}(x_M, x_B, \theta)] - C - x_M - x_B$.

²⁶Cost of merger initiation represent fixed cost. In general, the merger is profitable if the expected synergy gains surmount the fixed costs of setting the merger up. A huge part of the costs are allotted to law, consulting and investment firms which prepare for the merger.

by the following first-order conditions:

$$\frac{\partial V(x_M^*, x_B^*)}{\partial x_M} = 1 \quad \text{and} \quad \frac{\partial V(x_M^*, x_B^*)}{\partial x_B} = 1.$$

Proposition (B): *First-best restructuring investments (x_M^*, x_B^*) are uniquely defined by the first-order conditions*

$$\frac{\partial V(x_M^*, x_B^*)}{\partial x_M} = 1 \quad \text{and} \quad \frac{\partial V(x_M^*, x_B^*)}{\partial x_B} = 1.$$

Proof

Let $f(\cdot)$ be the value function of the following unconstrained maximization problem:

$$\max_{x_M \in R_0^+} \Sigma(x_M, x_B) \equiv E[\tilde{V}(x_M, x_B, \theta)] - x_M - x_B - C. \quad (5.2)$$

That is, $f(x_B)$ is the value attained by $\Sigma(\cdot)$ at a solution to optimization problem (5.2) if the parameter is x_B . Assume $f(x_B)$ to be well-defined in the neighborhood of some reference parameter vector $\bar{x}_B \in R_0^+$. With the help of the envelope theorem we will investigate marginal effects of changes in x_B on the value $f(x_B)$.

Further we assume that locally, that means for values of x_B close to \bar{x}_B , the solution to (5.2) is a differentiable function $x_M(x_B)$. We can then write $f(x_B) = \Sigma(x_M(x_B), x_B)$.

By the chain rule we have

$$\frac{df(\bar{x}_B)}{dx_B} = \frac{\partial \Sigma(x_M(\bar{x}_B), \bar{x}_B)}{\partial x_B} + \frac{\partial \Sigma(x_M(\bar{x}_B), \bar{x}_B)}{\partial x_M} \frac{dx_M(\bar{x}_B)}{dx_B}. \quad (5.3)$$

Note that by the first-order conditions for unconstrained maximization, we must have $\frac{\partial \Sigma(x_M(\bar{x}_B), \bar{x}_B)}{\partial x_M} = 0$.

Therefore the chain rule simplifies to

$$\frac{df(\bar{x}_B)}{dx_B} = \frac{\partial \Sigma(x_M(\bar{x}_B), \bar{x}_B)}{\partial x_B}. \quad (5.4)$$

The fact that $x_M(x_B)$ is determined by maximizing the function $\Sigma(\cdot, x_B)$ has the implication that in computing the first-order effects of changes in x_B on the maximum value, we can equally well assume that the maximizer will not adjust: the only effect of any consequence is the direct effect.

Now assume $\bar{x}_B = x_B^*$. We then have

$$\frac{df(x_B^*)}{dx_B} = \frac{\partial \Sigma(x_M(x_B^*), x_B^*)}{\partial x_B} = 1. \quad (5.5)$$

The same holds true for problem

$$\max_{x_B \in R_0^+} \Sigma(x_M, x_B) \equiv E[\tilde{V}(x_M, x_B, \theta)] - x_M - x_B - C. \quad (5.6)$$

Q.E.D.

Following the merging parties' investments in restructuring, the purchaser faces the following continuation gains from the asset transfer:

$$\Sigma'(x_M(\bar{x}_B)) = E[\tilde{V}(x_M, x_B, \theta)] - x_B.$$

Given the buyer observes restructuring investments x_M chosen by the merging parties, let $x_B^R(x_M) = \arg \max_{x_B} \Sigma'(x_M(\bar{x}_B))$ be the purchaser's best response function which gives her optimal investment level for any restructuring investments x_M chosen by the merging parties earlier in time.

In the above depicted reference model, the buyer will chose efficient investments whenever she observes $x_M = x_M^*$, i.e. $x_B^R(x_M^*) = x_B^*$. Thereupon, the purchaser will choose $x_B^R(x_M)$ in the light of acquiring full asset ownership which makes her residual claimant of her own investments in restructuring at stage $t = 5$.

In chapter 4 we saw that the attainability of first-best efficient restructuring investments essentially depends on the design of the renegotiation game. In our divestiture model, we depart from the assumption that possible gains from renegotiations will be shared cooperatively among the players accord-

ing the Nash bargaining solution.

Basically, we assume that the players are free to renegotiate the initial divestiture contract whenever they want to. We will show that in fact renegotiations will only occur after merging parties have invested in restructuring and before the purchaser undertakes her own investments. Renegotiations arising at points in time different from $t = 2$ are not part of the equilibrium path. At any later stage in the divestiture process, renegotiations will not alter the ex ante allocation of ownership rights and thus have no impact on restructuring investments. If renegotiations have no influence restructuring investments, they are worthless and do not alter the value of the transaction.

It is important to notice that alternative ex ante ownership structures do not have an impact on the value of the asset to be divested per se. Only the level of restructuring investments, (x_M, x_B) , and their impact on renegotiations influence the value of the transaction.

In line with Nöldeke and Schmidt (1998), we assume that the outcome of renegotiations is given by the Nash bargaining solution. Therefore, efficiency gains exceeding the individual threat payoffs that will be triggered in case of failing renegotiations, will be shared in a linear way in $t = 2$, where the merging parties' bargaining power amounts to $\alpha \in [0, 1]$ and the buyers accordingly to $(1 - \alpha)$.

For the remainder of this chapter we compare different asset ownership structures as required by the Commission in the form of a structural remedy with the preceding benchmark case and try to answer following central question:

Under which allocation of ownership rights, as defined in an ex ante binding divestiture agreement, is the Commission able to incite first-best restructuring investments?

For this question to answer, we take the following approach:

We analyze different asset ownership structures, the Commission prescribes at the beginning of the divestiture process, i.e. in $t = 0$. We will show that for all thinkable ex ante ownership structures the purchaser will choose the efficient restructuring investments conditional on the merging parties' choice of restructuring investments. After the merging parties have engaged in restructuring investments, both players are incited to renegotiate the initial divestiture contract in order to realize maximum continuation gains. In order to realize gains from renegotiations, the initial ownership structure will be altered as a result of renegotiations. The players will agree to the distribution of asset ownership rights which induces the purchaser to maximum restructuring investments. For the buyer to have optimal incentives for restructuring investments, in equilibrium she must become exclusive owner of the assets before she starts to invest in restructuring. As a result, she only invests efficiently if she can fully appropriate the returns on her investments.

In the next section we analyze the standard case of EC divestitures where merging parties enter the transaction with the purchaser being sole legal owner of the assets to be divested, i.e. they hold all equity shares in the asset. We will show, that under this asset ownership structure the merging parties will not be incited to invest in restructuring in an efficient way but underinvest.

5.4 Proof of inefficient restructuring investments under EC jurisdiction

In what follows, we analyze investment incentives that derive from the Commission's current jurisdiction and best practice in merger remedies. We will show that, whenever merging parties and a purchaser have to invest sequentially in order to implement structural merger remedies, we will not observe first-best investments by merging parties in the case that no formal divestiture contract is written.

Trivially, at the beginning of each structural divestiture process, the asset to be divested is physically in the hands of one of the two merging parties. As a starting point, we assume that merging parties are not only physically but also legally exclusive owners of the assets at date $t = 0$ when the divestiture process starts.²⁷

If the Commission admits the merging parties to enter into the divestiture process being exclusive owner of the asset to be divested, they engage in restructuring investments x_M at date $t = 1$. The purchaser will invest in restructuring in a conditionally efficient way, i.e. $x_B^R(x_M)$, whenever she anticipates that after renegotiations she will become residual claimant of her own restructuring investments in $t = 2$. Since the merging parties know the purchaser's best response function, both players have a common interest in renegotiations to be successful. The merging parties know that the purchaser only invests efficiently in the case she becomes full asset owner as a result of renegotiations. Thus, merging parties agree to transfer the asset to the purchaser.

Knowing that the purchaser will invest conditionally efficient is simply a matter of her anticipation of becoming residual claimant. In the following we have to analyze the merging parties' incentives to invest in restructuring under initially exclusive asset ownership. In order to show that under this institutional setting, in equilibrium, the merging parties will not have first-best incentives to prepare the assets for sale, we have to determine the merging parties' payoff in the case of failing renegotiations in $t = 2$.

A scenario of failing renegotiations is critical due to the fact that in our

²⁷Assuming the purchaser to be exclusive owner of the assets at the point in time when the divestiture contract is written, is thinkable only if she is made legal owner, i.e. all equity shares will be transferred before restructuring investments are undertaken. Nevertheless, in $t = 0$ the asset is physically in the merging parties' hands, i.e. the value of the asset is still dependent on both-sided restructuring investments. If the Commission made the purchaser ex ante legal owner of the assets, merging parties would not invest in restructuring at all, since there would be no renegotiations through which they could appropriate returns from their restructuring investments.

model this implies that the purchaser will not invest in restructuring at all since the asset will not be transferred. Thus, the merging parties remain owner of the assets, the merger will not be cleared and synergy gains remain uncovered. In case the Commission blocks the merger, the merging parties end up with the no transfer payoff $V(x_M, 0)$.

Therefore, the merging parties have a vital interest in successful renegotiations and consecutive asset transfer. Thus, in equilibrium we will always observe a transfer of ownership rights from merging parties to purchaser.

In $t = 2$, as part of the equilibrium path, merging parties and the purchaser will renegotiate and subsequently transfer the asset. At this point in time, the purchaser acquires the asset at a price

$$\begin{aligned} \Gamma(x_M) &\equiv E[\tilde{V}(x_M, 0, \theta)] & (5.7) \\ &+ \alpha \left[E[\tilde{V}(x_M, x_B^R(x_M), \theta)] - x_B^R(x_M) - E[\tilde{V}(x_M, 0, \theta)] \right]. & (5.8) \end{aligned}$$

Obviously, the purchaser has to make a transfer payment which consists of the merging parties' payoff in the case of failing renegotiations, i.e.

$$E[\tilde{V}(x_M, 0, \theta)]$$

plus the merging parties' share α of surplus from renegotiations, i.e.

$$\alpha \left[E[\tilde{V}(x_M, x_B^R(x_M), \theta)] - x_B^R(x_M) - E[\tilde{V}(x_M, 0, \theta)] \right]$$

where

$$E[\tilde{V}(x_M, x_B^R(x_M), \theta)] - x_B^R(x_M) - E[\tilde{V}(x_M, 0, \theta)]$$

represents total gains from transferring the asset to the purchaser who invests in restructuring conditionally efficient whenever she anticipates asset ownership as a result from renegotiations.

The merging parties are supposed to propose this transfer payment $\Gamma(x_m)$ to

the purchaser and to the Commission who will approve to the price of the asset, whenever it induces the purchaser to invest optimally. Since renegotiations are part of the equilibrium path, the asset will be transferred and the purchaser will choose a conditionally efficient level of restructuring investments.

The Commission is able to observe this price structure and knows about the purchasers incentives to invest conditionally efficient in the light of future asset ownership and thus she will accept the merging parties' price policy $\Gamma(x_M)$.

Under the assumption that ex ante the present value of synergy gains deriving from the concentration exceed the cost related to the transaction, i.e.

$$E[\tilde{V}(x_M, x_B^R(x_M), \theta)] > C,$$

the merging parties will choose x_M in a way that it maximizes her payoff function in $t = 1$:

$$\begin{aligned} \Pi_M(x_M) &= E[\tilde{V}(x_M, 0, \theta)] \\ &+ \alpha \left[E[\tilde{V}(x_M, x_B^R(x_M), \theta)] - x_B^R(x_M) - E[\tilde{V}(x_M, 0, \theta)] \right] \\ &- x_M - C. \end{aligned}$$

Obviously, the merging parties' profit function is a reduced-form of the following stages in the divestiture game, since it integrates the purchaser's best-response function x_B^R . This is due to the fact that the merging parties have perfect information of the purchaser's optimization problem and can thus take it into account while choosing their optimal level of restructuring investments.

Hence, in $t = 1$, the purchaser chooses her optimal investment level x_M^R . The merging parties' optimal level of restructuring investments x_M^{NE} in equilibrium are implicitly defined by the first-order condition of the merging

parties' profit function:

$$\frac{\partial \Pi_M(x_M)}{\partial x_M} = 0 \Leftrightarrow \quad (5.9)$$

$$(1 - \alpha) \frac{\partial V(x_M^{NE}, 0)}{\partial x_M} + \alpha \frac{\partial V(x_M^{NE}, x_B^R(x_M^{NE}))}{\partial x_M} = 1 \quad (5.10)$$

This optimality condition leads to the following central proposition of this thesis regarding the efficiency of restructuring investments under prevalent jurisdiction.²⁸

Proposition (C): *Whenever merging parties enter into a divestiture process being in full legal and physical ownership of the asset to be divested, the merging parties will not engage in first-best restructuring investments within the process of divestiture unless they possess all bargaining power, i.e. $\alpha = 1$. Conversely, for every bargaining power of merging parties $\alpha < 1$, they underinvest in restructuring, eventually triggering inefficient divestitures since the purchaser acquires ownership of the asset after she has observed the merging parties' restructuring investments x_M^{NE} . Given x_M^{NE} she will choose a conditionally efficient level of restructuring investments $x_B^R(x_M^{NE})$ which is lower than first-best investments x_B^* , i.e.*

$$x_B^R(x_M^{NE}) < x_B^*.$$

Proof

If $\alpha = 1$ then the first-order condition (5.10) collapses to

$$\frac{\partial V(x_M^{NE}, x_B^R(x_M^{NE}))}{\partial x_M} \Big|_{x_M^{NE}=x_M^*} = 1 \quad (5.11)$$

which is equal to the first-best conditions as deduced in proposition (B). From this it follows that for any $\alpha < 1$ the merging parties will choose inefficient restructuring investments, i.e. $x_M^{NE} < x_M^*$. Since the purchaser invests con-

²⁸This proposition is not completely new. It has been first proposed in a similar way by Nöldeke and Schmidt (1998) and is applied in Lülfsmann (2004) in the context of sequential investments in research collaborations.

ditionally efficient, she also will invest in restructuring in a sub-optimal way, i.e. $x_B^{NE} = x_B^R(x_M^{NE}) < x_B^$. By consequence merging parties and purchaser underinvest in restructuring in Nash equilibrium whenever the merging parties enter into the divestiture process as exclusive owner of the asset to be divested.*

Q.E.D.

Summarizing the result of proposition (C) we conclude that, if prevalent merger law prescribes to sign initial divestiture contracts where at the beginning of the divestiture process, merging parties invest in restructuring being sole owner of the asset to be divested, then both agents, the merging parties as well as the purchaser will not invest efficiently.

More precisely, if merging parties enter renegotiations holding all equity shares in the asset to be divested, they will underinvest unless they have unify all bargaining power. Being in possession of all bargaining power implies that merging parties could appropriate all gains from renegotiations and thus enjoy full return on her own restructuring investments.²⁹

Technically expressed, the merging parties' marginal return on restructuring investments in the case of failing renegotiations are much lower than efficient compared to the case of successful renegotiations that imply an asset transfer and subsequent restructuring investments by the purchaser, i.e.

$$\frac{\partial V(x_M^{NE}, 0)}{\partial x_M} < \frac{\partial V(x_M, x_B^R(x_M))}{\partial x_M}.$$

There are two main reasons for the difference in the merging parties' incentives for restructuring:

Firstly and most importantly, in the case that renegotiations fail, the purchaser will reject the asset transfer and deny restructuring investments at all. Secondly, restructuring investments are complementary by assumption. In

²⁹Since we assume that gains from renegotiations are shared among the actors according to the generalized Nash Bargaining solution, we have $\alpha = 1/2$. Thus merging parties anticipate the transfer of the asset to the purchaser as a result from renegotiations, not being able to reap all returns on investment. This validates proof of proposition (C).

the case of anticipated successful renegotiations, positive restructuring investments by the purchaser increase the merging parties' incentives to invest in restructuring.

