Dual-class Shares, Initial Public Offerings and the Market for Corporate Control

By

ULRIKE HOFFMANN-BURCHARDI

The London School of Economics and Political Science

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ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

Abstract

This dissertation focuses on two central capital market transactions, takeovers and initial public offerings (IPOs), from both a theoretical and an empirical point of view. After an introductory chapter, the first two chapters analyse how minority shareholders are affected by a change in take-over regulation (introduction of the mandatory bid rule) in Germany in 1995. The last chapter focuses on the pricing and timing of going-public transactions.

Chapter 2 focuses on the absolute wealth effect of the mandatory bid rule and formalises the trade-off minority shareholders of corporate raiders face with respect to the adoption of a mandatory tender offer after a shift in control. Under plausible assumptions about the distribution of security and control benefits, minority shareholders of acquirers profit from the adoption of the mandatory bid rule. A subsequent empirical study supports this hypothesis by measuring the stock price effects after the acceptance of the German Takeover Code.

Chapter 3 uses a dataset of German dual-class shares during 1988-1997 to study how the change of corporate governance rules affects the price differential between voting and non-voting stock. First, the chapter discusses how mechanisms to separate control from cash-flow rights relate to the value of control. Second, the chapter analyses how minority voting and non-voting shareholders participate in transfers of corporate control under the alternative regulatory structures pre- and post- 1995.

By providing an analysis of sequential going-public decisions, Chapter 4 outlines conditions under which the likelihood of a second IPO increases after a first firm has gone public ('hot issue markets'). Two effects can trigger the rise of hot issue markets in a setting with asymmetric and costly information about both firm quality and industry prospects: risk-induced selling pressure and informational free-riding on the industry news conveyed by a first IPO. Finally, the model offers an explanation for the empirical finding that hot issue markets exhibit a higher degree of underpricing than cold issue markets.

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Chapter 1

Introduction

1.1 Overview

The thesis focuses on two central capital market transactions from both a theoretical and empirical point of view: initial public offerings and takeovers. These are both transactions which change the ownership structure of companies, the former by introducing formerly privately held companies to the stock market, the latter by changing the majority owner of the company. The difference is that an IPO transforms concentrated into dispersed ownership, whereas takeovers imply a new majority owner, arising either from a dispersed ownership structure or a different prior controlling blockholder. The emphasis of the first part of the thesis lies on takeovers and their regulation (Chapter 2 and 3). These chapters analyse how different regulatory structures affect the wealth of minority shareholders in takeovers. Chapter 2 focuses generally on wealth effects for minority shareholders under a change in takeover rules. Chapter 3 analyses how a change in corporate governance rules affects the control value of voting stock, as measured by the price differential between voting and non-voting shares. The forth chapter studies the timing and pricing of Initial Public Offerings (IPOs). By providing an analysis of sequential going-public decisions, the paper proposes a model which explains the driving forces for the evident swings in IPO activity over time.

1.2 Takeovers and corporate governance (Chapters 2 and 3)

1.2.1 Takeover regulation

While virtually absent in the 1960s, takeover regulation has appeared on the Continental European policy agenda only in the 1980s, along with an increase in takeover

activity in the European Union. In an attempt to create a 'level playing-field' in European takeover regulation, the EU Commission drafted a Proposal for a Thirteenth Council Directive on Company Law in 1989. Its current version, which was presented in 1990, contains disclosure rules, prescriptions on public takeover bids and rules on the equal treatment of all shareholders. The most controversial element of the proposed Company Law Directive, probably the most disputed regulation among takeover rules as such (Burkart [1997]), is the Mandatory Bid Rule (MBR). The mandatory bid rule stipulates that a party which purchases a controlling interest of another listed company's voting equity is obliged to make an offer to the remaining target shareholders at a price not smaller than the price paid for the controlling block. Besides the proposed Directive, the rule has been adopted in various European countries including France, Italy, Norway and Germany. Germany introduced the MBR through the Takeover Code which was introduced in Germany in 1995 as a self-regulatory initiative. The MBR is also part of the UK City Code on Takeovers and Mergers and prevalent in the US state legislation of Pennsylvania and Maine. The Williams Act, the principal federal US legislation, however, reneges on the MBR and allows partial bids (market rule). Despite its widespread use the MBR has only gained relatively scarce attention in the literature (for an overview of the theoretical contributions see Chapter 2). The first two chapters of the thesis seek to address this shortcoming by analysing the wealth implications of the MBR for minority shareholders from both a theoretical and an empirical point of view.

1.2.2 Assumptions about ownership structure

The first two chapters differentiate themselves from the main body of the corporate governance literature in that their assumptions reflect the institutional reality of Continental European corporate governance. Whereas the prevalent corporate governance literature is based on the 'US-UK' paradigm of a large publicly traded company with dispersed ownership, these chapters presuppose that companies are controlled by an incumbent blockholder. Ownership concentration in Continental European economies is characterized by a widespread presence of block ownership. In Germany, for example, concentration of ownership is prevalent: the average free float of companies listed on the segments 'Amtlicher Handel' and 'Geregelter Markt' equals roughly 30% of the companies' equity capital and there are only 40% of companies without a dominant ultimate blockholder. There is also increasing evidence that even in Anglo-Saxon economies large controlling shareholders are not negligible. A recent study on worldwide corporate ownership structures by La Porta et al. [1998] challenges the 'Berle and Means image' of ownership of public corporations. Berle and Means [1932] called