The assumption $\alpha < 1$ is not only a purely technical one but has realistic economic background. In most merger cases, there is only a small set of suitable purchasers from which merging parties can choose. The structural merger remedy chosen by the merging parties and suggested to the Commission depends on the future competitor, which should buy the asset. In most cases the purchaser is irreplaceable; in all other cases changing the purchaser generates substantial additional costs. In other words, merging parties do not unify all bargaining power since they are prone to the purchaser's relationship-specific restructuring investments for the merger to be successful.

Following their investments in restructuring, the merging parties are willing to enter into renegotiations with the purchaser in order to transfer the asset and thus trigger the Commission's clearance decision. They are thus not independent of the purchaser's decision and will offer a substantial part of gains from renegotiations, i.e. $\alpha < 1$.³⁰

To sum up the key findings in the present section: given our incomplete contracts approach to the Commission's divestiture process, we found out that the merging parties' payoff function is a convex combination of their restructuring investments in the case of failing renegotiations and their equilibrium investments. This linear combination of marginal restructuring investments in default and marginal investment incentives complementary to the purchaser's investments, weighted by the bargaining power parameter α shows that first-best efficient restructuring investments are not feasible unless the merging parties have all bargaining power in renegotiations.

³⁰In other words, the merging parties' marginal return from investments is far smaller in the case of blocked merger payoff than it would be efficient because the restructuring investments of both, merging parties and purchaser are assumed to be complementary on the margin.

In the following section, we try to find a first improvement of incentives in restructuring incentives by analyzing contractual agreements between merging parties and the purchaser that alter ex ante control rights in the asset to be divested and therefore change the incentive structure to prepare the assets for sale and post-merger integration.³¹

³¹In contract-theoretical terms, we try to find ownership structures that improve the merging parties' incentives for more efficient restructuring investments which induce improved investments by the purchaser as a result of her conditional efficient best-response function.

5.5 Ex ante shared ownership structures and improved investment incentives

In contrast to prevalent jurisdiction of the European Commission, we now suppose that the merging parties are forced to sell a fraction $\lambda \in [0, 1]$ of control rights of the asset that has to be divested to the purchaser thus holding the remaining equity shares $(1 - \lambda)$.

In the previous chapter we observed both-sided inefficient restructuring investments under an ownership structure where the merging parties enter the divestiture game as sole owner of all control rights. In the presence of the purchaser's ex ante participation in returns on restructuring investments, we expect even lower investment incentives of the merging parties. Under this distribution of ownership rights, the initial divestiture agreement, the merging parties are contractually not able to fully appropriate their returns on restructuring investments.

In this section we show that it is an erroneous assumption to believe that an ex ante participation of the purchaser in the asset to be divested would even lower the merging parties' investment incentives. An ex ante shared ownership is capable to induce the merging parties to invest more in the restructuring process compared to the status quo case. The economic intuition of this finding is that the purchaser cannot deny in a credible way to invest when renegotiations on the asset transfer fail. Knowing this, the merging parties' payoff in case of failing renegotiations raises and thus their marginal incentives to invest in restructuring increase as well.

As a result of the altered initial ownership regime as dictated by the Commission and due to renegotiations, in equilibrium, the asset will be transferred to the purchaser who eventually acquires sole ownership thereby inducing merger clearance. Concretely, as a result of successful renegotiations, the merging parties transfer their shares in the asset to the purchaser, such that in $t = 3$, when it comes to the purchaser's restructuring investments, the

latter is exclusive owner of the asset. By the closing of the transaction, the asset transfer will be not only legally but also physically completed.

Under this flexible ownership structure, renegotiations allow the purchaser to appropriate all of her returns on restructuring investments. In other words, by finding an institution or some certain allocation of ownership rights which makes the buyer residual claimant of her own restructuring investments, thus being induced to invest conditionally efficient, i.e. $x_B^R(x_M)$, both actors in the end can increase the shared continuation payoff $\Sigma'(x_M(\bar{x}_B)) = E[\tilde{V}(x_M, x_B, \theta)] - x_B$.

Although we know from backwards induction logic that only successful renegotiations are part of the equilibrium path, we have to calculate the players default payoffs that arise in the case of failing renegotiations. It is precisely the knowledge of both actors about the default payoff which makes unsuccessful renegotiations an event out of the equilibrium path.

For convenience, we start to determine the buyer's default restructuring investments. In the event that renegotiations fail, the asset will not be transferred to the competitor and thus the merger will be prohibited by the European Commission.

If the merging parties undertake restructuring investments x_M in $t = 1$ but the asset will not be transferred to the buyer at date $t = 2$, then the buyer chooses to maximize her continuation payoff according to her share λ in the assets, i.e. formally

$$\Pi'_B(x_M, x_B) = \lambda E[\tilde{V}(x_M, x_B, \theta)] - x_B. \quad (5.12)$$

Obviously, the buyer's optimization problem is independent of bargaining power. We assume the existence of a unique solution to this problem: $x'_B(x_M, \lambda)$ which represents the optimal continuation investments for the purchaser. The buyer's optimal restructuring investments in case of failing

renegotiations $x'_B(x_M, \lambda)$ are implicitly defined by the first-order condition

$$\lambda \frac{\partial V(x_M, x'_B(x_M, \lambda))}{\partial x_B} = 1. \quad (5.13)$$

According to our assumptions, the buyer's default restructuring efforts are strictly positive for positive values of shares in the assets, i.e. $\lambda > 0$. In other words, a divestiture contract which foresees a non-trivial distribution of ex ante shares, i.e. $\lambda > 0$ in the assets, induces the purchaser to invest in restructuring in the presence of failing renegotiations. The reason is, that under this initial divestiture contract, she is able to acquire a positive fraction of the total marginal return on the sum of restructuring investments by the merging parties and herself.

The purchaser's default restructuring investments are a monotonically in λ and may reach the conditionally efficient level, i.e. $x_B^R(x_M)$ in the case that the initial divestiture contract turns her into exclusive owner of the assets, $\lambda = 1$ right before she engages in restructuring investments.

What happens to the purchaser's marginal incentive to invest in restructuring being initially partial owner, given the merging parties undertake infinitesimal changes in their restructuring investments?

This question will prove to be of great importance when it comes to compare divestiture contracts which depart from the inefficient case as presented in the preceding section.

The answer involves an analysis of the marginal incentives to invest in restructuring:

The purchaser's choice of restructuring investments under the partial asset ownership regime, in case of default, reacts on infinitesimal small changes of the merging parties' investments in the following functional way:

$$\frac{dx'_B(x_M, \lambda)}{dx_M} = - \frac{\frac{\partial V(x_M, x'_B(x_M, \lambda))}{\partial x_M \partial x_B}}{\frac{\partial^2 V(x_M, x'_B(x_M, \lambda))}{(\partial x_M)^2}} > 0. \quad (5.14)$$

According to our assumptions, the players' restructuring investments are complementary. Thus, the cross-derivative $\frac{\partial V(x_M, x'_B)}{\partial x_M \partial x_B} > 0$ is positive for every initial ex ante distribution of equity shares among the players $\lambda > 0$. Therefore, whenever the merging parties decide to increase their restructuring investments, the buyer finds it optimal to react with increasing default restructuring investments.

As may have become evident from preceding analysis, by admitting ex ante partial ownership structures as structural merger remedies in order to improve both-sided restructuring investments, the Commission can choose from a continuum of possible ex ante divestiture contracts, as long as extreme cases of exclusive ownership are excluded, i.e. $\lambda \in (0, 1)$.

On the equilibrium path, the two competitors renegotiate every initial distribution of shares in the asset as imposed by the Commission at date $t = 2$, as long as the buyer does not enter renegotiations being exclusive owner of the assets, i.e. $\lambda < 1$. By consequence, successful renegotiations lead to a full transfer of the merging parties' equity shares to the purchaser in $t = 3$, who thus becomes sole owner of the assets at the closing of the transaction. Therefore, the Commission, being able to observe the asset transfer, subsequently clears the merger.

Following our verbal reasoning that a more flexible class of divestiture contracts induces positive reactions of the buyer's marginal incentives to invest in restructuring as a result of marginal increases of the merging parties' investments, we now focus on the players equilibrium restructuring investments and give a formal proof.

In order to determine the merging parties' marginal incentives to invest, we first construct their payoff function in the presence of a shared ex ante ownership structure and then build the first-order condition which provides the implicit definition of the merging parties' optimal restructuring investments.

For the transfer of the merging parties' shares in the asset to the purchaser, they require some monetary compensation. For the players to have efficient incentives in restructuring, the Commission composes the payment as follows:

The lowest payment, the merging parties can assure, is their payoff in case of no asset transfer, i.e. if renegotiations fail. Thus, one price component the buyer has to pay, is the merging parties' default payoff

$$(1 - \lambda)E[\tilde{V}(x_M, x'_B(x_M, \lambda), \theta)]$$

which depends on the ex ante distribution of asset ownership rights λ .

Additionally, the buyer has to pay over the merging parties' share of cash flows they would earn in the case of successful renegotiations with the buyer being residual claimant. As mentioned before, the outcome of renegotiations is described by the generalized Nash bargaining solution. Consequently, the distribution of the expected shared surplus or total cash flows generated by the asset among the players, is a function of their bargaining power α . Hence, the second part of the price, the buyer has to pay over consists of

$$E[\tilde{V}(x_M, x_B^R, \theta)] - x_B^R(x_M) - E[\tilde{V}(x_M, x'_B(x_M, \lambda), \theta)] + x'_B(x_M, \lambda).$$

This is the total amount of gains from renegotiations which are realizable as a result of the asset transfer.

Taken together, the merging parties' profit function represents a share of the common surplus according to their bargaining strength plus their share of default payoff which is determined by the ex ante distribution of ownership rights, λ .

Therefore, the merging parties face the following optimization problem in

$t = 1$:

$$\max_{x_M} \Pi_M(x_M, \lambda) = (1 - \lambda)E[\tilde{V}(x_M, x'_B(\cdot), \theta)] \quad (5.15)$$

$$+ \alpha[E[\tilde{V}(x_M, x_B^R, \theta)] - x_B^R(x_M)] \quad (5.16)$$

$$- \alpha[E[\tilde{V}(x_M, x'_B(\cdot), \theta)] + x'_B(\cdot)] - x_M. \quad (5.17)$$

Under concavity assumptions we find a unique solution, $x'_M(\lambda)$, to the merging parties' maximization problem which can be expressed implicitly by the following first-order condition, where we make use of relationship (5.13) $\lambda \frac{\partial V(x_M, x'_B(\cdot))}{\partial x_B} = 1 \Leftrightarrow \frac{\partial V(x_M, x'_B(\cdot))}{\partial x_B} = 1/\lambda$:

$$(1 - \lambda - \alpha) \frac{\partial V(x_M, x'_B(\cdot))}{\partial x_M} + \left(\frac{1 - \lambda - \alpha}{\lambda} + \alpha \right) \frac{dx'_B(\cdot)}{dx_m} + \alpha \frac{\partial V(x_M, x_B^R(x_M))}{\partial x_M} = 1. \quad (5.18)$$

Since this expression is very important for our analysis of marginal investment incentives, in the following we take a closer look at it.

The first part of (5.18) describes the merging parties' marginal return on restructuring investments for infinitesimal small increases in x_M . The right hand side represents the marginal increase in the shared continuation gains in the case of successful renegotiations reduced by the part $(1 - \alpha)$, that is the part of gains from renegotiations, the purchaser can assure due to her bargaining strength.

Comparing this term with the benchmark case of first-best efficient restructuring investments, the merging parties will choose restructuring investments lower than optimal, whenever $\alpha < 1$. In the case that the merging parties hold all bargaining power, i.e. $\alpha = 1$, an ex ante divestiture contract which foresees no share holdings of the purchaser in the assets, i.e. $\lambda = 0$ would implement first-best restructuring investments by the merging parties. Formally, under a divestiture contract $\lambda = 0$ and full bargaining power $\alpha = 1$, the merging parties' first-order condition collapses to:

$$\frac{\partial V(x_M, x_B^R(x_M))}{\partial x_M} = 1.$$

Full bargaining power of the merging parties is an unrealistic assumption. Therefore, we restrict attention to cases where their bargaining power is smaller than one, i.e. $\alpha < 1$. For smaller values of α , in order to achieve improved incentives for restructuring investments on the merging parties' side, the terms $(1 - \lambda - \alpha) \frac{\partial V(x_M, x'_B(\cdot))}{\partial x_M} + \left(\frac{1 - \lambda - \alpha}{\lambda} + \alpha\right) \frac{dx'_B(\cdot)}{dx_m}$ have to be large enough to mitigate the effect from making the purchaser ex ante partial residual claimant of the merging parties' investments in restructuring. Via these terms, the merging parties can influence her own returns in the event of failing renegotiations.

If the Commission requires a divestiture contract that allows the merging parties to enter the divestiture process as exclusive owner, i.e. $\lambda = 0$, the expression $\left(\frac{1 - \lambda - \alpha}{\lambda} + \alpha\right) \frac{dx'_B(\cdot)}{dx_m}$ cancels out. Under exclusive asset ownership, higher investments in restructuring by the merging parties have no impact on the purchaser's incentives for default investments, i.e. $\frac{dx'_B(\cdot)}{dx_m} = 0$.

As a result of our previous analysis of restructuring investments in the case the merging parties enter the divestiture process as sole owner of the asset to be divested, we know that the purchaser would not invest in restructuring at all, i.e. $x'_B = 0$. By consequence, we saw that the merging parties' marginal incentives to invest in restructuring were too low to be efficient, i.e. $\frac{\partial V(x_M^{NE}, 0)}{\partial x_M} < \frac{\partial V(x_M, x'_B(x_M))}{\partial x_M}$. This is due to two main reasons: firstly, in the case of failing renegotiations, the purchaser rejects the asset transfer and denies restructuring investments at all. Secondly, restructuring investments are complementary by assumption. In the case the purchaser does not invest in restructuring, the positive complementary effect which derives from her investments is missing. Thus the merging parties' marginal incentives to invest in restructuring are too low to be efficient.

Under the contractual institution of the purchaser's ex ante participation at the asset to be divested, i.e. for positive fractions of shares in the asset, $\lambda > 0$, the expression $\left(\frac{1 - \lambda - \alpha}{\lambda} + \alpha\right) \frac{dx'_B(\cdot)}{dx_m}$ is positive and may outweigh the reduction of the merging parties' shares in the assets which materializes in the following

term of the merging parties' first-order condition: $(1 - \lambda - \alpha) \frac{\partial V(x_M, x'_B(\cdot))}{\partial x_M}$.

Thus, we found a necessary condition for improved incentives to invest in restructuring in the presence of a non-trivial distribution of ex ante ownership:

$$\left(\frac{1 - \lambda - \alpha}{\lambda} + \alpha \right) \frac{dx'_B(\cdot)}{dx_m} > (1 - \lambda - \alpha) \frac{\partial V(x_M, x'_B(\cdot))}{\partial x_M} \quad \text{for all } \lambda \in (0, 1). \quad (5.19)$$

As an interim result, we found out that there are two major effects that derive from admitting for divestiture contracts that foresee an ex ante flexible ownership structure. Letting the buyer acquire shares in the assets before the actual divestiture process starts, the Commission achieves to incite the purchaser to invest in the merging parties default payoff. This exercises a positive effect on the merging parties own restructuring investments. Whenever this positive effect exceeds the negative effect deriving from the sale of shares in the assets, we implement improved bilateral restructuring investments.

In the following, we show that there is a non-trivial solution to the problem of finding some optimal ex ante distribution of equity shares, i.e. some new efficiency enhancing divestiture contract, through which the Commission is able to mitigate the two sided underinvestment problem. Resulting restructuring investments are superior to those in status quo, where at the beginning of the divestiture process all shares legally belong to the merging parties.