attention to the separation of ownership and control in US publicly traded corporations. While ownership was dispersed among atomistic shareholders, a small number of managers exerted de facto control over the corporation. This view has transfixed a large stream of the corporate governance literature which focused on the agency conflicts between dispersed shareholders and management. The recent empirical study of worldwide ownership patterns by La Porta et al. [1998] is so far the most comprehensive report which questions the empirical validity of the image of the widely-held, manager-run corporation. They report that only 36% of large publicly traded companies in 27 industrialized economies are widely held without a major shareholder owning more than a 20% equity fraction. Even in the UK and the US about 40% and 10% respectively of medium-sized publicly traded companies possess a significant shareholder owning more than 20%. These findings corroborate the results of other studies which have highlighted the importance of incumbent blockholders, e.g. Demsetz and Lehn [1985], Shleifer and Vishny [1988], Holderness and Sheehan [1988], and Barclay and Holderness [1991]. This body of research suggests that the potential conflict of interests between majority and minority shareholders is of central importance for corporate governance. La Porta et al. [1998] conclude that

> *"... the principal agency problem in large corporations around the world is that of restricting expropriation of minority shareholders by the controlling shareholders, rather than that of restricting empire building by professional managers unaccountable to shareholders."*

Most literature surveys on corporate governance have given the latter prime consideration (e.g. Hart [1995], and Shleifer and Vishny [1997]) and only marginally focused on the potential expropriation by large blockholders. The above conclusion provides a new direction to research in corporate finance focusing on inter-shareholder rather than shareholder-manager agency problems. The two chapters following the introduction seek to do justice to this objective and study the effect of takeover regulation in the presence of shareholders with a controlling influence.

1.2.3 Ownership structure, control transfers and takeover regulation

The prevailing ownership pattern and means of control transfers are crucial for the analysis of the impact of takeover regulation on shareholder wealth. The majority of the literature on takeover regulation presupposes a dispersed ownership structure and tender offers as the dominant mode of control transfer (see Burkart [1997]). Given the empirical evidence discussed under 1.2.2, the presence of a controlling blockholder

is the key assumption in the first part of the thesis. As a consequence of this ownership pattern transfers of control take place through sales of share packages rather than share purchases from atomistic shareholders (via tender offers or purchases in the open market). Franks and Mayer [1997] report that even in the UK about 40% of control changes take place via sales of blockholdings. This influences the way in which takeover regulation affects shareholder wealth. In particular, it does affect the payoff to minority shareholders of target companies under the MBR. If control is transferred via sales of share stakes, the MBR opens the opportunity for minority shareholders of target companies to participate in the surplus resulting from the control transfer. The incumbent blockholder is only willing to sell the controlling stake to the 'control aspirant' if he obtains at least his reservation value, i.e. the sum of security and private benefits of control. Since minority target shareholders are entitled to participate in the transfer on the same terms as the selling blockholder, they are able to be compensated for the private control benefits of the incumbent blockholder. With a dispersed ownership structure and no competition for control minority shareholders will not profit from the mandatory bid rule since the control aspirant will only compensate them for the security benefits under his management (Grossman and Hart [1980]).

The first two chapters of the thesis analyse how the MBR affects shareholder wealth under the assumptions about ownership and control transfers as discussed above.Chapter 2 investigates the absolute wealth effect for minority shareholders of companies which are controlled by an incumbent blockholder and likely to undertake acquisitions in the future. Chapter 3 focuses on the relative wealth effects for voting and non-voting shareholders upon adoption of the MBR. The chapter analyses the differential payoff to voting and non-voting shareholders under the MBR and derives implications for the voting premium. Since the price differential between voting and non-voting stock reflects the control value of voting stock, the first chapter analyses the effect of the MBR on the value of control which a voting share confers.

1.2.4 The effect on shareholder wealth (Chapter 2)

The focus of Chapter 2 rests on the wealth effects for minority shareholders of blockholder-controlled companies with a high acquisition activity ('barbarians'), which the debate on the welfare implications of takeover regulation has so far largely ignored. The two-fold objective of this paper is to study the wealth effect for minority shareholders of acquirers from both a theoretical and empirical perspective.

The chapter first proposes a model which formalizes the trade-off minority share-

holders of corporate raiders face with respect to the adoption of a mandatory tender offer after a shift in control. On the one hand, minority shareholders of bidders are worse off because the MBR effectively grants a call option to the minority shareholders of the target, thus redistributing wealth from (minority) shareholders of the bidder to minority shareholders of the target. On the other hand, the MBR reduces the number of wealth-decreasing bids by preventing the bidding blockholder from acquisitions which do not sufficiently increase security benefits for its minority shareholders. Under reasonable assumptions about the distribution of security and control benefits, the model suggests that minority shareholders of acquirers profit from the adoption of the mandatory bid rule.

The subsequent empirical study tests this hypothesis by measuring the wealth effects for minority shareholders of acquirers in response to the acceptance of the German Takeover Code. The Code contains the mandatory bid rule as its core element and was introduced in Germany in 1995 as a self-regulatory initiative. The excess stock returns of signatory companies are regressed on variables proxying for the likelihood of becoming a prospective bidder. A fully efficient maximum likelihood estimator is derived for a trivariate regression model which estimates characteristics of corporate acquirers and takes account of the endogeneity of the acceptance decision. The empirical study confirms the hypothesis of the theoretical model that minority stockholders are better off with '*Barbarians in chains*'.

1.2.5 The value of control (Chapter 3)

Whereas the previous chapter analyses the overall wealth effect resulting from the adoption of the MBR, this chapter focuses on the effect on the control value of voting minority shareholders, A substantial body of empirical literature has analysed the price differential between voting and non-voting stock. Almost all of the studies which focused on the determinants of the voting premium (e.g. Zingales [1994], Zingales [1995], Rydqvist [1997], Nicodano [1997]) have argued that the premium arises because voting shares can make a difference to the outcome of a control contest. These studies mainly use majority control as a proxy for the degree of control competition. If a company is majority-controlled, competition for control is thwarted and the voting premium correspondingly lower. This reasoning crucially depends on competition for control; as soon as control is uncontested, atomistic voting shares do not capture any private benefits of control and hence give not rise to a voting premium. In Anglo-Saxon capital markets competition for control is intense so that the framework is useful to study explanatory factors for the voting premium. Franks and Mayer [1997]

point to a virtual absence of an active market for corporate control in Continental European capital markets. For instance, they report that there were only three cases of hostile takeovers of non-financial corporations in Germany between 1945 and 1994. In Continental European countries the analysis therefore has to be complemented with another dominant mode of control transfer, sale of share stakes. This becomes particularly important when analysing the effect of the MBR on the payoffs to minority voting and non-voting shareholders in corporate control transactions. Whereas in the absence of the MBR minority voting shareholders will be excluded from any sale-of-control transaction, the MBR provides the option to participate in the control transfer on the same terms as the selling blockholder. The presence of a controlling blockholder can therefore, even in the absence of competition for control, result in a superior payoff to voting minority shareholders.

The chapter investigates the determinants of the voting premium, the price differential between voting and non-voting shares in Germany during 1988-1997. It shows that the price differential results from two factors: the value of controlled assets per unit invested in voting stock and the way in which minority voting and non-voting shareholders participate in transfers of control. Both factors are influenced by the existing regulation of corporate governance. The paper studies how a change in corporate governance rules in Germany in 1995 affects the voting premium through these two channels. The German stock exchange introduced the mandatory bid rule through a voluntary Takeover Code in October 1995.

The chapter focuses on the regulatory change from two different points of view: first, it examines the effect on the voting premium as a result of an individual acceptance decision of the Code and second, it analyses the overall change in the payoff to minority voting and non-voting shareholders in corporate control transactions. First, the paper shows how non-voting stock, debt and a pyramiding structure of subsidiaries increase the amount of controlled assets without diluting control rights. Acceptance of the Code reduces the extent to which a pyramiding structure of subsidiaries can be used to increase the control value of voting stock and therefore has a negative effect on the voting premium. Second, in the absence of the mandatory bid rule shareholders of voting and non-voting stock experience identical payoffs when a majority block changes hands. The existence of a majority shareholder tends to preclude any superior payoff for voting minority shareholders. Under the mandatory bid rule, however, voting minority shareholders can participate in a sale-of-control transaction on the same terms as the controlling blockholder. Regressions of the voting premium on majority-control support this hypothesis and show that the coefficient estimate is

negative during the pre- 1995 period and positive after 1995.

1.3 Initial Public Offerings (Chapter 4)

1.3.1 Empirical evidence on the timing and pricing of IPOs

Whereas the first two chapters focus on ownership transition from one controlling shareholder to another via takeovers, the last chapter deals with Initial Public Offerings (IPOs). In an IPO a controlling shareholder sells a formerly privately-held company to dispersed shareholders by introducing a fraction of the company's shares to the stock market. Besides the phenomenon of long-term underperformance of IPO shares (e.g. Loughran and Ritter [1995], Levis [1993], and Ljungqvist [1993]), three empirical regularities have emerged in the literature on IPOs: short-run underpricing, a concentration of IPO activity in periods of high stock market valuations and an industry-specific clustering of IPO activity. Underpricing denotes the average price run-up from the issue price to the secondary market price, i.e. the average percentage price change from the offering price to the market price. Significant positive initial returns were found in all stock markets, although the magnitude of underpricing differs across countries (Loughran et al. [1994]). A second stylized fact suggests that firms time their primary equity issues for periods of high stock market prices. There is a large body of empirical evidence across different countries which confirms a positive correlation between IPO volume and the level of stock valuations (see Loughran et al. [1994] for a cross-sectional overview). More recent empirical evidence shows that the bunching of IPO activity coincides with an increase in underpricing. In a recent paper Helwege and Liang [1996] document that underpricing averaged 14.6% in the hot issue year of 1983 and only 6.6% in 1988, where the number of IPOs shrunk to a quarter of the 1983 figure. Ljungqvist [1997] also reports that a positive macroeconomic climate raises the average amount of underpricing. Thirdly, there exists evidence that hot issue markets typically arise from the bunching of IPO activity in a few industries (Ritter [1984], Helwege and Liang [1996]).

While theoretical explanations for underpricing are abundant in the literature, the timing of the IPO decision has only recently been the subject of theoretical investigation (see Chapter 4 for an overview). In particular, there has so far been no model which explains the positive correlation between issuance activity and the magnitude of underpricing. Chapter 4 seeks to provide a model which in a first step offers an explanation for the bunching of IPO activity and subsequently establishes a link between underpricing and the level of issuance activity.