Henceforth, we assume some implicitly defined solution for the merging parties' optimization problem in the presence of a shared ownership divestiture contract that is able to induce the merging parties to invest first-best efficiently, i.e. $x_M = x_M^*$. The optimal divestiture contract which is assumed to be able to implement the reference solution shall be given by $\lambda^* > 0$. Besides this first-best contract, we assume the existence of another divestiture contract involving a shared equity structure, $\tilde{\lambda}^{max}$ which induces the merging

parties to engage in maximal restructuring investments, i.e.

$$\tilde{\lambda}^{max} = \max_{\lambda \in (0,1]} x'_M(\lambda).$$

In the following, we show that there are optimal ex ante shared ownership contracts which implement restructuring investments that exceed investments under prevalent EC merger policy.

Proposition (D): *Let $\tilde{\lambda}$ be the optimal distribution of shares in the asset to be divested among the buyer and the merging parties as required by the Commission. Such an optimal divestiture contract exists, if conditions (I.) to (III.) are fulfilled.*

(I.) $\tilde{\lambda} \in \{\tilde{\lambda}^{max}, \lambda^*\}.$

If there is an optimal divestiture contract, then the Commission chooses $\tilde{\lambda} = \lambda^$.*

Proof of part (I.)

According to our definition, λ^ is the optimal divestiture contract that implements $x_M = x_M^*$.*

♣ *If this optimal divestiture contract is to exist, then the underlying distribution of ownership among the merging parties and purchaser induces*

$$\bar{\lambda} = \{\lambda \in (0, 1] | x'_M(\lambda) \geq x_M^*\}.$$

♣ *If there is no λ^* under which the merging parties' first-order condition collapses to the case of first-best restructuring investments, then the merging parties will choose restructuring investments that are lower than would be optimal, i.e.*

$$x'_M(\lambda) < x_M^*.$$

Thus, merging parties underinvest, choosing the maximal level of restructuring investments for all ex ante divestiture contracts:

$$\tilde{\lambda} = \tilde{\lambda}^{max} = \max_{\lambda \in (0,1]} x'_M(\lambda).$$

Q.E.D

(II.) Under an optimal ex ante shared ownership divestiture contract, the purchaser must not enter the divestiture process being exclusive owner of the asset, i.e. $\tilde{\lambda} < 1$. For these cases, the initial distribution of ownership rights will be renegotiated in $t = 2$. At that date, the purchaser acquires all remaining equity shares that are initially in the merging parties' possession, $(1 - \tilde{\lambda})$, thus becoming sole owner of the asset. Anticipating being residual claimant of her own restructuring investments, the purchaser invests conditionally efficient, i.e. $x_B = x_B^R$.

Proof of part (II.)

♣ An optimal divestiture contract cannot involve no ex ante participation of the merging parties, i.e. $\lambda = 0$. If the purchaser was owner of all equity shares from the beginning of the divestiture process, the Commission puts her into the position of being residual claimant. By consequence, in $t = 2$ no renegotiations and thus no asset transfer would occur, after the merging parties have invested in restructuring. Due to missing renegotiations, the merging parties are unable to recover returns on her investments thus choosing $x'_M(\tilde{\lambda} = 1) = 0$. Instead, an optimal divestiture contract foresees the merging parties to hold positive shares in the asset from the beginning of the divestiture contract, i.e. $\tilde{\lambda} > 0$. This holds true for both first - order conditions (5.10) and (5.18) of the merging parties under both divestiture contracts $\lambda = 0$ and $\lambda \in (0, 1)$. Under the purchaser's exclusive asset ownership, the merging parties choose $x'_M(\lambda = 1) < x'_M(\lambda = 0)$, that is no investments in restructuring at all. In the case of $\lambda = 0$ the merging parties' incentives to invest in restructuring are higher since at least they can increase their default payoff.

♣ *Still, the merging parties' maximal restructuring investments are lower than in the case of the reference solution, i.e. $x'_M(\lambda = 0) < x_M^*$, since under a divestiture agreement $\lambda = 0$, the purchaser denies to invest. Hence, the merging parties' investment incentives are also reduced due to missing positive complementary effects in restructuring investments. For any positive fraction $\tilde{\lambda} \in (0, 1)$ of equity shares in ex ante possession of the purchaser, the initial divestiture contract will be renegotiated in $t = 2$. As a result of renegotiations, the purchaser acquires sole ownership being able to appropriate returns on her investments. In $t = 3$ she invests conditionally efficient, i.e. $x_B = x_M^R$. This is the case since the merging parties' maximal investments are an increasing function in the share of assets held by the purchaser. This holds also true for continuous profit functions of the merging parties $\Pi_M(x_M, \lambda)$. By consequence, the purchaser must not be made ex ante residual claimant by the Commission in order to implement an optimal divestiture contract under which both actors initially hold positive fractions in the asset. Q.E.D*

(III.) *Assuming sufficiently complementary restructuring investments, there exists a divestiture contract which is ex ante optimal where both players hold positive shares in the asset, i.e. $\tilde{\lambda} > 0$. Formally expressed,*

$$\frac{\partial V(x_M, x'_B(x_M, \lambda))}{\partial x_M \partial x_B} \gg 0 \Leftrightarrow \tilde{\lambda} > 0.$$

Proof of part (III.)

The basic argument to start the proof refers to the merging parties' restructuring investments under ex ante exclusive ownership structure. By analyzing the merging parties' first-order conditions (5.10) and (5.18) we know that the implicitly defined maximal level of restructuring investments under exclusive asset ownership is lower than compared to the first-best solution, i.e. $x'_M(\lambda = 0) < x_M^$. Thus, an optimal divestiture contract which foresees both-sided ex ante asset ownership involves positive values of λ . In order to show that increasing values of λ increase the merging parties' restructuring invest-*

ments if and only if the degree of complementary of restructuring investments is sufficiently large, we rewrite the first-order condition (5.18) as follows:

$$\underbrace{(1 - \lambda - \alpha) \frac{\partial V(\cdot, x'_B(\cdot))}{\partial x_M}}_{1.} + \underbrace{\left(\frac{1 - \lambda - \alpha}{\lambda} + \alpha \right) \left(- \frac{\frac{\partial V(x_M, x'_B(\cdot))}{\partial x_M \partial x_B}}{\frac{\partial^2 V(x_M, x'_B(\cdot))}{(\partial x_M)^2}} \right)}_{2.} + \alpha \frac{\partial V(\cdot, x_B^R(\cdot))}{\partial x_M} = 1,$$

where

$$- \frac{\frac{\partial V(x_M, x'_B(\cdot))}{\partial x_M \partial x_B}}{\frac{\partial^2 V(x_M, x'_B(\cdot))}{(\partial x_M)^2}} = \frac{dx'_B(\cdot)}{dx_M}.$$

By small increases of the purchaser's ex ante share λ , part 1. of the merging parties' first-order condition will be reduced. For a constant level of the purchaser's second partial derivative, term 2. is positive and the cross derivative of the asset value increases in λ in an unbounded way. Thus, for restructuring investments being sufficiently complementary, the Commission will implement an ex ante divestiture contract which $\lambda > 0$ which induces the merging parties to invest more in restructuring than entering the divestiture under exclusive ownership as under prevalent EC merger law, i.e. for the merging parties' maximal restructuring investments under two alternative divestiture regimes we have: $x'_M(\lambda) > x'_M(0)$. Hence, the extreme case of pure merging parties' ownership, can be technically excluded.

Q.E.D

As an important interim result, ex ante divestiture contracts as prescribed by the Commission which install exclusive asset ownership either of merging parties or purchaser at the beginning of the divestiture process, are unable to implement maximal restructuring investments on the side of the merging parties and by consequence on the side of the purchaser.

Instead, by the proof of proposition (II.), we have shown, that there are non-trivial divestiture contracts $\tilde{\lambda}^{max} > 0$ that are able to implement at least maximal restructuring investments.

In what follows, we try to figure out under which conditions the institution of a non-trivial ex ante distribution of shares in the asset establishes first-best restructuring investments. As will be shown, the answer again depends on the degree of complementarity of restructuring investments.

Our analysis starts with an initial divestiture contract

$$\bar{\lambda} = 1 - \alpha, \quad (5.20)$$

which puts the purchaser's equity shares in relation to her bargaining strength in renegotiations. For this special divestiture contract, the merging parties' first-order condition (5.18) collapses to

$$\alpha \frac{dx'_B(\cdot)}{dx_M} + \alpha \frac{\partial V(\cdot, x_B^R(\cdot))}{\partial x_M} = 1. \quad (5.21)$$

From our preceding analysis we know that the merging parties' marginal incentives for restructuring investments in the case of two-sided first-best efficient investments assume $\frac{\partial V(x_M^*, x_B^*)}{\partial x_M} = 1$. This is a necessary condition for a divestiture contract to implement the reference solution. Thus, equation (5.21) takes the form of

$$\alpha \frac{dx'_B(\cdot)}{dx_M} + \alpha \underbrace{\frac{\partial V(x_M^*, x_B^*)}{\partial x_M}}_{=1} = 1 \Leftrightarrow$$

$$\frac{dx'_B(x_M^*, \lambda)}{dx_M} = \frac{1 - \alpha}{\alpha}. \quad (5.22)$$

Thus, there are three cases in which the merging parties' first-order condition (5.18) collapses to (5.10) under a divestiture contract $\lambda = 1 - \alpha$:

1.) $\alpha = 1 \vee \frac{dx'_B(\cdot)}{dx_M} = 0$:

Under the divestiture contract $\lambda = 0$ we observe first-best efficient restructuring investments x_M^* by the merging parties who are made exclusive owner of the assets by the Commission regarding condition $\lambda = 1 - \alpha$. Nevertheless,

we do not arrive at the reference solution since the purchaser is completely left out under this divestiture contract. From preceding considerations we know that non-trivial divestiture contracts, involving both-sided restructuring investments, need a sufficient degree of complementarity of restructuring investments. In this case, the purchaser's investments are not required to establish first-best restructuring investments on the side of the merging parties. This in turn contradicts our assumption that the purchaser plays a vital role in the divestiture process.

In total this is only a purely technical result since the divestiture process will not start under such an ownership structure. The purchaser would deny restructuring investments. As a result, the asset would not be transferred and the merger would eventually be prohibited.

2.) $\alpha = 1 \vee \frac{dx'_B(\cdot)}{dx_M} > 0 :$

Under a divestiture contract which foresees exclusive asset ownership of the merging parties at the beginning of the divestiture process, $\lambda = 0$, and in the presence of complementary restructuring investments, i.e. $\frac{dx'_B(\cdot)}{dx_M} > 0$, merging parties choose an equilibrium investment level which is lower than optimal, i.e. $x'_M < x_M^*$.³²

Since cases 1.) and 2.) are either unrealistic or suboptimal, we concentrate on the following non-trivial case involving both-sided positive equity shares under the divestiture contract $\lambda = 1 - \alpha$.

3.) $\alpha < 1 \vee \frac{dx'_B(\cdot)}{dx_M} > 0 :$

In the case of a non-trivial distribution of ex ante ownership rights it is much more difficult to implement first-best restructuring investments for the merging parties. The purchaser observes the merging parties' first-best investments and as a result of renegotiations, the asset will be transferred to her. Consecutively, she will invest conditionally efficient, i.e. she chooses first-best restructuring investments. For this to be the case, we require a min-

³²This becomes obvious by considering the merging parties optimization problem in the presence of the divestiture contract $\alpha = 1$.

imum degree of complementarity of the players' restructuring investments. Concretely, for a divestiture contract to exist which implements the reference solution, i.e. $\lambda^* \in (0, 1 - \alpha]$, the purchaser's marginal incentive to invest, given the merging parties' level of investments, has to fulfill the following condition:

$$\frac{dx'_B(x_M^*, \lambda)}{dx_M} \geq \frac{1 - \alpha}{\alpha}. \quad (5.23)$$

Hence, if both actors' investments in restructuring are complementary to a certain degree, then under the divestiture contract $\lambda = (1 - \alpha)$, the purchaser's marginal incentive to invest in restructuring $\frac{dx'_B(x_M^*, \lambda)}{dx_M}$ exceeds $\frac{1 - \alpha}{\alpha}$ which implies slight overinvestments by the merging parties.

Combining results from cases 2.) and 3.) we deduce that for $\lambda = 0$, merging parties underinvest and for $\lambda = 1 - \alpha$ they invest too much in restructuring. Therefore, there must be some intermediate value $\lambda^* \in (0, 1 - \alpha)$ for which merging parties choose first-best restructuring investments thus triggering successful renegotiations, where the purchaser acquires full asset ownership which induces her to invest efficiently in own restructuring.³³

To sum up, if the Commission switches from divestiture contracts, that admit the merging parties to enter the divestiture process as exclusive owner of the asset to contracts that allow the purchaser to acquire partial ownership at the assets to be divested right before the divestiture process begins, then the Commission implements improved both-sided restructuring investments. Under certain conditions the institution of an ex ante distribution of ownership rights establishes the reference solution. This is the case whenever the degree of complementarity between the players' restructuring investments is sufficiently high enough.

In the case of an ex ante imposed divestiture contract λ which foresees that the purchaser buys some shares of the asset that has to be transferred, renegotiations

³³We leave out the rather technical proof of this result which involves the theorem of the maximum and the intermediate value theorem. For a detailed presentation see Lüllesmann (2004).

tiations are of great importance for an ownership structure capable to induce both players to restructuring investments that are higher compared to those in status quo. The incompleteness of the contract derives from the fact that the initial divestiture agreement between the players is not able to make the asset transfer and thus merger clearance directly contingent on the merging parties restructuring investments. Anticipating renegotiations induces the merging parties to invest more compared to the case where renegotiations were impossible.

Our approach to modeling the merger remedy process comes very close to reality since by definition of a structural merger remedy and its effective implementation, in the end there must be a total transfer of all shares or control rights from the merging parties to the purchaser. Otherwise the transfer is not in line with the Commission's requirements. Prevalent jurisdiction departs from the natural case where, at the point of entering into the divestiture process, the merging parties are exclusive owner of the asset. As shown above, this ownership structure implements suboptimal restructuring investments. By admitting for a more flexible ownership structure at the point in time when the players enter into the divestiture contract, we end up with significantly improved efficiency results.

In order to anticipate some criticism which may be expressed concerning the applicability of such a model with respect to structural merger remedies, surely the model is theory driven. Renegotiations are mainly a phenomenon which derives from the fact that contracts are incomplete but we believe that renegotiations in the present context do have a practical meaning. We interpret renegotiations as an expression of the necessity for both players to be part of the transaction. The key feature is, that both investments are necessary for the transaction since restructuring investments are no substitutes. Hence, if one party denies to invest in restructuring, the deal breaks and the surplus materializing in synergy gains is gone. The incentive for the merging parties to invest is obvious. They are interested in uncovering synergy gains through cost reductions, for instance. In her position as possible deal

breaker, the purchaser requires a substantial share of the synergy gains, she can request in renegotiations through exercising bargaining strength. In so far she too has a vital interest to renegotiate the initial contractual agreement.

It is important to mention that this kind of divestiture contract is not implementable in every merger case possibly involving structural remedies. In our model we assume that after the merging parties have invested in asset isolation, preservation and viability, they remain passive. The purchaser is able to integrate the asset subsequently and starts production without further support or investments by the merging parties.³⁴ Thus, the solution to the inefficiency problem we elaborated up to this point does not account for cases where the merging parties' investments are necessary timely after the purchaser's investments in restructuring took place.

The key insight of this section is that an ex ante flexible ownership structure helps to mitigate the double moral hazard problem which is obviously prevalent in merger remedies practice. Redesigning the merger remedies process according to the structure of our sequential divestiture game should improve restructuring investment incentives of both players. As a result of our model, we found out that, departing from some minor necessary assumption, there exists a set of parameters that allow for the implementation of first-best efficient restructuring investments.