1.3.2 IPO clustering and underpricing

The main objective of Chapter 4 is to determine the driving forces which cause the evident swings in the quantity of initial public offerings (IPOs) over time. By providing an analysis of sequential going-public decisions the paper outlines conditions under which hot issue markets arise, i.e. to define conditions under which the likelihood of a second IPO increases after a first firm has gone public. The feed-back mechanism from one IPO to the next consists of informational externalities about a common value factor (industry outlook) conveyed by the first IPO. In this respect the chapter is related to herding models with information externalities (Welch [1996]). A common value factor might represent the prospects for a specific industry or the overall state of the economy.

In the model there are two risk-averse utility maximising owner-entrepreneurs who successively decide whether to undertake an IPO or to remain private. There are potential gains to an IPO, since the entrepreneur can sell his firm to risk-neutral investors. At the same time entrepreneurs and investors have to overcome frictions due to bilateral asymmetry of information. The aggregate value of the firm depends, in a multiplicative way, on a firm-specific and an industry-wide factor. Whereas the entrepreneur knows the firm-specific factor, investors are neither aware of the firms' quality nor the industry prospects. They can, however, purchase a noisy signal about the overall firm value.

The signal realization in the wake of the first IPO allows investors to update their expectation about the industry-wide factor and thus the value of the second firm in the industry. There are two key factors in the model which increase the likelihood of a second IPO: risk-induced selling pressure and informational free-riding. First, if the uncertainty about the state of the industry rises after the first IPO, the risk of staying private increases so that the entrepreneur's private valuation decreases relative to the market valuation. Second, the superior knowledge about industry prospects after the first IPO reduces the marginal benefit of further information production. If investors free-ride on this additional information and abstain from further costly information production, the market valuation can increase to a larger extent than the entrepreneur's private valuation.

Finally, the model offers an explanation for why hot issue markets often coincide with more pronounced underpricing than cold issue markets. Underpricing comes about if the private information accrued by investors during the IPO is better than prior expectations about the firm value. Equally, risk-induced selling pressure is

triggered by unexpectedly positive industry information. So, both the clustering and underpricing phenomena result from the same underlying fact, i.e. positive surprise about industry prospects.

Chapter 2

'Barbarians in Chains' - Takeover Regulation and Minority Shareholder Wealth

2.1 Introduction

Hitherto the debate on the welfare implications of takeover regulation (for an overview see Burkart [1997]) has largely disregarded the wealth effects for minority shareholders of 'barbarians', i.e., of companies with a high acquisition activity. Most studies on takeovers and their regulation portray the acquirer as a unified entity (the 'bidder' Grossman and Hart [1980], 'rival' (Harris and Raviv [1988]), 'outside buyer' Bebchuk [1994], etc.). Very frequently, however, acquirers are publicly traded corporations and subject to potential conflicts of interest between majority and minority shareholders. Inter-shareholder conflicts are especially acute in an institutional setting where ownership is concentrated. The presence of block ownership, a widespread characteristic of Continental European corporate governance, raises a number of unresolved welfare issues for minority shareholders of companies with acquisitive intentions. Is it, for example, in the interest of minority shareholders to adopt regulation that confines the company's acquisition activity, i.e., to '*lay the barbarian in chains*'? One regulatory measure to decrease takeover activity is to implement a mandatory bid requirement, which requires a tender offer to minority shareholders after a shift in control. Do minority shareholders of corporate acquirers fare better under this mandatory bid rule?

An answer to this question seems pressing as the mandatory bid rule (MBR) belongs to the core issues of takeover regulation and is currently subject to a controversial regulatory debate. Germany introduced a voluntary Takeover Code in 1995, which contains the mandatory bid rule as its core element. Its declared distributional

objective is the protection of minority shareholders. This warrants a closer look at its wealth effects on minority shareholders of potential 'barbarians'. The mandatory bid rule (MBR) stipulates that a party that purchases more than $x\%$ of another listed company's voting equity is obliged to make an offer to the remaining target shareholders at a price not significantly smaller than the price paid in the original offer. The threshold of $x\%$ should reflect a controlling interest and usually varies between 20 and 50 percent of the company's voting equity. The MBR applies both in the case of dispersed ownership, where $x\%$ of shares are acquired via tender offer or open market purchases, and in a transfer of a controlling block of more than $x\%$. The unsettled theoretical debate on the wealth effects of the MBR is reflected in diverse regulatory implementations across different countries. The MBR is part of the UK City Code on Takeovers and Mergers and the proposed Thirteenth EU Company Law Directive. It is also present in the US state legislation of Pennsylvania and Maine. The Williams Act, the principal federal US legislation, however, abstains from the MBR and allows partial bids (market rule).

The objective of this chapter is two-fold: it studies the wealth effects for minority shareholders of acquirers from both a theoretical and empirical perspective. The first objective of the chapter is to model the wealth effects for minority shareholders of corporate bidders in the two alternative regulatory environments of the MBR and the market rule. On the one hand, the MBR restrains the 'control hungry' barbarian from acquisitions that do not sufficiently increase the security benefits of the target. On the other hand, it gives minority target shareholders the option to participate in the takeover, reducing the wealth of the shareholders of the acquiring company. Under reasonable distributional assumptions about control and security benefits under the incumbent controller and acquirer, the model suggests that minority shareholders profit from the adoption of the mandatory bid rule. The second objective of the chapter is to test the hypothesis by analysing the stock price reactions of companies in response to the acceptance of the German Takeover Code. The empirical study confirms the hypothesis of the theoretical model: Minority stockholders are better off with '*Barbarians in chains*'.

In the first part the chapter develops a theoretical model that analyses the wealth trade-off for minority shareholders of corporate acquirers with respect to the MBR. At the same time, the model takes account of the institutional characteristics of Continental European corporate governance. A view on German corporate control transactions reveals that corporate rather than individual 'barbarians' are predominant. Out of the 85 transfers of share blocks of publicly traded companies (with a fractional equity

ownership of at least 20%) during 1990-1995 a total of 54 (or 63%) of listed companies have been acquired by another listed company. Besides the prevalence of corporate raiders empirical evidence suggests that both bidder and target companies are likely to be controlled by a large blockholder. La Porta et al. [1998] report that only 36% of large (!) publicly traded companies in 27 industrialized economies are widely held without a major shareholder owning more than a 20% equity fraction. In Germany concentration of ownership is even more prevalent: the average free float of companies listed on the segments 'Amtlicher Handel' and 'Geregelter Markt' equals roughly 30% of the companies' equity capital and there are only 40% of companies without a dominant ultimate blockholder.

In this institutional setting the large blockholder of the bidder has two potential sources of preserving a takeover gain. The bidder can bargain with the blockholder of the target over the surplus resulting from the control transfer. If the security benefits under the management of the acquirer are higher than the negotiated takeover price, the blockholder of the bidder is better off compared to share purchases from atomistic shareholders. Secondly, and crucial to the argument of this chapter, the costs of acquisition are partly passed on to the small shareholders who do not share any private benefits of control. The introduction of the MBR has two opposite effects on the welfare of small shareholders of the *bidder*. In the event of a control transfer the tender option of atomistic shareholders of the *target* company can lead to a welfare loss for the shareholders of the bidder. The expected welfare loss corresponds to the value of the call option embedded in the obligatory tender offer. This redistributes wealth from (minority) shareholders of the bidder to minority shareholders of the target. On the other hand, the amount of wealth-decreasing transfers is reduced under the MBR since the relative importance of future cash-flows increases in the overall takeover benefit. As the blockholder of the bidder will have to make an offer for the entire stock of the target, security benefits have to be higher, ceteris paribus, to warrant a takeover. The interests of small shareholders and blockholder of the bidding company are thus better aligned. In this respect the MBR is analogous to the 'one share-one vote' principle analysed in Grossman and Hart [1988]. In the same way in which 'one share-one vote' crystallizes more efficient bidders, the MBR sifts out targets with higher efficiency gains than the market rule.

The subsequent empirical study measures the wealth effects for minority shareholders in response to the acceptance of the MBR, which was introduced in Germany as part of the voluntary Takeover Code in 1995. The wealth effects are analysed in two ways: by measuring the abnormal returns of likely acquirers in a standard event

study procedure and by conducting a cross-sectional return study where abnormal returns are regressed on firm-specific characteristics. The voluntary nature of the acceptance decision makes it necessary to take account of a potential selection bias in the cross-sectional return regression which surfaces because we only focus on excess stock returns of companies that signed the Code. Recent cross-sectional return studies have used consistent estimators by explicitly allowing for the selection bias in analysing excess stock returns following voluntary corporate events (Eckbo et al. [1990] and Acharya [1993]). This chapter uses a maximum likelihood estimator to incorporate potential correlation between the error terms of the selection equation, i.e., the acceptance decision of the Code, and the continuous cross-sectional return regression. By incorporating the endogeneity of the Code's acceptance in the specification the estimation will cast light on the incentive structure of management with respect to the compliance decision.

The specification consists of a three equation system for which a fully efficient maximum likelihood estimator is derived. The theoretical model suggests that the likelihood of undertaking future acquisitions is crucial both for the acceptance decision and the magnitude of abnormal stock returns subsequent to acceptance. The specification therefore includes a first equation that determines the characteristics of corporate acquisition activity. The predicted future acquisition activity is used together with other firm-specific characteristics as an explanatory variable for the acceptance decision in the second equation. Finally the third equation which only incorporates the truncated observations of companies with a positive acceptance decision explains the excess returns in the wake of the compliance decision. The excess stock returns of signatory companies after the publication of the acceptance decision are regressed on firm characteristics including the number of predicted takeovers.

The chapter proceeds as follows. Section 2 reviews the theoretical and empirical literature on the welfare effects of the mandatory bid rule. Section 3 develops a *model* that analyses the trade-off for minority shareholders of acquiring companies with respect to the introduction of the mandatory bid rule. The model allows us to derive *hypotheses* regarding the wealth effects for both minority and majority shareholders of 'barbarians' under the mandatory bid rule. The second half of the chapter tests the hypotheses of the theoretical model and conducts an *empirical study* on the wealth effects minority shareholders of corporate acquirers experience following the acceptance of the Takeover Code in Germany. The empirical specification is developed in three steps. Because fundamental to both the acceptance decision and the wealth effects, Section 5 determines the characteristics of corporate acquirers. The following section

then discusses the costs and benefits of compliance with the Code. Section 7 finally estimates the complete model including the cross-sectional return equation.