Up to this point we are not able to make a statement whether this set is large enough or too narrow to be practically implementable. This depends on the merger case under consideration as well as on the case-by-case applicability of our solution method.

The intention of this section was to give an idea about the contract-theoretical mechanics behind divestiture contracts that involve ex ante shared owner-

³⁴This is an essential requirement by the Commission since the purchaser should be completely independent of the merging parties in the post-merger competition stage.

ship between the buyer and the merging parties. In the following chapter we introduce a new divestiture contract which involves an option on asset ownership for the purchaser as a structural merger remedy. The basic mechanics of ownership options in the context of incomplete contracts draws back to seminal work by Demski and Sappington (1991), Edlin and Hermalin (1997) and Nöldeke and Schmidt (1998). We make use of their key insight that completely flexible ownership structures as induced by options on asset ownership, are able to implement the reference solution in situations where sequential relationship-specific investments are not observable. Our modeling approach will give proof that the Commission, endowing the purchaser with a call-option on the asset to be divested, implements first-best efficient restructuring investments in those cases where the partial asset ownership approach failed.³⁵

³⁵This approach is in line with Lülkesmann (2004).

5.6 Option contracts and first-best efficient restructuring investments

In the preceding analysis, we have shown that the institution of ex ante shared equity ownership structures induces merging parties and the purchaser to invest more in restructuring than under prevalent European merger remedy policy, where the merging parties enter the divestiture process as exclusive legal and physical owner of the asset to be divested. In some cases, i.e. for restructuring investments being sufficiently complementary at the margin, the Commission is able to implement both-sided restructuring investments that are first-best efficient thus solving the holdup problem whose existence was proven in section (5.4).

In this chapter, we introduce options on asset ownership to our divestiture game as a possible way for the Commission to incite the actors to engage in first-best efficient restructuring investments in all those cases where the partial asset ownership approach failed. Hence, by moving from rigid ex ante allocations of property rights as is the case with exclusive or shared ownership to so-called contingent ownership structures involving options, we enlarge latitude of the Commission in implementing efficient restructuring investments.

We assume that the Commission defines the contractual parameters that are written in the option contract on the underlying asset to be divested. Subsequently, the purchaser obtains the option at the beginning of the divestiture process with the right to exercise it at the closing of the transaction.

The option contract can be considered as a complete contract, since it is verifiable and all parameters can be observed at the point in time when the merging parties and the purchaser enter into a binding divestiture agreement. Throughout the divestiture process, the value of the underlying, i.e. the asset to be divested, is private knowledge to the merging parties and to the purchaser since we continue to assume that it depends on both-sided

restructuring investments as well as on some source of uncertainty.

Before we apply the idea of options on asset ownership to the divestiture process, we give a short introduction to the theoretical background of options on ownership as part of the theory of incomplete contracts.

The contract-theoretical basis for contingent ownership structures is provided by Demski and Sappington (1991). In their model the authors show that an option contract on asset ownership including an ex ante negotiated exercise price, implements the reference solution in the presence of a sequential double moral hazard problem.³⁶ Edlin and Hermalin (1997) criticize that contracts, designed according to Demski and Sappington (1991), are not robust to renegotiations. Edlin and Hermalin (1997) thus admit for the possibility of renegotiations to arise within a contractual relationship involving sequential investments. They show that for first-best efficient efforts to be implementable, investments have to be substitutes at the margin. The authors assume that the owner of the assets exclusively appropriates return on both-sided investments in equilibrium, leaving the counter-party empty-handed.

In section (5.2) we presented our model assumptions which intended to give a realistic picture of divestiture processes. We pointed out that restructuring investments are complementary in nature since both players are vital for the success of the transaction. Restructuring investments are assumed to be sequential because merging firms have to isolate the asset timely before it can be transferred and subsequently integrated in the purchasing firm's business. Merging firms as well, as purchaser are assumed to be risk-neutral since the value of the asset to be divested is assumed to constitute only a small part relative to the total value of the merged entity. Finally, renegotiations are

³⁶The authors show that an option contract which gives the principal the right to sell a firm to an agent at a fixed price which has been chosen earlier, induces both players to choose the efficient effort level. In their model, the option will not be exercised in equilibrium. Only the existence of such an option contract establishes the reference solution in the case that the parties are risk averse.

part of each divestiture contract since they are rather long-term in nature and contractual conditions change in the run of the divestiture process.

The only model of incomplete contracts which fulfills the requirements of a realistic modeling of divestiture processes with sequential restructuring investments is given by Nöldeke and Schmidt (1998). They show that first-best efficient investments are implementable in the presence of renegotiations and complementarity of investments if the option on asset ownership is exercised following the players investments. Additionally and contrasting to Edlin and Hermalin (1997), the authors allow for more general payoff functions under risk-neutrality of both players.

Therefore, our model builds on Nöldeke and Schmidt (1998) whose approach to options on asset ownership will be applied to divestiture processes in the context of structural merger remedies. Originally the authors applied option contracts in the context of joint ventures in order to solve a holdup problem in which two parties undertake sequential relationship-specific investments, generating a joint surplus in the future.

Nöldeke and Schmidt (1996) and Maskin and Tirole (1996) earlier considered options on asset ownership involving only one-sided investments and thus form an important basis for Nöldeke and Schmidt (1998) where results are generalized to both-sided investments, establishing first-best efficient investments in the presence of renegotiations.³⁷ Their article can be related to work by Aghion, Dewatripont, and Rey (1994), Chung (1991), Hart and Moore (1988), Hermalin and Katz (1993), and Nöldeke and Schmidt (1995)

³⁷Maskin and Tirole (1996) depart from the assumption that a firm initially is in the ownership of both parties. The authors assume simultaneous investments. Each party may be endowed with an option on ownership depending on a draw by nature. Subsequently, the owner of the option can sell her shares via option exercise to the other party at some predetermined strike price. This model is not appropriate for our purposes since on one hand, the direction of the asset transfer uniquely determines the role of the "seller", i.e. the merging parties and the role of the "buyer". A reversion of these positions by option allocation would not make sense in the modeling of divestiture processes. On the other hand, in their model, option exercise only occurs in the case of inefficient investments but does not trigger efficiency.

analyzing long-term contracts on trade between players where the question of efficiency depends on some stochastic parameter which renders the contract incomplete since the agreement *ex ante* cannot condition on its realization.

Nöldeke and Schmidt (1998) in contrast consider option contracts on asset ownership. This is line with our perception of structural merger remedies being interpretable as legally enforced changes in the allocation of asset ownerships.

As a general result of incomplete contracts, where firms are interpreted as bundles of assets, the contractual agreed ownership structure plays a vital role when it comes to the determination of investment incentives. Nöldeke and Schmidt (1998) provide a solution to the holdup problem by the following contractual provision: a firm initially is exclusive owner of the assets. The other firm holds the option to buy the asset or some share of it in exchange of a certain predetermined price at some previously fixed point in time.

In what follows, we apply Nöldeke and Schmidt (1998) to a divestiture process where the merging parties' assets have to be sold and transferred to a buyer, being initially under their exclusive control. As part of the merger remedy process, the competition authority endows a single buyer with the option to buy the assets paying a certain price following the integration of the assets in her business.

Options on asset ownership in divestiture processes are a completely new instrument to induce changes in the allocation of ownership rights which has not been discussed in theoretical treatments of mergers remedies nor been applied in practice before. The mechanics of such option contracts is fairly simple and close to financial option contracts such that a practical implementation should be tractable.

As will be shown in the following, the right choice of the option contract parameters is essential for the implementation of first-best efficient restruc-

turing investments. An agreeable feature of such an option contract is that some important issues with incomplete contracts are avoided since the Commission writes the option contract containing parameters that are observable, verifiable and thus enforceable in court.

The application of the divestiture options approach could improve the efficiency of mergers involving structural remedies since assumed synergy gains from a merger will not be reduced by suboptimal and thus welfare damaging implementations of commitments.³⁸

5.6.1 Options on asset ownership and restructuring investments

The central mechanism which implements first-best efficient restructuring investments involves options on asset ownership. Before addressing implications for the players' incentives to invest in restructuring, we start with a more detailed consideration of an option contract used as an instrument to implement a remedy.

An option on asset ownership represents a divestiture contract between the purchaser, being made option owner and thus in the long position, and the merging parties, being short in the asset to be divested. Through the divestiture option, merging parties are forced by the Commission to transfer the underlying upon option exercise. Naturally, the merging parties are initially in sole legal ownership of the asset which forms the underlying of the divestiture option. The purchaser in turn has primarily no control over the asset but the right to acquire it at the end of the divestiture process.

The major difference between options on ownership and financial options is that the ownership option is not emitted by the merging parties. Instead, the Commission issues the contract and gives the divestiture option to the

³⁸We are aware of the fact that the following analysis is mainly theoretical. Caveats and frontiers of application will be discussed in the following chapter.

purchaser without charging an option premium. The reason is that the option contract forms a structural merger remedy and is thus part of the regulatory intervention by the competition authority and not a right or a bet which is traded on a market thus having a price in the form of an option premium.³⁹ By consequence, the purchaser receives the option without paying over an option premium to the merging parties. For an option to have a market price, it must be a traded asset. Since the option on ownership is tailored to a specific asset transfer, written on an asset that is only valuable within the divestiture relationship, the option has no value outside of the transaction.

In analogy with financial options, an option on asset ownership is a derivative instrument. This means that the value of the option is a function of the underlying asset to be divested. The value of financial options is mainly driven by some value process of the underlying which is in most cases the price process of a stock. Considering the value of the underlying divestiture object, i.e.

$$\tilde{V}(t, x_M, x_B, \theta),$$

it becomes obvious that it is not dependent on the instantaneous return and the instantaneous volatility of some underlying price process. Conversely, there are three different determinants for the value process of the underlying asset to be divested and thus for the value of the option contract which is written on it:⁴⁰

³⁹Furthermore, divestiture options do not have the character of being speculative. Such an option would bear the risk of financial loss. If the divestiture option had a price to be paid to the issuer, the divestiture process became the character of a bet. This of course cannot be the intention by a competition authority.

⁴⁰In the following, it is important to differentiate between price and value. The price or premium of a financial option is the result of demand and supply on the market of financial options. Option contracts on ownership are non-traded assets that have a value but no price since there is no market for such options. Such a market cannot be brought to existence because options are written on purely transaction-specific underlyings. Option exercise leading to physical delivery is worthless for firms outside of the divestiture transaction

1. *Time:*

Financial options are traded assets whose price depends on the price process of the underlying in the time range between option issue and option maturity. As long as the option has not reached maturity yet, it has a positive value, since it represents the right containing the chance to make a profit at the terminal date. At maturity, the value of the option exactly corresponds to the difference between the value of the underlying asset and the predetermined strike price. In contrast to financial options, divestiture options are non-traded assets that have no value before maturity. Nevertheless, options on ownership are not independent of time since at as soon as maturity is reached, i.e. the point in time in the divestitures process when the purchaser decides on option exercise, the value of the option exactly corresponds to the difference between the total value of the merger transaction and some previously fixed strike price.⁴¹

2. *Restructuring investments:*

The value of divestiture options is not totally random since it is positively affected by increasing two-sided investments in restructuring.

3. *Uncertainty:*

There is some degree of randomness involved. The terminal value of the asset is a function of a continuous distribution function $F(\theta)$. Thus, the option value bears the same risk as the underlying asset, possibly making exercise at maturity unprofitable.

These basic consideration on divestiture options lead us to the following definition:

Definition: Options on asset ownership

A European-style option contract, (P, ϕ) , on asset ownership represents the

⁴¹Making use of further analogies with financial options, an ownership option has the touch of a digital option. The value of such instruments is an indicator function of the underlying.

costless but valuable right to acquire some fraction $\phi \in (0, 1]$ of the underlying asset which has to be divested, $\tilde{V}(\cdot)$, at some fixed point in time, $t = T$, following two-sided restructuring investments (x_M, x_B) at a fixed price P , i.e. the strike price which is given to the purchaser by the competition authority. The value of such a right is zero at $t < T$ and corresponds to the difference between the terminal value of the underlying divestiture and the exercise price P at maturity $t = T$, i.e.

$$\phi \tilde{V}(x_M, x_B, \theta, t = T) - P.$$

The contractual parameters have the following meaning:

$$\begin{aligned} \tilde{V}(t, x_M, x_B, \theta) &= \text{value of the asset to be divested int } t \in [0, T] \\ P &= \text{strike price} \\ T &= \text{maturity date} \\ T - t &= \text{time - to - maturity.} \end{aligned}$$

We restrict our attention to European-style ownership options, i.e. the option owner is only allowed to exercise the option at some contractually specified point in time. In our divestiture model, the date of maturity is identical to the closing of the transaction in $t = 5$. Besides this, we assume that the competition authority only admits for call options.

Thus, from the perspective of the option owner, the payoff function of the option at maturity takes the form of

$$\max \left\{ \phi \tilde{V}(t = T, x_M, x_B, \theta) - P, 0 \right\} = \begin{cases} \phi \tilde{V}(\cdot) - P, & \text{if } \phi \tilde{V}(\cdot) \geq P \\ 0, & \text{if } \phi \tilde{V}(\cdot) < P. \end{cases}$$

At the core of the present section lies the proof, that the institution of an ownership option, given to the purchaser by the Commission, implements efficient restructuring investments thus solving the double moral hazard problem as manifested in our proof of inefficiency in section (5.4) and empirically

observed in practice by the Merger Remedies Study.

Since we have shown that under the institution of ex ante shared ownership structures first-best efficient restructuring investments are possible, it remains to prove, that the option mechanism yields the first-best outcome in such cases where the ex ante shared ownership is not able to.

An option contract on the underlying asset induces a conditional ownership structure implemented by the Commission, requiring the merging parties as well as the purchaser to agree on the divestiture contract (P, ϕ) which comprises a strike price, P , and a share ϕ , of equity of the asset to be divested, the purchaser can acquire via option exercise.

We depart from the natural assumption, that the merging parties are exclusive owner of the asset to be divested at the beginning of the divestiture process. The designated purchaser of the asset will be initially endowed with the right to acquire a fraction $\phi \in (0, 1]$ of equity shares by the Commission following both parties' investments in restructuring at the closing of the transaction. At this point in time, the option reaches maturity and the purchaser, depending on the value of the underlying asset, considers whether to exercise the option or to let it expire. In the case that the value of the asset exceeds the strike price P , the ownership option terminates in the money which induces the purchaser to exercise the option. She thus has to pay the fixed price P to the merging parties and acquires fraction ϕ of equity stakes in the asset.

In the following we analyze the impact of the introduction of option contracts on the efficiency of the players' restructuring investments in our previously introduced divestiture game.

The timing of events in our divestiture model with an option on asset ownership is as depicted in Figure 5.2.

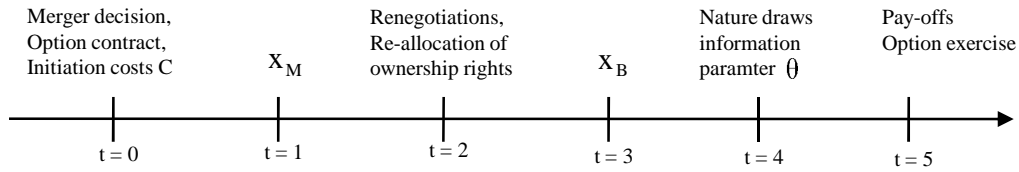


Figure 5.2: The divestiture game with an option on ownership

Therefore, we start from the known structure of our divestiture game, where the merging parties begin with restructuring investments in $t = 1$. Following this, we observe renegotiations. Now assume that renegotiations of the initial divestiture contract fail. Hence, the merging parties' restructuring investments are sunk costs at this point in time. In $t = 3$, while choosing her own level of restructuring investments, the purchaser anticipates that in $t = 5$ she will exercise her option on ownership of ϕ - shares of the asset, if and only if the ownership option's payoff, she can assure via exercise, is higher than the strike price P she has to pay over to the merging parties. Formally expressed:

$$\phi \tilde{V}(x_M, x_B, \theta) \geq P. \quad (5.24)$$

In the case of option exercise, the purchaser is able to recover some return on her own restructuring investments but not all since the merging parties still hold $(1 - \phi)$ - shares in the asset.⁴²

The Commission designs the asset ownership option contract as a structural merger remedy which ex ante determines the share of assets, the purchaser has to acquire if the commitment is to restore effective competition post-merger. Besides the scope of the asset sale, ϕ , the Commission determines the exercise price P for the share ϕ of ownership of the asset to be divested in the option contract.