2.2 Literature

The *theoretical* contributions on the welfare effects of the mandatory bid rule can be subdivided into two classes according to the ownership structure of the target company: models where the target company is controlled by a large incumbent blockholder and models of target companies with dispersed ownership. As part of the former category Bebchuk [1994] derives the aggregate welfare of target shareholders and bidding investor with and without the obligation to submit a tender offer to minority shareholders after a transfer in control. He first outlined the basic welfare trade-off between the market rule and the mandatory bid rule. Partial bids facilitate efficient transfers of control, but are inferior in discouraging inefficient transfers. If existing and new controllers draw their characteristics from the same distribution the chapter shows that the market rule dominates the MBR. In a similar setting Burkart, Gromb, and Panunzi [1998] find that the MBR increases social welfare since it results in a larger stake held by the new controlling party, which implies less inefficient extraction of private benefits. Yarrow [1985] falls into the latter category of models of target companies with a dispersed ownership where control is acquired via tender offers. Under the MBR non-differentiated bids are not possible, since all target shareholders are to be offered a price not lower than the price at which the initial equity position was acquired. Yarrow [1985] focuses exclusively on the detrimental effects of the market rule. In his setting the MBR serves as means to protect target shareholders from being forced into a minority position subject to oppression from a large shareholder. Under the same ownership assumptions Bergström, Högfeldt and Molin [1995] find that the MBR only increases the welfare of target shareholders if the difference in private benefits of two contestants for control is significant. In this case the MBR puts relatively more weight on security benefits so that the relative willingness to pay for security benefits is similar and competition is as fierce as possible.

There are two ways in which *empirical* studies have directly or indirectly addressed the welfare effects of the MBR for atomistic shareholders of target and bidder companies. Karpoff and Malatesta [1989] have analysed the stock price reactions after the enactment of the MBR in Pennsylvania, Maine, Utah and New York[1]. They found negative, but insignificant average excess returns for the stocks of the com-

[1]The MBR in New York and Utah was repealed in 1987; for details see Karpoff and Malatesta [1989].

panies incorporated in these federal states on the two-day interval of announcement and pre-announcement day. Whereas this study provides an estimate for the overall welfare implications of the MBR, it blurs the wealth effects for small shareholders for potential target and bidding companies[2]. In a different approach Holderness and Sheehan [1988] focus on the wealth effects for minority shareholders following sale-of-control transactions. They report that in cases in which a simultaneous offer was made to minority shareholders, abnormal event period returns for target company shareholders were significantly higher than for the complete sample. This finding lends support to the wealth-increasing effects of the MBR to target shareholders in the case of a takeover. However, it does not (and does not claim to) provide a direct test on the welfare effects of the MBR, since it disregards the potential of the MBR to hinder wealth-increasing bids for minority target shareholders.

The overview of the existing literature shows that although comparative studies on target shareholder or aggregate welfare effects are numerous, the wealth implications for minority shareholders of bidding companies have not yet been the focus of the welfare analysis. Since the MBR originates in the distributional objective of protecting minority shareholders it seems equally important to analyse how minority shareholders of potential corporate raiders are affected by the rule.

2.3 Model

2.3.1 Assumptions

There are two publicly traded companies, R and T, both controlled by an existing blockholder. The set-up of the model is similar to Bebchuk [1994] with the main difference that the raider is another listed company with a dominant shareholder. The companies have n_T and n_R shares outstanding, of which k_T and k_R shares are owned by the incumbent blockholders respectively. Both k_T and k_R should be sufficiently large to grant control. The remaining $n_T - k_T$ and $n_R - k_R$ shares are dispersed among public investors. The blockholder of R, r, is a potential new controller of T. Under the control of its existing owner t, the value of firm T consists of its discounted future cash-flow stream, Y_t, and private benefits of control, B_t,

$$V_t = n_T Y_t + n_T B_t$$

[2]The market price reaction to the introduction of the MBR reflects a change in share value to the marginal investor. Since it is unlikely that the marginal investor is a controlling shareholder, the shareprices reflect the value of the shares to a small shareholder uninvolved in the control of the company.

of which $(n_T - k_T)Y_t$ accrue to the small shareholders and $k_T Y_t + n_T B_t$ to the controlling blockholder. Under the control of the new blockholder, r, the firm value of T corresponds to $V_r = n_T Y_r + n_T B_r$. The variables Y_r, B_r, Y_t, and B_t are common knowledge and B_r, $B_t > 0$. The bargaining game between t and r about the transaction price is modelled in the following fashion: In one round of bargaining one of the two randomly chosen parties will make a take-it-or-leave-it offer to the other party. The contender r will make a take-it-or-leave-it offer to t with probability θ, and t will make a take-it-or-leave-it offer to r with probability $(1 - \theta)$.

2.3.2 Transfers of control

First, we will compare the conditions under which transfers of control take place in the two regulatory environments. Under the market rule (MR) the seller is free to sell the control block to the acquiring party without being obliged to extend an offer to minority shareholders. Under the mandatory bid rule (MBR), however, the acquiring party has to make an offer to minority shareholders on the same terms as to the blockholder. In both instances a sale-of-control transaction will only occur if the parties agree on a price that will make both of them better off. This is the case if r has a higher reservation value for the share block than t.

Proposition 1 *Under the MR a transfer of control will occur if and only if*

$$\underbrace{Y_r + \frac{n_R}{k_R}\frac{n_T}{k_T}B_r}_{\text{per share value of block to } r} > \underbrace{Y_t + \frac{n_T}{k_T}B_t}_{\text{per share value of block to } t \text{ in absence of sale}}. \tag{2.1}$$

Since r can bargain with t about the price of control transfer his takeover gain is not completely dissipated[3]. Inequality [2.1] is more likely to be satisfied, the smaller the controlling equity position of r in R, k_R/n_R. The smaller his fraction of cash-flow rights, the more r can (mis)use the funds from minority shareholders in order to finance his private benefits of control. This result might explain why VW instead of BMW succeeded in the takeover bid for Rolls Royce. Assume that the blockholders of the two companies derived the same security and control benefits from an acquisition of Rolls Royce. The company which is controlled with a smaller equity block is in a position to make a higher bid. This was VW which is only controlled with a 25% equity stake by the Federal State of Lower Saxony, whereas the major shareholder of BMW, the Quandt family, owns just under 50% of the company's equity. Analogously, the higher the equity fraction r has to acquire of T, the smaller his reservation value

[3]Proofs for propositions and lemmas that are not a straightforward result from the model set–up will be relegated to the Appendix.

for t's block. In the extreme case where $k_T/n_T = 1$, as is the case under the MBR, we obtain Proposition 2:

Proposition 2 *Under the MBR a transfer of control will occur if and only if*

$$\underbrace{Y_r + \frac{n_R}{k_R}B_r}_{\text{per share value of block to } r} > \underbrace{Y_t + \frac{n_T}{k_T}B_t}_{\text{per share value of block to } t \text{ in absence of sale}} . \tag{2.2}$$

The transaction price under the MBR has to be greater than $Y_t + (n_T B_t)/k_T$ to make t better off, but cannot be larger than $Y_r + (n_R B_r)/k_R$, since r would incur a welfare loss. The component of private benefits in r's reservation value for the share block shrinks because small shareholders of the target company have the option to tender their shares. The raider's willingness to pay is reduced and with an unchanged reservation value of t a transfer of control is less likely. A comparison of condition [2.1] and [2.2] shows that the circumstances in which transfers occur under MBR are a subset of circumstances in which transfers occur under MR. Whereas the analysis of control transfers has been independent of the surplus division between t and r, the study of the wealth effects will have to take account of the relative bargaining power of the two parties.

2.3.3 Aggregate Comparison of Wealth Effects

The analysis of the wealth differential between the MR and MBR follows two steps. First, we divide the possible states of nature into three subsets. We subsume under Case 1 all states of nature where transfers of control do not take place either under the MR or under the MBR. Since all transfers which occur under the MBR also occur under MR, it is sufficient to impose $Y_r + (n_R n_T B_r)/(k_T k_R) < Y_t + (n_T B_t)/k_T$ for no transfers to take place. For $Y_r + (n_R B_r)/k_R < Y_t + (n_T B_t)/k_T$ no sale-of-control transactions occur under the MBR, but condition [2.1] ensures that transfers occur under MR (Case 2). A transfer of control from t to r will take place under both regimes if inequality [2.2] is satisfied (Case 3).

In order to determine which of the two rules generates greater wealth to the minority shareholders of R, we derive the welfare differential between the two rules for each of the three cases. We denote ΔW as the difference between the expected payoff for small R shareholders under MR and under MBR, i.e., $\Delta W > 0$ implies a welfare surplus of the MR over the MBR. In particular, ΔW_{TN} stands for the welfare effect of the MR in case 2, where no transfers occur under the MBR. The wealth differential ΔW_{TN} thus exclusively depends on whether transfers of the MR are wealth-increasing

or wealth-decreasing for minority shareholders of R. When transfers occur under both rules, ΔW_{TT} captures the wealth difference between MR and MBR.

Lemma 1 *The aggregate expected welfare differential between MR and MBR to minority R shareholders, ΔW, equals*

$$\begin{aligned}\Delta W = Prob(Y_r + \tfrac{n_R}{k_R}B_r > Y_t + \tfrac{n_T}{k_T}B_t) \cdot E(\Delta W_{TT} \mid Y_r + \tfrac{n_R}{k_R}B_r > Y_t + \tfrac{n_T}{k_T}B_t) \quad (2.3)\\ + Prob(Y_r + \tfrac{n_R}{k_R}B_r < Y_t + \tfrac{n_T}{k_T}B_t < Y_r + \tfrac{n_R}{k_R}\tfrac{n_T}{k_T}B_r)\\ \cdot E(\Delta W_{TN} \mid Y_r + \tfrac{n_R}{k_R}B_r < Y_t + \tfrac{n_T}{k_T}B_t < Y_r + \tfrac{n_R}{k_R}\tfrac{n_T}{k_T}B_r)\ .\end{aligned}$$

The first term on the right-hand side corresponds to the expected welfare differential between MR and MBR in cases where transfers occur under both regimes. The second term on the right-hand side corresponds to the expected welfare differential between MR and MBR in cases where transfers occur under MR, but not under MBR. When no transfers occur the wealth difference is zero.

Lemma 2 *If conditions are such that transfers occur both under the MBR and MR (Case 3), the differential welfare effect for minority R shareholders between MR and MBR corresponds to*

$$\Delta W_{TT} = -\theta\left[\tfrac{n_R - k_R}{n_R}(n_T - k_T)\left(Y_r - \max\{Y_r, Y_t + \tfrac{n_T}{k_T}B_t\}\right)\right]. \quad (2.4)$$

Small shareholders of the bidding company are likely to incur an expected differential welfare loss under the regime of the MBR, i.e., $E(\Delta W_{TT} \mid .) \geq 0$.