In order to trigger option exercise, the merging parties and the purchaser

⁴²In analogy with financial options, exercise is profitable if the payoff from exercising the option exceeds the strike price at maturity.

take these contractual parameters as given, being only in the position of influencing the value of the asset and therefore indirectly option exercise through individual restructuring investments.

Merging parties as well as purchaser know that for the merger to be cleared, the ownership option must be exercised by the purchaser and ϕ - shares of the asset must be transferred in order to achieve a distribution of productive capital among the competitors which ensures effective competition on the post-merger market.

In the case of substantial synergy gains deriving from the merger, being only realizable via fulfillment of structural commitments and subsequent merger clearance, both players are interested in option exercise at the closing of the transaction. Thus, they both can at least partially recover returns on their investments. Since firm-individual restructuring investments are unobservable for the Commission but complementary in nature, the players are incited to choose investment levels that are as low as possible, therefore trying to free-ride on the competitor's investments and speculating on favorable realizations of the stochastic information parameter θ .

The following section gives a deeper insight in the mechanics behind an option on asset ownership.

5.6.2 The option's mechanics

The minimum value of the share of ownership rights to be sold to the purchaser which renders the former just indifferent between exercising her ownership option and expiration in $t = 5$ is:

$$V(\phi) \equiv \phi \tilde{V}(x_M, x_B, \theta) = P. \quad (5.25)$$

There is exactly one state of the world in the support of θ which is uniquely related to $V(\phi)$ implying the purchaser's indifference between option exercise

and expiration. Formally, this state of the world is defined as follows:

$$\theta'(x_M, x_B, \phi, P) = \{\theta | \phi \tilde{V}(x_M, x'_B, \theta) = P\}. \quad (5.26)$$

We define the expected probability of exercising the option for any tuple of restructuring investments (x_M, x_B) and some initial divestiture contract (ϕ, P) as

$$p(x_M, x_B, \phi, P) \equiv 1 - F(\hat{\phi}). \quad (5.27)$$

Hence, the expected probability of exercising the divestiture option increases in the arguments x_M and x_B as well as in the fraction of assets ϕ , the option is written on. The higher the exercise price of the option, the lower the expected probability of exercise.

For an option to be a valid instrument to implement restructuring investments that are higher compared to the status quo case of section (5.4), we restrict our attention to those option contracts, that imply a set of states of the world, where option exercise is profitable from the buyer's perspective, i.e. the probability for the option to be exercised at maturity is strictly positive.

Therefore, we define some threshold state

$$\hat{\theta}(x_M, x_B, \phi, P) = \min\{\theta \in [\underline{\theta}, \bar{\theta}] | \phi \tilde{V}(x_M, x_B, \theta) \geq P\}. \quad (5.28)$$

By consequence, the purchaser exercises her option (P, ϕ) if and only if the realized state of the world exceeds the threshold state, i.e. $\theta \geq \hat{\theta}$. As became obvious from the reasoning above, the threshold state $\hat{\theta}$ is a function of both-sided restructuring investments as well as of the option contract parameters ϕ and P chosen by the Commission.

The interval of states that trigger option exercise, increases in the share of assets ϕ as well as in the merging parties' and the purchaser's investments (x_M, x_B) . The range of states decreases for higher strike prices P . We

define the minimum threshold state implying option exercise whenever the purchaser's share in the asset value exceeds the strike price P , i.e.

$$\hat{\theta}(x_M, x_B, \phi, P) = \underline{\theta} \quad \text{if} \quad \phi \tilde{V}(x_M, x'_B, \underline{\theta}) \geq P. \quad (5.29)$$

After having exposed the basic mechanics of options on asset ownership, in the following section we solve our divestiture game by backwards induction for the case of a purchaser receiving an option on asset ownership by the Commission.

5.6.3 Marginal incentives for restructuring investments under option contracts

The purpose of the following analysis is to measure the impact of the introduction of options on the player's incentives to invest in restructuring, i.e. technically expressed, the change in the players' first-order conditions. Eventually, we need the reduced-form of the merging parties' first-order condition in order to compare it with the first-order condition in the case of shared asset ownership structures. At the end of the analysis we should be able to point out, under which ownership structure the players' have optimal incentives to invest in restructuring.

A reduced-form representation of the merging parties' first-order condition would be possible and sufficient for the following analysis. Nevertheless, we prefer the extensive-form representation of our divestiture game since the strategic interaction between merging parties and purchaser thus becomes transparent. Since our argumentation is based on backwards induction, we start with the purchaser's incentives for restructuring investments in $t = 3$.

t=3

At date $t = 3$, the purchaser chooses to maximize her continuation payoff, being in possession of an option to acquire ϕ - shares of the asset as a divestiture

remedy. Thus the purchaser maximizes the profit function

$$\Pi'_B(x_M, x_B, \phi, P) = \int_{\hat{\theta}}^{\bar{\theta}} \left[\phi \tilde{V}(x_M, x_B, \theta) - P \right] dF(\theta) - x_B. \quad (5.30)$$

The solution to the upper optimization problem yields the purchaser's default investment in restructuring, $x'_B(\cdot) > 0$ which is uniquely defined by the first-order condition

$$\int_{\hat{\theta}}^{\bar{\theta}} \left(\phi \frac{\partial \tilde{V}(x_M, x'_B, \theta)}{\partial x_B} \right) dF(\theta) - 1 = 0. \quad (5.31)$$

In the case that the stochastic information parameter θ enters the asset value function in a linear way, i.e. $\tilde{V}(x_M, x_B, \theta) = V(x_M, x_B) + \theta$ with an expected exercise probability of $p(\cdot) = 1 - F(\hat{\theta}(\cdot))$, the purchaser's default investment in restructuring $x'_B(\cdot)$ for a given level of restructuring investments by the merging parties x_M is implicitly defined by the first-order condition

$$\phi p(x'_B, \cdot) \frac{\partial V(x_M, x'_B)}{\partial x_B} = 1. \quad (5.32)$$

The following step is important for a comparison of incentives to invest in restructuring under different divestiture contracts. We calculate the purchaser's marginal incentive to invest in restructuring. Differentiating the purchaser's default investment with respect to the merging parties' restructuring investments, yields

$$\frac{dx'_B(\phi)}{dx_M} = - \frac{\frac{\partial V(x_M, x'_B)}{\partial x_M \partial x_B} + \frac{\frac{\partial(\partial V / \partial x_B)}{\partial p}}{\frac{\partial p}{\partial x_M}}}{\frac{\partial^2 V(x_M, x'_B)}{(\partial x_B)^2} + \frac{\frac{\partial(\partial V / \partial x_B)}{\partial p}}{\frac{\partial p}{\partial x_M}}} > - \frac{\frac{\partial V(x_M, x'_B)}{\partial x_M \partial x_B}}{\frac{\partial^2 V(x_M, x'_B)}{(\partial x_B)^2}} = \frac{dx'_B(\lambda)}{dx_M}. \quad (5.33)$$

This holds true for any value of $p(\cdot) \in (0, 1)$ and $\phi > 0$.

Hence, the purchaser's reaction on larger restructuring investments by the merging parties in case of failing renegotiations under an option on equity shares strictly dominates marginal investment incentives under a shared own-

ership structure.

t=1

Anticipating the purchaser's behavior on the third stage of the divestiture game, the merging parties maximize their expected payoff from the divestiture. Thus they choose restructuring investments in a way such that they maximize the following expression:

$$\begin{aligned} \Pi_M(\cdot) = & E[\tilde{V}(x_M, x'_B, \theta)] - \int_{\hat{\theta}}^{\bar{\theta}} [\phi \tilde{V}(x_M, x'_B, \theta) - P] dF(\theta) \quad (5.34) \\ & + \alpha [E[\tilde{V}(x_M, x_B^R, \theta)] - x_B^R - E[\tilde{V}(x_M, x'_B, \theta)] + x'_B] - x_M. \end{aligned}$$

The merging parties' first-order condition implicitly determines their equilibrium investments $x'_M(\phi, P)$:

$$(1-p(\cdot)\phi-\alpha)\frac{\partial V(x_M, x'_B)}{\partial x_M} + \alpha\frac{\partial V(x_M, x_B^R)}{\partial x_M} + \left(\frac{1-p(\cdot)\phi-\alpha}{p(\cdot)\phi} + \alpha\right)\frac{dx'_B(\phi)}{dx_M} = 1. \quad (5.35)$$

Hence, for given restructuring investments x_B by the purchaser being in possession of the option contract (P, ϕ) , the merging parties choose equilibrium restructuring investments x'_M .⁴³

The following explanations lie at the core of this chapter. With the help of the following proposition (E), we show that the merging parties' maximum restructuring investments that are implementable by the Commission via option contracts, (ϕ, P) , strictly dominate their restructuring investments under ex ante partial asset ownership, i.e. $(\lambda, 1 - \lambda)$.⁴⁴

The proof of proposition (E) comprises two steps. In a first step we show that there is at least one option contract $(\bar{\phi}, \bar{P})$ for which the purchaser's restructuring investments under partial asset ownership, are identical to in-

⁴³Since the merging parties' restructuring investments account for the choice of investments by the buyer in $t = 3$, the equilibrium is subgame perfect.

⁴⁴The idea of this proof traces back to Lülfsmann (2004).

vestments under this option contract in the case of failing renegotiations. In a second step we demonstrate that the merging parties' equilibrium investments under such a contract, $x'_M(\bar{\phi}, \bar{P})$, strictly dominate their equilibrium restructuring investments under a ex ante shared ownership structure which implements maximal restructuring investments, $x'_M(\tilde{\lambda}^{max})$.

Summarizing, we state the following proposition:

Proposition (E): *Let $x_M^{max}(\phi)$ be the merging parties' restructuring investments that are maximally implementable by an option contract (ϕ, P) constructed by the Commission and let $x_M^{max}(\lambda)$ be maximum investments in the case of an ex ante shared ownership structure, respectively. For both ownership structures, the merging parties' investments under ownership options strictly dominates their investments under shared ownership, i.e.*

$$x_M^{max}(\phi) > x_M^{max}(\lambda).$$

The proof of proposition (E) will be carried out via proof of Lemma (E.1) and Lemma (E.2).

Lemma (E.1): *The Commission can always select the contractual parameters of the ownership option (ϕ, P) in such a way that she finds a unique contract, $(\bar{\phi}, \bar{P})$, under which a shared ownership structure contract implementing maximal investments, $\tilde{\lambda}^{max}$, corresponds to the expected equity share $\bar{\phi}p(\cdot)$. Formally expressed, i.e.*

$$\tilde{\lambda}^{max} = \bar{\phi}p(\bar{\phi}, \bar{P}, x'_M(\bar{\phi}, \bar{P})).$$

Thereby, we only admit for non-trivial ex ante distributions of shares among the players, $\tilde{\lambda}^{max} < 1$, which implements maximum restructuring investments $x_M^{max}(\lambda)$.

Proof of Lemma (E.1)

Per assumption, the merging parties' profit function $\Pi_M(\phi, P, x'_M(\phi, P))$ is continuous in ϕ and P . For every strike price $P \geq 0$, the purchaser's expected equity share, $\phi p(\cdot)$, approaches zero for divestitures ϕ close to zero.

In the case the Commission gives the purchaser the right to acquire approximately full asset ownership through option exercise, i.e. $\phi \rightarrow 1$, then the expected probability of option execution approaches one for sufficiently small transfer payments P .

By the theorem of the maximum and the intermediate value theorem, there must exist at least one option contract, the Commission can implement such that $\bar{\phi} p(\bar{\phi}, \bar{P}, x'_M(\bar{\phi}, \bar{P})) = \tilde{\lambda}^{max}$ for positive and non-trivial option execution probabilities $0 < p < 1$.

Q.E.D

As an interim result, we have shown that the parameters of the option contract (P, ϕ) can be chosen by the Commission such that the default restructuring investments in the presence of a shared ownership divestiture contract λ are identical with those under a divestiture option for any given investment level x_M .

The idea behind this assertion is that for very small strike prices, the probability for option exercise is close to one, i.e. $p(\cdot) = 1$. In contrast to this, the option is not very likely to be exercised for any positive strike prices and a share ϕ which is close to zero. Since we admit for a continuous distribution, there will be a combination of (P, ϕ) , such that the probability of exercising the option and thereby acquiring ϕ - shares of the asset exactly corresponds to λ .

Thus, both divestiture contracts have a very similar impact on the merging parties' choice of restructuring investments in equilibrium. Obviously, the purchaser's default restructuring investments are zero in case that the option allows her to acquire no shares of the assets, i.e. $\theta = 0$. Her default investments are an increasing function of the shares in the asset, approaching

the conditional efficient level $x_B^R(x_M)$ in the case that the strike price P is chosen sufficiently small and the purchaser's share in the assets reaches one, i.e. $\phi \rightarrow 1$.

By the proof of the following Lemma (E.2) we will show that an option on asset ownership induces the merging parties to invest strictly more in restructuring than under a shared ownership divestiture contract. As a consequence, first-best efficient restructuring investments will be more likely under option contracts.

Hence, we state the following lemma:

Lemma (E.2): *For every option contract $(\bar{\phi}, \bar{P})$ that equates the expected probability under the merging parties' equilibrium investments, $x'_M(\phi)$, weighted by their ex ante equity shares, ϕ with the ex ante ownership structure $\tilde{\lambda}^{max}$ that implements maximal investments, $x_M^{max}(\lambda)$, we find that:*

$$x'_M(\bar{\phi}, \bar{P}) > x'_M(\tilde{\lambda}^{max}).$$

This holds true due to equation (5.34) for non-trivial exercise probabilities $0 < p < 1$.

Proof of Lemma (E.2)

Comparing a divestiture contract $\tilde{\lambda}^{max}$ with an option contract on equity shares $(\bar{\phi}, \bar{P})$, for any level of restructuring investments by the merging parties, under an option contract $(\bar{\phi}, \bar{P})$, the merging parties' equilibrium investments are larger than under a shared ownership divestiture contract, i.e.

$$(1 - p(\cdot)\phi - \alpha) \frac{\partial V(x_M, x'_B)}{\partial x_M} + \alpha \frac{\partial V(x_M, x_B^R)}{\partial x_M} + \left(\frac{1 - p(\cdot)\phi - \alpha}{p(\cdot)\phi} + \alpha \right) \frac{dx'_B(\phi)}{dx_M} >$$

$$(1 - \lambda - \alpha) \frac{\partial V(x_M, x'_B(\cdot))}{\partial x_M} + \left(\frac{1 - \lambda - \alpha}{\lambda} + \alpha \right) \frac{dx'_B(\cdot)}{dx_m} + \alpha \frac{\partial V(x_M, x_B^R(x_M))}{\partial x_M}.$$

Thus, the merging parties' maximum restructuring investments implementable under divestiture options strictly exceed those under shared ownership divestiture contracts, i.e.

$$x_M^{max}(\phi) > x_M^{max}(\lambda).$$

Since per assumption $x_M^{max}(\phi) \geq x'_M(\bar{\phi}, \bar{P})$ and $x'_M(\tilde{\lambda}^{max}) = x_M^{max}(\lambda)$, we know that this holds also true for equilibrium investments:

$$x'_M(\bar{\phi}, \bar{P}) > x'_M(\tilde{\lambda}^{max}).$$

Q.E.D

This proves proposition (E).

To sum up, we have shown that the maximum implementable restructuring investments by the merging parties under divestiture contracts strictly dominate their investments in the case of ex ante shared asset ownership divestiture contracts. This holds also true for the merging parties' equilibrium restructuring investments.

The decisive mechanics of the option contract is the creation of a link between the purchaser's restructuring investments and the event of becoming partial owner of the asset. The larger the buyer's default restructuring investments x'_B , the higher her payoff in states where she exercises her option on asset ownership. Additionally, a larger default investment increases the likelihood for option exercise. Thus the purchaser positively influences the likelihood of finding option exercise profitable via increased investments. Depending on the Commission's choice of contractual parameter, the purchaser can be incited to find exercise profitable, thus becoming residual claimant. Technically, the threshold state for option exercise to be profitable is a decreasing function of the buyer's default restructuring investments. Higher restructuring investments thus increase the range of states, where option exercise is

profitable: $\frac{d\hat{\theta}}{dx_B} < 0$ and $\frac{dp(\cdot)}{dx_B} > 0$.⁴⁵

The effect of an increased exercise probability for higher values of the buyer's restructuring investments raises $\frac{dx'_B}{dx_M}$, i.e. the way, marginal investments by the merging parties affect the buyer's default restructuring investments.

We conclude that the Commission is able to solve the underinvestment problem involved in the implementation of structural merger remedies by giving the purchaser an option contract at the beginning of the divestiture process which is written on observable and enforceable parameters: a strike price and a related fraction of equity shares of the divestiture that can be acquired by the purchaser upon option exercise.

5.6.4 Options contracts and renegotiations

In this section we address the role of renegotiations for divestiture processes involving options on asset ownership. The focus will be on the fact that renegotiations are necessary for first-best efficient restructuring investments to be implementable in the presence of uncertainty over the underlying value of the asset.

In the following proof of proposition (F) we demonstrate that an optimally designed divestiture option contract not only induces the merging parties to invest optimally in equilibrium but that the former will also be renegotiated as part of the equilibrium path such that the purchaser becomes exclusive owner of the asset. Expressed in terms of the purchaser's equity shares: the pre-merger fraction $\phi \in (0, 1)$ will change to $\phi = 1$ post-merger which implies full transfer of ownership rights to the purchaser inducing the Commission to clear the merger.⁴⁶

⁴⁵This functional relationship is valid for all parameter constellations of (x_M, ϕ, P) .

⁴⁶The approach to the following proof of proposition (F) is in line with Lülfsmann (2004) who shows that renegotiations are an essential feature of any optimal divestiture contract in the context of research collaboration involving sequential investments.

Proposition (F): *In equilibrium, any divestiture contract implementing positive restructuring investments of the merging parties, $x_M > 0$, will be renegotiated in $t = 2$.*

Proof

Assume the Commission admitted for some divestiture contract (ϕ, P) which is not subject to renegotiations in equilibrium inducing two-sided investments $(x_M, x'_B(x_M))$, where the merging parties' investments are strictly positive, i.e. $x_M > 0$.

Using backwards induction arguments, we show by contradiction that this contract cannot exist.

t=3

We observe renegotiations whenever the purchaser chooses a suboptimal investment level, given some restructuring investment level by the merging parties. Therefore it follows that for any level of x_M , the purchaser chooses $x'_B(x_M) = x^R(x_M)$. From the purchaser's first-order condition under an option contract we know, that her default investment for a given level x_M is implicitly defined by $\phi p(x_M, x'_B, \phi, P) \frac{\partial V(x_M, x'_B)}{\partial x_B} = 1$. From this optimality condition follows, that $x'_B(x_M) = x^R(x_M)$ if and only if $\phi = 1$ and $p(x_M, x_B^R, 1, P) = 1$. Hence, the buyer exercises her divestiture option in equilibrium with probability one, thus becoming exclusive owner of the assets and therefore triggering asset transfer with subsequent merger clearance.

t=1

Under this class of contracts, for the merging parties' restructuring investments must hold that $x_M \geq x'_M$, with x'_M representing the smallest restructuring investment such that the probability of exercising the option amounts to $p(x'_M, x'_B(x'_M), 1, P) = 1$. In this case the buyer becomes exclusive owner of the assets, i.e. $\phi = 1$. With $\hat{\theta} = \underline{\theta}$ and $x'_B(x_M) = x^R(x_M)$ the merging

parties's expected payoff function (5.35) collapses to

$$\begin{aligned}\Pi_M(x_M)|_{x_M \geq x'_M} &= E[\tilde{V}(x_M, x_B^R(x_M, \theta))] - \left[E[\tilde{V}(x_M, x_B^R(x_M, \theta))] - P \right] - x_M \\ &= P - x_M.\end{aligned}$$

As can be easily retraced, all restructuring investment levels exceeding the threshold level x'_B cannot be part of an equilibrium restructuring investment path since $\partial\Pi_M/\partial x_M = -1 < 0$. Thus, the merging parties would not have an incentive to marginally increase their restructuring investments.

It remains to check whether it is potentially part of the equilibrium that $x_M = x'_M$. From previous analysis we know that $\partial\Pi_{x_M}/\partial x_M|_{x_M \rightarrow x'_M} = -1$. For any values of the merging parties restructuring investments approaching x'_M from the lower bound, i.e. $x_M \rightarrow x'_M$ the merging parties' marginal utility is given by (5.36). In the case of the purchaser's exclusive ownership, i.e. $\phi = 1$, the sum of the first and the second term of equation (5.36) converges to zero as the probability of exercising the divestiture option approaches one, i.e. $p(\cdot) \rightarrow 1$ and the default effort response converges from $x'_B(\cdot)$ to $x_B^R(x_M)$. The expression $(\frac{1-p(\cdot)\phi-\alpha}{p(\cdot)\phi} + \alpha)\frac{dx'_B}{dx_M}$ converges to zero as well for $p(\cdot) \rightarrow 1$. Thus for restructuring investments approaching x'_M the expression must take the form of $\partial\Pi_{x_M}/\partial x_M = -1$. Therefore, $x_M = x'_M$ cannot be part of an equilibrium path as well.

Q.E.D

Hence, the initial divestiture contract has to be renegotiated in equilibrium, otherwise first-best efficient restructuring investments are not implementable.

For an intuitive explanation, assume there is a divestiture option contract (P, ϕ) which is not renegotiated on the equilibrium path. For the purchaser to invest conditionally efficient, the divestiture contract has to foresee an option which guarantees the purchaser full ownership of the asset upon option exercise, i.e. $\phi = 1$. Furthermore, the Commission has to choose the strike price of the option sufficiently small so that for some positive restructuring

investments by the merging parties, the purchaser will invest conditionally efficient and subsequently exercise the option for every possible state of nature, θ . Assuming that the purchaser exercises her option in any case for a given value of restructuring investments by the merging parties, the former could decrease investments by a small amount. Under the previous assumptions, the purchaser would still exercise her option and the merging parties could appropriate the strike price. Since the merging parties would thus increase profits, they are incited to unilateral deviations from the equilibrium path.

Thus, in the absence of renegotiations the first-best efficient solution is not implementable since this requires the purchaser to exercise the option in any case which induces the merging parties to undercut their investments. The only case where first-best efficient investments are part of equilibrium absent renegotiations, is that at maturity, the purchaser is just indifferent between option exercise or rejection in the indifference case $\underline{\theta}$ for given investments by both parties. Since in this case the purchaser does not exercise the option with full probability, a reduction in the merging parties' investments reduces the likelihood of the option to end in the money, i.e. $p(\phi\tilde{V}(\cdot) \geq P) < 1$. This in turn induces the purchaser to invest less than optimal. This holds true for substantial reductions of the merging parties' investments but not for very small ones. Small decreases in x_M still induce the purchaser to exercise the option and to invest a little bit less than optimal. Since in this case the purchaser exercises the option with probability one in the least favorable state of the world, the surplus is close to zero as is the gain from renegotiations. For the likelihood of option exercise close to one and no gains from bargaining, the merging parties cannot appropriate returns on their restructuring investments and thus invest not at all.

Therefore, absent renegotiations we do not observe positive restructuring investments in combination with option exercise by the buyer. Since the reference solution requires positive investments by merging parties and by the purchaser who subsequently acquires ownership via option exercise, renegotiations necessarily occur under optimal divestiture option contracts.

Thus, renegotiations are part of the equilibrium path independent of the ex ante allocation of ownership rights which is implemented by the Commission. The only necessary condition for renegotiations to take place in equilibrium is that the ownership structure, either partial divestiture contracts or option contracts are optimal with regard to the investment incentives of the players.

To sum up, there are two reasons for improved incentives under ownership option contracts compared to the case of shared ownership structures.

Firstly, under shared ownership, the buyer has no possibility to increase her shares in the asset. The equity share she holds at the beginning of the divestiture process is given by the Commission and written in the ex ante divestiture contract. Ex post, in the case of failing renegotiations, the initial distribution of ownership right, λ , is independent of the realization of the information parameter θ . Secondly, under a partial ownership divestiture contract, the purchaser cannot increase her shares in the asset by increasing her restructuring investments significantly. By contrast, divestiture contracts involving options on ownership establish a functional relationship between the purchaser's restructuring investments and the likelihood of becoming owner of ϕ - shares in the asset. It is exactly the link between the amount of equity stakes that are purchasable through option exercise and the buyer's restructuring investments that determine the degree of moneyness of the remedy option. Obviously, larger investments in the case of failing renegotiations have two effects: on one hand, they increase the purchaser's payoff in the case of option exercise on the other they increase the likelihood for the option to expire in the money, that is in the case that the value share of the purchaser exceeds the strike price. Via option exercise, the purchaser becomes residual claimant of her previously undertaken investments.

Chapter 6

Policy implications and conclusion

"And, if God exists, why didn't he shape the world according to our model?"

R. Gibson, *Model Risk: Concepts, Calibration and Pricing*.

6.1 Summary

The aim of this thesis is twofold. In the first chapter we analyze the effect of introducing restructuring costs to a model of imperfect competition with divestitures. In the second chapter we initially introduce the notion of relationship-specific restructuring investments as essential part of structural merger remedies to classical contract theory. Subsequently we create our own model of a divestiture process as observed under EC merger policy and give solutions to the inefficiencies that were assessed by the EC Merger Remedies Study in practice.

Our first modeling approach presented in chapter 3 provides a simple theoretical framework for an analysis of structural merger remedies involving restructuring costs. Based on work by Medvedev (2004), we assume a Cournot market with capital assets. Medvedev (2004) shows that admitting divestiture of capital extends the range of model parameters in the case that the merger impact is measured in terms of the consumer surplus standard. We introduce the notion of a costly implementation of divestitures to Medvedev

(2004) as required by international competition authorities by extending the Cournot model through an additional cost parameter representing restructuring investments. As a major result, the beneficial price decreasing effect which derives from divestitures is at least partially foiled by the introduction of restructuring costs. Under certain conditions, the negative effect deriving from this additional cost factor may be dominant thus reducing consumer surplus.

More precisely, in line with Medvedev (2004) we restrict attention to firms with an initially symmetric cost structure due to equally distributed productive capital in the Cournot industry. Medvedev's (2004) production technology assumes that substantial economies of scale can be realized by concentrating productive capital through a merger. From basic Cournot analysis we know that asymmetric cost structures lead to the following market outcome: the lower a firm's marginal cost of production under imperfect quantity competition, the more output is generated by this firm relative to the competitors, being able to acquire a higher share of the market and thus earning higher profits. A general insight from this analysis is that the higher the degree of asymmetry of the cost of production under Cournot competition, the higher is the equilibrium market price and hence the lower the consumer surplus. This is exactly the effect of a merger under Cournot competition.

In our work, we consider a merger from three to two firms in the market. Departing from an initially equal distribution of productive capital, post-merger the productive capital is doubled and thus, the total costs of production are cut into halves. Structural merger remedies in this setting are an effective tool to restore the symmetry in the market in that a divestiture, i.e. the transfer of productive capital in the ownership of the last remaining competitor in the market, decreases her total cost of production, thus increasing her competitiveness relative to the merging parties. As an important result, although the market structure changed from a three players oligopoly to duopoly, in the presence of structural merger remedies, there are parameter constellations for which the post-merger equilibrium market price remains

on the same level as the pre-merger price. Hence, the consumer surplus will not be negatively affected by the concentration.

By introducing restructuring costs, beneficial effects from divestiture may be totally eliminated, depending on the level of restructuring investments that are necessary to realize the asset transfer. We extend Medvedev (2004) by the introduction of one-sided restructuring costs and show that the original extension of the range of parameters which allow for the consumer surplus to be unchanged, will decrease by the level of restructuring investments. We thus find critical conditions for maximum restructuring costs and the necessary scale of divestitures for unilateral effects not to harm the consumer surplus. Hence, the degree of complexity which is involved in finding the right divestiture to solve the competition problem is increased by the existence of restructuring costs that even reinforce the beneficial effect of divestitures in that the merging parties' cost of production increase. The negative effect deriving from restructuring costs materializes in the reduction of the total industry equilibrium output, thus increasing the equilibrium market price.

As soon as the competition authority does not account for restructuring costs, in a Cournot setting, she requires divestiture and related restructuring cause cost increases for the merging parties that in sum are higher than originally intended. Thus, the authority systematically over-fixes the merger. Therefore, by introducing restructuring costs, we find a theoretical explanation for the phenomenon of over-fixing.

In the second part of this thesis we introduce structural merger remedies to contract theory. Here we start with the basic assumption that restructuring investments are relationship-specific. This permits the application of contract-theoretical models to divestiture processes which induce strategic interaction between merging parties and the purchaser of the assets from the point in time when the actors enter into a binding divestiture agreement until the closing of the transaction implying successful transfer of the asset to the purchaser.

Departing from this stylized divestiture relationship between merging parties and the purchaser of the assets to be divested, we create a sequential divestiture game on the basis of EC competition law. The analysis of the strategic interaction leads to the following key insight: under prevalent EC merger policy, both sides of the transaction are not incited to first-best efficient restructuring investments. Thereby we find a contract-theoretical explanation for the empirically observed double moral hazard problem as asserted by the EC Merger Remedies Study.

In more detail, we investigate the divestiture relationship between merging parties and some previously determined purchaser of the assets to be divested. The actors enter into a divestiture contract at the point in time when the EC decides on the merger transaction. We depart from the assumption that the EC allows for the merger under structural commitments that subsequently have to be implemented by the merging parties. The implementation of a divestiture commitment requires restructuring investments of both, merging parties and purchaser. These investments are sequential since the merging parties have to isolate and maintain the asset to be divested prior to the phase when the asset is physically transferred to the purchaser and subsequently integrated into her business. We assume that restructuring investments are non-contractible. That is, the EC cannot enforce a certain level of investments but is only able to observe whether the asset has been transferred, hence deducing that restructuring investments which are exclusively observable for the merging parties and the purchaser, have been undertaken. Furthermore, in our model we assume complementarity of restructuring investments. This assumption mirrors reality in that the purchaser's investments are a necessary condition for the clearance of the merger. Hence, the merging parties cannot trigger merger clearance by undertaking investments in the place of the purchaser. Additionally, in our model we admit for some source of uncertainty which reflects changing market conditions in the run of the divestiture process influencing the value of the transaction.

The value of the assets to be divested is central for the divestiture process. The distribution of ex ante ownership rights and the change in their allocation as result of renegotiations alter the players incentives to invest in restructuring. Since the value of the asset to be divested is a function of two-sided restructuring investments and some uncertainty parameter, different ownership structures induce different values of the asset. We assume that the value of the asset represents the total value of the merger, i.e. for instance the present value of future cost savings. Hence, the purchaser, knowing that she is vital for a successful transaction, requires a part of this value which is expressed in bargaining over the value distribution among the players.

Since divestiture processes are rather long-term relationships, we admit for renegotiations to arise in the run of the implementing phase. Renegotiations form a fundamental part of our divestiture modeling since only in the case of successful renegotiations over the distribution of gains deriving from the transaction, ownership rights on the asset will be transferred to the purchaser. In the case of failing renegotiations, the merging parties will remain exclusive owner of the asset which induces the EC to withdraw her clearance decision under remedies, thus prohibiting the transaction. Due to the necessity of the purchaser to take part in the divestiture process, we assume that she has at least the same bargaining strength as the merging parties.

Under prevalent EC merger policy, the merging parties enter the divestiture process as exclusive ownership of the asset to be divested. Given this allocation of ownership rights, we observe two-sided suboptimal incentives to invest in restructuring thus finding a theoretical explanation for empirically observed double moral hazard issues as part of the implementing phase of structural merger remedies. The reason for inefficient implementations of divestitures is the ex ante distribution of ownership rights at the beginning of the divestiture process. We show that, when the merging parties sign the divestiture process being exclusive owner of the asset to be divested, they will underinvest in restructuring unless they are in the possession of all bar-

gaining power in renegotiations with the purchaser, that possibly arise in the run of the asset transfer.

Subsequently to this proof of inefficiency involved in divestiture processes under EC merger law, we apply the theory of incomplete contracts which concludes that different allocations of ex ante ownership rights on the asset alter incentives of the players to invest in restructuring. Therefore, we assume that the EC endows the purchaser with shares in the asset to be divested at the point in time when she enters into a divestiture agreement with the merging parties. Instead of reduced investment incentives of the merging parties, we observe strengthened two-sided restructuring investments since in the case that ex ante, the purchaser is made partial owner of the value of the merger transaction, she cannot credibly refuse to invest in restructuring in the case of failing renegotiations. This in turn increases the merging parties' payoff in the case of failing renegotiations. By consequence, their marginal incentives to invest in restructuring are increased and overall incentives to invest in restructuring are higher than under exclusive ownership divestiture contracts.

Eventually, we base our model on findings by Nöldeke and Schmidt (1998) and introduce contingent ownership structures to the sequential investments relationship between merging parties and purchaser. In the case that the EC competition authority allows for divestiture contracts that ex ante foresee an option for the purchaser on some shares of the asset to be exercised at the end of the divestiture process, we observe two-sided first-best efficient restructuring investments. Hence, allowing for options on asset ownership as divestiture contracts, the competition authority implements first-best efficient asset transfers and eliminates the holdup problem which is prevalent in divestiture processes.

The solution of the holdup problem thus lies at the very beginning of a divestiture process. Right at the point in time when the merging parties and the purchaser sign the divestiture contract, the purchaser has to acquire

a share of ownership in the divestiture. This change in the allocation of ownership rights increases the merging parties incentives to invest in restructuring since the purchaser's investments in case of failing renegotiations are higher compared to the status quo case, where the merging parties sign the divestiture contract being exclusive owner of the assets.

6.2 Policy implications

Restructuring costs in the context of Cournot mergers under divestitures have not been studied in the literature on competition policy before. This is remarkable since this additional cost component has important implications for the design of the remedy and thus for post-merger competition. The competition authority not considering restructuring costs in the process of determining the size of the divestiture, may require too extensive asset sales, that is the cost increasing effect of the divestiture and its implementation is larger than actually intended, hence the authority engages in over-fixing the merger.

In merger remedy practice, the authority should be aware of two contrary effects that derive from restructuring costs. The positive one decreases the merging parties' market power via divestitures and restructuring costs in that they increase the merging parties' total cost of production and thus lowers their equilibrium output. The negative effect derives from the fact that restructuring costs reduce the total industry equilibrium output. Hence, divestitures simply lead to reallocations of productive capital in the industry but restructuring costs reduce equilibrium output and therefore cause higher market prices which eventually harms consumer surplus.

Thus, in the context of a Cournot model where merger incentives derive from expected economies of scale that can be realized due to an increased capital stock, the size of a structural merger remedy can be defined and controlled by the amount of cost reductions that are allowed by the competition authority. That is, the merger decreases production costs through the concentration

of productive capital. In some cases, the cost decreasing economies of scale are too large, i.e. the merging parties market share becomes too big or their turnover exceeds certain thresholds that indicate a creation of a dominant position. As a merger remedy, the competition authority increases the merging parties' cost of production by requiring divestitures. Not accounting for restructuring costs, the authority's intended cost increases may be too large. This eventually may harm the merging parties being forced to divest more than actually necessary.

Extending Medvedev (2004) by introducing restructuring costs to a Cournot market with divestitures shows that a competition authority neglecting restructuring costs may execute strong negative effects on the consumer surplus. Requiring divestitures without accounting for the cost of implementation that accrue to the merging parties, neither the intended level of effectiveness of the divestiture nor the true value of efficiency gains will be realized. Restructuring investments are inherent in every divestiture process. Thus, the competition authority has to take into consideration that restructuring costs increase the total cost of production and therefore lower the output of the merging parties which reduces their competitive advantage deriving from additional productive capital. Hence, competition authorities should try to exactly determine the expected cost of implementing a divestiture in order to find the right size of the structural merger remedy and not to require asset sales that are not proportionate to the competition problem.

Therefore, based on our insights from the introduction of restructuring costs to a Cournot model with capital divestitures we make the following policy implication:

The competition authority should take restructuring costs into consideration when determining scale and scope of the divestiture since in markets driven by quantity competition, these costs reduce total industry output post-merger and thus lead to a higher market price. Especially regarding extensive divestitures which are likely

to involve large-scale restructuring investments, the competition authority should engage in market tests that analyze the impact of the additional cost component with respect to her potential to increase post-merger prices by reducing total market output.

From our contract-theoretical analysis of the divestiture process we know that under the current EC merger policy, neither merging parties nor purchaser are incited to optimally invest in restructuring. The reason is that starting the divestiture process when merging parties are still legal and physical owner of the asset to be divested, the merging parties underinvest since they are not able to appropriate the returns on their investments within renegotiations since parts of the gains from renegotiations have to be paid to the purchaser since she is necessary for the transaction to be completed. Hence, the purchaser will acquire the asset after the merging parties invested in restructuring and subsequently engage in restructuring investments that are lower than optimal since they are conditional on the merging parties' investments.

The EC can only improve both-sided restructuring investments in the case that *ex ante*, i.e. before the players undertake restructuring investments and prior to the realization of uncertainty, the merging parties' marginal incentives to invest are increased. This in turn is only possible if we increase the purchaser's marginal investment incentives in the case of failing renegotiations which will be anticipated by the merging parties when choosing their restructuring investments. The key to alter the purchaser's marginal investments in case of default is to make her residual claimant of her own investments early in the divestiture process. From the theory of incomplete contracts we know that changes in the allocation of ownership rights alter incentives to engage in relationship-specific investments. Thus, in order to establish improved restructuring investments, the Commission should not allow for divestiture contracts where the merging parties are initially exclusive owner of the asset to be divested. Instead, the EC should transfer parts of the asset ownership to the purchaser, for instance in the form of

equity shares. Therefore, the buyer becomes residual claimant of her restructuring investments and thus cannot credibly deny to invest in case of failing renegotiations.

Depending on the degree of complementarity of restructuring investments, such an ex ante shared ownership divestiture contract may implement first-best efficient investments. In cases where the purchaser's reaction on an infinitesimal increase in the merging parties' investments is not strong enough, options on asset ownership are able to implement the first-best efficient outcome. Admitting for divestiture contracts that foresee an option for the purchaser to acquire shares of the asset via exercise, in contrast to a fixed ex ante distribution of a shared ownership structure, the purchaser is ex ante put in the position to be able to increase her expected equity shares in the transaction by engaging in larger restructuring investments. In the case of ex ante shared ownership, the purchaser's share in the transaction is predetermined in the initial divestiture contract. The purchaser's equity shares remain unaffected by the realization of uncertainty. Hence ex post, the ownership structure will not be changed in the case of failing renegotiations. In contrast, the option on asset ownership establishes a functional relationship between the purchaser's investments and the event of becoming partial owner of the asset.

Thus, for an improvement of the prevalent inefficient divestiture process under EC merger policy, we recommend the following:

Divestiture processes must not be started with the merging parties entering the divestiture contract remaining exclusive legal owner of the asset to be divested. As a result, we observe inefficient implementations of structural merger remedies. In dependence on the degree of complementarity of the investments, first-best efficient restructuring investments are implementable if the Commission admits for flexible ownership structures at the beginning of the divestiture process possibly involving options on asset ownership.

6.3 Discussion

One of the major issues in the practice of competition authorities is that key parameters are unobservable and important information is difficult to gather. This becomes essential in the case of a Cournot modeling in the presence of structural merger remedies and restructuring costs. For the authority to exactly determine the effects of the size of a divestiture on post-merger competition, she needs to know the level of restructuring costs otherwise she systematically over-fixes the merger. Requiring observability of restructuring investments represents a very strong assumption. As mentioned earlier, the restructuring cost can be partially retraced by institutions such as divestiture trustees but still there is enough room for the merging parties to overstate the cost of implementation. A competition authority, making the design of the divestiture conditional on the merging parties' wrong declarations on the level of restructuring cost, in the context of the Cournot merger will lead to an unfair and unintended competitive advantage for the merging parties over the competitor. We conclude that the assumption of observable restructuring cost for the competition authority in order to be able to adjust the divestiture is crucial and may be too strong for an application in real world divestiture processes.

The application of the theory of incomplete contracts to structural merger remedy processes provides a solution to the empirically observed holdup problem regarding restructuring investments by changing the allocation of ownership rights as fundamental part of the ex ante divestiture contract. The reason for opportunistic behaviour in the implementing phase of both, merging parties and purchaser, is obvious: two players enter into a contractual relationship which requires actions that are unobservable for the authority which aim to improve the post-merger competitiveness of the purchaser.

Certainly, our modeling only focuses on the divestiture process and abstracts from questions regarding the size and effectiveness of the remedy as well as from issues regarding the suitability of the purchaser. Anyway, we are convinced that the interpretation of a divestiture agreement to be an incomplete contract in that it determines the allocation of ownership rights throughout the divestiture process in the presence of relationship-specific investments is appropriate since divestitures imply legally enforced changes in ownership structure. This subject to research of theory of incomplete contracts, analyzing the impact of alternative ownership structures on the incentives within a contractual relationship.

In the case that the Commission gives an option on asset ownership to the purchaser, the authority not only establishes two-sided first-best efficient restructuring investments, she also solves the issue of non-observability of restructuring investments. The only thing she needs to know for decision-making is whether at the end of the divestiture process, the purchaser exercised her option on asset ownership. By an appropriate choice of the parameter in the option contract, the Commission implements efficient divestitures. Whenever she observes that the asset has been transferred to the purchaser at the closing of the divestiture process, she knows that two-sided optimal restructuring investments have been previously undertaken. Another elegant feature of the option contract is that the issue of finding an appropriate price for the asset to be divested is solved in that it is made an endogenous result of both-sided restructuring investments.

There is a critical assumption for the applicability of the model to divestiture processes. In order to find the optimal distribution of ex ante ownership rights among the purchaser and the merging parties or in order to determine the optimal option contract, the Commission needs to quantify the degree of complementarity of restructuring investments which in general may not be observable and thus cannot be precisely measured by the competition authority. Since the restructuring investments' complementarity can be seen as a proxy for the relevance of the purchaser for the transaction, the Commission

can deduce that in cases where only one purchaser is suitable to acquire the asset hence being decisive for asset transfer and subsequent merger clearance, investments can be considered to be highly complementary.

6.4 Further research

We introduced restructuring costs to a Cournot model with divestitures in order to analyze the effects that derive from such an additional cost factor on the equilibrium market outcome in isolation. However, various model extensions are thinkable. Hence, an advanced model could involve restructuring costs that additionally accrue to the purchaser of the asset which would presumably further restrict the range of parameters under which the post-merger price level could be maintained on the same level as the pre-merger price. Another model extension could consider restructuring costs in the presence of a asymmetric cost structure in the Cournot industry. Further investigations could formalize a functional relationship between the size of a structural merger remedy and the costs of implementation. Different types of merger remedies could be analyzed in a Cournot market with respect to welfare measures different from the consumer surplus standard that exclusively focuses on unilateral effects of a merger.

Furthermore, restructuring investments could be analyzed in models of differentiated Bertrand competition. To our knowledge, there is no literature on divestitures and their costly implementation in market that are characterized by price competition.

In this thesis, our focus was exclusively on the strategic interaction between the merging parties and the purchaser. A more extensive and complex way of modeling could include strategic interaction between the merging parties and the competition authority in the pre-divestiture phase as well as competition among merging parties and several competitors on the post-merger product market.

In our model, we assume that the size of the divestiture is exogenously given by the competition authority, i.e. we completely abstract from questions re-

garding the post-merger effectiveness of the divestiture.

With regard to pre-divestiture modeling, it may be worth to endogenize the shape of the divestiture and to put it into relationship with restructuring investments. A more detailed modeling could analyze the impact of different types of divestitures on restructuring investments. Furthermore, we assumed the existence of a single suitable purchaser who is willing to buy the divestiture. Hence, a more complex model could consider competition among several firms outside of the merger transaction that aim to acquire the asset. In this context, an explicit modeling of the allocation mechanism of the divestiture among the competing firms would be of interest. Here, we think of auction-theoretical considerations.

Our approach to the implementation of structural merger remedies is a contract-theoretical one. We assumed that restructuring costs are prevalent in any divestiture process and we affirmed that they may be substantial in size. We also supposed that insufficient restructuring investments are the result of double moral hazard issues which are involved in divestitures since the competition authority artificially creates a business relationship between two competing firms. However, to our knowledge, there is no study which analyzes the relationship between the level of restructuring costs and the size of a divestiture. We assume that deeper regulatory interventions require higher restructuring costs. Further research may give an answer to this assumption.

Finally, we conclude that a lot of research has to follow, especially concerning the application of contract-theoretical models to merger remedies. We are convinced that the EC Merger Remedies Study can be understood as a research agenda for further analysis in the field of competition policy since the study contains several issues related to merger remedies that are theoretically unexplained.

Chapter 7

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Chapter 8

Appendix

8.1 Definitions

*Commitments (or remedies)*¹

Proposal by the parties to a concentration to modify their originally notified project within a specified period (for example, by divesting a business or assets). Such commitments must address the competition concerns raised by the Commission and restore competition in the relevant product and geographic markets. They can form the basis for the Commission's clearance of the notified concentration. The Commission may attach conditions and/or obligations to its clearance decision, so as to ensure compliance with the commitments offered.²

Concentration

A concentration arises either where two or more previously independent undertakings merge (merger), where an undertaking acquires control of another undertaking (acquisition of control), or where a joint venture is created, performing on lasting basis all the functions of an autonomous economic entity

¹C.f. Glossary of terms used in EU competition policy - Antitrust and control of concentrations

²C.f. Articles 6(2) and 8(2) of the merger regulation; Commission notice on remedies (OJ C 68, 2.3.2001, p.3).

(full-function joint venture).³

Divestiture

Decision by a firm to sell part of its current operations, divisions or subsidiaries as a result of business restructuring in order to concentrate on certain products or markets. Under EC competition law, divestiture may also be offered by firms as a commitment to the Commission in order to eliminate competition concerns related to notified agreement or concentration.

Restructuring investments

The *merging parties' restructuring investments* comprise all actions and monetary payments that aim to preserve viability, marketability and competitiveness of the divestiture.

The Commission requires in detail to:

- maintain the business and not to carry out any act which might have significant negative impact on its value, management or competitiveness
- finance the divested business to allow continued development on the basis of the existing business plans
- retain key personnel by offering, if necessary, appropriate incentive schemes.

The *suitable purchaser's restructuring investments* intend to ensure the viability of the divestiture. Concretely this requires the purchaser to:

- adapt business processes to the divestiture
- provide key personnel for the operations
- integrate the asset in the corporate strategy and fix corporate goals
- create or continue a business-and financial plan for the deployment of the asset.

³C.f. Article 3(1) and (2) of the EC Merger Regulation; Commission notice on the concept of concentration (OJ C 66, 2.3.1998, p.2).

8.2 Calculations and proofs

$n = 3$: pre-merger situation

$$\begin{aligned}\Pi_i &= (a - bQ)q_i - C(q_i, k_i) \\ &= (a - bQ)q_i - \frac{d_i}{k_i}q_i \\ &= \left(a - b \sum_{i=1}^3 q_i \right) q_i - \frac{d_i}{k_i}q_i\end{aligned}$$

Assumption (1):

$$d_1 = d_2 = d_3 = d$$

$$k_1 = k_2 = k_3 = k$$

$$\begin{aligned}\frac{\partial \Pi_i}{\partial q_i} = 0 : \quad a - 2bq_i - b \sum_{j=1, i \neq j}^3 q_j - \frac{d}{k} &= 0 \\ \Leftrightarrow \frac{a - b \sum_{j=1, i \neq j}^3 q_j - \frac{d}{k}}{2b} &= q_i \left(\sum_{j=1, i \neq j}^3 q_j \right)\end{aligned}$$

Assumption (2):

In the Cournot equilibrium, firms choose symmetrically

$$q_1 = q_2 = q_3 = q^c$$

$$\begin{aligned}\Leftrightarrow q^c &= \frac{a - b(q^c + q^c) - \frac{d}{k}}{2b} \\ \Leftrightarrow q^c &= \frac{1}{4b} \left(a - \frac{d}{k} \right)\end{aligned}$$

The total pre-merger industry output amounts accordingly to

$$Q_{total}^{pre} = 3q^c = \frac{3}{4b} \left(a - \frac{d}{k} \right)$$

with a market price of

$$P(Q_{total}^{pre}) = (a - bQ_{total}^{pre}) = \frac{1}{4} \left(a + 3\frac{d}{k} \right)$$

and an individual profit of

$$\pi_i^{pre} = \frac{1}{16b} \left(a - \frac{d}{k}\right)^2.$$

$n = 2$: post-merger situation without structural merger remedies

The merging parties choose q_M in order to

$$\begin{aligned} \max_{q_M} (a - bQ)q_M - C(q_M, 2k) = \\ \max_{q_M} [a - b(q_M + q_O)]q_M - \frac{d}{2k}q_M. \end{aligned}$$

$$\begin{aligned} \frac{\partial \pi_M}{\partial q_M} = 0 : \quad a - 2bq_M - bq_O - \frac{d}{2k} &= 0 \\ \Leftrightarrow \frac{1}{2} \left[\frac{a}{b} - q_O - \frac{d}{2bk} \right] &= q_M \quad (I) \end{aligned}$$

The last remaining competitor on the market simultaneously chooses her output that maximizes

$$\begin{aligned} \max_{q_O} (a - bQ)q_O - C(q_O, k) = \\ \max_{q_O} [a - b(q_M + q_O)]q_O - \frac{d}{k}q_O. \end{aligned}$$

$$\begin{aligned} \frac{\partial \pi_O}{\partial q_O} = 0 : \quad a - 2bq_O - bq_M - \frac{d}{k} &= 0 \\ \Leftrightarrow \frac{1}{2} \left[\frac{a}{b} - q_M - \frac{d}{bk} \right] &= q_O \quad (II) \end{aligned}$$

Plugging (I) in (II) yields the equilibrium output of the merging parties and the competitor:

$$\begin{aligned} q_M^c &= \frac{a}{3b} \\ q_O^c &= \frac{1}{3b} \left[a - \frac{3d}{2k} \right] \end{aligned}$$

The total post-merger industry output amounts accordingly to $Q_{total}^{post} = q_M^c + q_O^c = \frac{1}{3b} \left(2a - \frac{3d}{2k} \right)$

with a market price of

$$P(Q_{total}^{post}) = (a - bQ_{total}^{post}) = \frac{a}{3} + \frac{d}{2k}.$$

The merged firm yields a profit of

$$\pi_M^{post} = \frac{1}{9b} \left(a - 2\frac{d}{2k} + \frac{d}{k} \right)^2 = \frac{a^2}{9b}.$$

The competitor gains

$$\pi_O^{post} = \frac{1}{9b} \left(a - 2\frac{d}{k} + \frac{d}{2k} \right)^2 = \frac{1}{9b} \left(a - \frac{3d}{2k} \right)^2.$$

$n = 2$: **post-merger situation with divestiture δ**

The merging parties choose q_M in order to

$$\begin{aligned} \max_{q_M} (a - bQ)q_M - C(q_M, 2k - \delta) = \\ \max_{q_M} [a - b(q_M + q_O)]q_M - \frac{d}{(2k - \delta)}q_M. \end{aligned}$$

$$\begin{aligned} \frac{\partial \pi_M^\delta}{\partial q_M} = 0 : \quad a - 2bq_M - bq_O - \frac{d}{(2k - \delta)} &= 0 \\ \Leftrightarrow \frac{1}{2} \left[\frac{a}{b} - q_O - \frac{d}{b(2k - \delta)} \right] &= q_M^\delta \quad (I) \end{aligned}$$

The last remaining competitor on the market simultaneously chooses her output that maximizes

$$\begin{aligned} \max_{q_O} (a - bQ)q_O - C(q_O, k + \delta) = \\ \max_{q_O} [a - b(q_M + q_O)]q_O - \frac{d}{(k + \delta)}q_O. \end{aligned}$$

$$\begin{aligned} \frac{\partial \pi_O^\delta}{\partial q_O} = 0 : \quad a - 2bq_O - bq_M - \frac{d}{(k + \delta)} &= 0 \\ \Leftrightarrow \frac{1}{2} \left[\frac{a}{b} - q_M - \frac{d}{b(k + \delta)} \right] &= q_O^\delta \quad (II) \end{aligned}$$

Plugging (I) in (II) yields the equilibrium output of the merging parties and the competitor in the presence of asset sales:

$$\begin{aligned} q_M^\delta &= \frac{1}{3b} \left[a + \frac{d}{k + \delta} - \frac{2d}{2k - \delta} \right] \\ q_O^\delta &= \frac{1}{3b} \left[a + \frac{d}{2k - \delta} - \frac{2d}{k + \delta} \right] \end{aligned}$$

The total post-merger industry output amounts accordingly to

$$Q_{total}^{post}(\delta) = q_M^\delta + q_O^\delta = \frac{1}{3b} \left[2a - \frac{d}{2k - \delta} - \frac{d}{k + \delta} \right]$$

with a market price of

$$P^{post}(\delta) = (a - bQ_{total}^{post}(\delta)) = \frac{1}{3}\left[a + \frac{d}{2k-\delta} + \frac{d}{k+\delta}\right].$$

The merged firm yields under divestments

$$\pi_M^\delta = \frac{1}{9b}\left[a - 2\frac{d}{2k-\delta} + \frac{d}{k+\delta}\right]^2.$$

The competitor gains with the additional assets

$$\pi_O^\delta = \frac{1}{9b}\left[a - 2\frac{d}{k+\delta} + \frac{d}{2k-\delta}\right]^2.$$

$n = 2$: **post-merger situation with divestiture and restructuring costs** r_M

The merging parties choose q_M in order to

$$\begin{aligned} \max_{q_M} (a - bQ)q_M - C(q_M, r_M, 2k - \delta) = \\ \max_{q_M} [a - b(q_M + q_O)]q_M - \frac{d + r_M}{(2k - \delta)}q_M. \end{aligned}$$

$$\begin{aligned} \frac{\partial \pi_M^\delta(r_M)}{\partial q_M} = 0 : \quad a - 2bq_M - bq_O - \frac{d + r_M}{(2k - \delta)} = 0 \\ \Leftrightarrow \frac{1}{2} \left[\frac{a}{b} - q_O - \frac{d + r_M}{b(2k - \delta)} \right] = q_M^\delta(r_M) \quad (I) \end{aligned}$$

The last remaining competitor on the market simultaneously chooses her output that maximizes

$$\begin{aligned} \max_{q_O} (a - bQ)q_O - C(q_O, k + \delta) = \\ \max_{q_O} [a - b(q_M + q_O)]q_O - \frac{d}{(k + \delta)}q_O. \end{aligned}$$

$$\begin{aligned} \frac{\partial \pi_O^\delta}{\partial q_O} = 0 : \quad a - 2bq_O - bq_M - \frac{d}{(k + \delta)} = 0 \\ \Leftrightarrow \frac{1}{2} \left[\frac{a}{b} - q_M - \frac{d}{b(k + \delta)} \right] = q_O^\delta \quad (II) \end{aligned}$$

Plugging (I) in (II) yields the equilibrium output of the merging parties and the competitor in the presence of asset sales:

$$\begin{aligned} q_M^\delta(r_M) &= \frac{1}{3b} \left[a + \frac{d}{k + \delta} - 2 \frac{(d + r_M)}{2k - \delta} \right] \\ q_O^\delta(r_M) &= \frac{1}{3b} \left[a + \frac{d + r_M}{2k - \delta} - \frac{2d}{k + \delta} \right] \end{aligned}$$

The total post-merger industry output amounts accordingly to

$$Q_{total}^{post}(\delta, r_M) = q_M^\delta(r_M) + q_O^\delta(r_M) = \frac{1}{3b} \left[2a - \frac{d+r_M}{2k-\delta} - \frac{d}{k+\delta} \right]$$

with a market price of

$$P^{post}(\delta, r_M) = (a - bQ_{total}^{post}(\delta, r_M)) = \frac{1}{3} \left[a + \frac{d+r_M}{2k-\delta} + \frac{d}{k+\delta} \right].$$

The merged firm yields under divestments

$$\pi_M^\delta(r_M) = \frac{1}{9b} \left[a - 2 \frac{d+r_M}{2k-\delta} + \frac{d}{k+\delta} \right]^2.$$

The competitor gains with the additional assets

$$\pi_O^\delta(r_M) = \frac{1}{9b} \left[a - 2 \frac{d}{k+\delta} + \frac{d+r_M}{2k-\delta} \right]^2.$$

Proof of Proposition (A)⁴

In a first step we restate the players' delta functions

$$\Delta_M(x_M, x_B) \equiv \vartheta_M(x_M, x_B) - \Sigma(x_M, x_B)$$

$$\Delta_B(x_M, x_B) \equiv \vartheta_B(x_M, x_B) - \Sigma(x_M, x_B)$$

in the following way:

$$\Delta_M(x_M, x_B) = E[\Lambda_M(V, C)|x_M, x_B] \quad (8.1)$$

$$\Delta_B(x_M, x_B) = E[\Lambda_B(V, C)|x_M, x_B], \quad (8.2)$$

where

$$\Lambda_M(V, C) = \Pi_M(V, C) - (V - C)q^*(V, C) \quad (8.3)$$

$$\Lambda_B(V, C) = \Pi_M(V, C) - (V - C)q^*(V, C). \quad (8.4)$$

Taking different subgame perfect renegotiation outcomes (4.15) into consideration, the merging parties delta function assumes:

$$\Lambda_M(V, C) = \begin{cases} \pi(0, \Phi^0) & \text{if (i)} \\ \pi(0, \Phi^0) + p^0 - V & \text{if (ii)} \\ \pi(0, \Phi^0) - (V - C) & \text{if (iii)} \\ \pi(0, \Phi^0) & \text{if (iv)}. \end{cases} \quad (8.5)$$

Accordingly, we make the buyer's delta function explicit:

$$\Lambda_B(V, C) = [(V - C)q^*(V, C) - \Pi_M(V, C)] - (V - C)q^*(V, C) = -\Pi_M(V, C). \quad (8.6)$$

We now form expectations with respect to the information parameters V and C . The delta value function of the merging parties thus amounts to

$$\Delta_M(x_M, x_B) = E_C[Z_M(C, x_B)|x_M]$$

⁴This proof is in line with Schweizer (1999), p. 224-226.

$$\Delta_B(x_M, x_B) = E_V[Z_B(C, x_B)|x_B],$$

where,

$$Z_M(C, x_B) \equiv E_V[\Lambda_M(V, C)|x_B] \quad (8.7)$$

$$Z_B(V, x_M) \equiv E_C[\Lambda_B(V, C)|x_M], \quad (8.8)$$

Now we build the partial derivative of the delta function using the functional relationships from above:

$$\frac{\partial \Delta_M}{\partial x_M} = -E_C \left[Z'_M \frac{F_x}{f} |x_M \right] \quad (8.9)$$

$$\frac{\partial \Delta_B}{\partial x_B} = -E_V \left[Z'_B \frac{G_x}{g} |x_B \right], \quad (8.10)$$

with $Z'_M = \partial Z_M / \partial C$ and $Z'_B = \partial Z_B / \partial V$.

Taking the case differentiation (8.5) into consideration, it becomes obvious that only case (iii) is a function of C . Thus, building the first derivative of $\Lambda_M(V, C)$ yields $\partial \Lambda_M / \partial C = 1$. Hence, we can integrate the case differentiation via an indicator function 1_C which assumes 1 if case (iii) is realized else 0 for every other case. In total, the function assumes

$$Z'_M(C, x_B) = E_V[1_{(iii)}|x_B] \geq 0. \quad (8.11)$$

We now plug equation (8.11) into (8.9) which yields $\partial \Delta_M / \partial x_M \leq 0$. We know that $Z'_M > 0$ if there exists a value of the asset within the support of (V_L, V_H) such that (V, C) lies within the range of case (iii). This holds true, whenever the value of the asset is strictly larger than the cost of producing the merger plus $\pi(0, \phi^0) = \Gamma^0 > \pi(1, \Gamma^0) = p^0 - C + \Gamma^0$, i.e. if $V > C > p^0$. This is only possible if the buyer's willingness to pay is as large as

$$V_H > C > p^0. \quad (8.12)$$

As an important result, the delta-profit-welfare-function is strictly decreasing in the merging parties' restructuring investments, $\partial \Delta_M / \partial x_M < 0$ if there

exists some parameter of merger cost in the interval (C_L, C_H) , which satisfies $V_H > C > p^0$. This holds only true if indeed

$$\max\{p^0, C_L\} < \min\{V_H, C_H\}.$$

The proof which has been applied to the merging parties' restructuring incentives can be applied in an analogous way for the incentives of the buyer, i.e.

$$Z'_B(V, x_M) = E_C \left[\frac{\partial \Delta_B}{\partial V} | x_M \right] = -E_C[1_{(iv)} | x_M] \leq 0. \quad (8.13)$$

Plugging this relationship into equation (8.10) we receive accordingly $\partial \Delta_B / \partial x_B \leq 0$. Very much as in the analysis of the merging parties' restructuring incentives, we know from (8.13) that $Z'_B < 0$ if there is a parameter for merger initiation costs C within the interval (C_L, C_H) such that the parameter constellation (V, C) lies within the range of (iv). This is only the case if $V > C$ and $\pi(1, \phi^0) = p^0 - C + \Gamma^0 > V - C + \pi(0, \Gamma^0) = V - C + \Gamma^0$ which holds only true for the constellation $p^0 > V > C_L$. The parameters (V, C) lie within the range of case (iv) if there is some lower bound for merger initiation cost such that

$$p^0 > V > C_L. \quad (8.14)$$

In the case that there exists some willingness to pay from the range (V_L, V_H) which satisfies (8.14), an increase in the buyer's restructuring investments actually has a strictly negative impact on the delta-function, i.e. formally $\partial \Delta_B / \partial x_B < 0$. This is only the case if

$$\max\{V_L, C_L\} < \min\{p^0, V_H\}.$$

This completes the proof.

Q.E.D.

**Erklärung nach §11 Nr. 5 der Promotionsordnung der WHU i.
d. F. vom 19.11.2003**

Ich erkläre hiermit, dass ich die bei der Wissenschaftlichen Hochschule für Unternehmensführung (WHU)-Otto-Beisheim-Hochschule- vorgelegte Dissertation selbständig und ohne die Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sind als solche kenntlich gemacht.

Die Arbeit wurde bisher in gleicher oder ähnlicher Weise keiner anderen Prüfungsbehörde vorgelegt.

Düsseldorf, den 28. April 2008

(Christian Steiner)