The only difference in the payoffs between the two rules results from the tender offer the bidder has to submit under the MBR. The obligatory tender offer confers a call option with the payoff $\max\{Y_r, Y_t + (n_T B_t)/k_T\}$ to the small shareholders of the target. The wealth loss to small shareholders of the bidder under the MBR equals the value of the option to tender. It can be easily seen from [2.4] that the MR is superior for small R shareholders if $Y_r < Y_t + (n_T B_t)/k_T$, i.e., if small shareholders of T have an incentive to exercise their call option. Because of this wealth redistribution from bidder to minority shareholders of T it is always more profitable for R to only acquire the block of shares under the MR. Only if $Y_t + (n_T B_t)/k_T < Y_r$, are small R shareholders indifferent between the two rules ($\Delta W_{TT} = 0$). In this case small target shareholders are better off to refrain from tendering their shares and remain shareholders of T. The welfare differential is also zero if r never enjoys absolute bargaining power, i.e., $\theta = 0$. In this case t skims the surplus from r under both rules, so the wealth gain to r is zero. Small T shareholders, however, still have to finance r's private benefits

in an order of magnitude of $-n_T B_r(n_R - k_R)/k_R$. The two regulations only differ in how the surplus is divided between the minority shareholders and blockholder of the target. Under the MR the blockholder of T obtains $Y_r + (n_R n_T B_r)/(k_R k_T)$ per share and minority shareholders receive security benefits of Y_r. Under the MBR all T shareholders receive a payoff of $Y_r + (n_R B_r)/k_R$ if t makes a take-it-or-leave-it offer to r.

Lemma 3 *If conditions are such that transfers occur under the MR, but not under the MBR (Case 2), the differential welfare effect between MR and MBR for the minority R shareholders corresponds to*

$$\Delta W_{TN} = \frac{n_R - k_R}{n_R}\left(\theta[k_T(Y_r - Y_t) - n_T B_t] - (1-\theta) n_T \frac{n_R}{k_R} B_r\right).$$

Small shareholders of the bidding company will always incur an expected differential welfare loss under the regime of the MR, i.e., $E(\Delta W_{TN} \mid .) < 0$.

In this case the welfare differential ΔW_{TN} equals the payoff small R shareholders receive from the acquisition of t's block of T shares. The first term in the inner square brackets corresponds to their share of the bargaining surplus which arises if r has absolute bargaining power. At the same time, small R shareholders still have to finance part of r's private benefits, $n_T B_t$. However, if t is the one making the take-it-or-leave-it offer, there will be no bargaining surplus for R and small R shareholders will have to finance the full value of private benefits $(n_R n_T B_r)/k_R$. The incremental term n_R/k_R takes account of the fact that r can spread the financing costs of the acquisition across its minority shareholders. In a sense, if t enjoys absolute bargaining power, t 'exploits' the fact that r can 'exploit' minority R shareholders in financing his private benefits of control.

If transfers occur under MR, but not under MBR this implies that $k_T(Y_r - Y_t) < n_T B_t$. The private benefits of the existing blockholder t, for which he has to be compensated, are larger than the increase in cash-flows from which small shareholders of R can profit. The only potential source of gain for small R shareholders are increased security benefits under the new management of r. Since these are smaller than the minimum outlays for private benefits of control, $n_T B_t$, small shareholders of R do incur a wealth loss. So far, we have seen that the MR implies higher welfare for small shareholders of 'barbarians' in situations where transfers of control would occur under both regulatory regimes. The MR, however, reduces minority shareholder wealth in control transactions which would not have taken place under the MBR.

Proposition 3 *If t makes a take-it-or-leave-it offer to r with a higher than 50% probability, then the ex post welfare of minority R shareholders is lower under the MR than under the MBR, i.e., $|E(\Delta W_{TN} \mid .)| > E(\Delta W_{TT} \mid .)$.*

A smaller bargaining power of r makes the relative advantage of the MR over the MBR in Case 3 shrink. As discussed above, as r's bargaining power approaches zero, the small shareholders of the bidder fare equally well under the two rules. A smaller probability with which r is the one making the take-it-or-leave-it offer to t, however, does affect the expected loss of the MR in Case 2 in an opposite way. The worse r's bargaining position the higher the price t obtains and thus the higher the price which is the basis of the tender offer to minority shareholders of T. If the probability of t making a take-it-or-leave-it offer to r is greater than 50%, the former effect outweighs the latter.

So far we have exclusively focused on ex post welfare implications of the two rules. In order to derive the aggregate wealth impact of the regulations one has to take account of the ex ante expected values of the different cases. This requires distributional assumptions about the private control benefits and cash-flow generating power of the two parties. We obtain an unambiguous result of the ex ante wealth effects under the following distributional assumptions:

Proposition 4 *If B_r and B_t are distributed on $[0;\alpha_r]$ and $[0;\alpha_t]$ respectively, and if $Y_r - Y_t$ is uniformly distributed on $[-\omega_0,\omega_1]$ with ω_0 and ω_1 sufficiently large, the MBR constitutes ex ante a welfare-increasing regime for small shareholders of R.*

With these general assumptions about the distribution of control and security benefits of the two parties, small shareholders of prospective acquirers will unequivocally profit from the introduction from the MBR. Note that the assumptions do not require symmetric characteristics of the incumbent controller and the control aspirant. The superiority of the MBR results from the fact that the probability of a welfare loss of the MBR in cases of transfers under both rules is smaller than the probability of a welfare gain in cases of transfers under only the MR. With transfers under both rules a wealth loss occurs in the presence of the MBR if $Y_r - Y_t$ ranges between $B_t n_T/k_T$ and $B_t n_T/k_T - B_r n_R/k_R$, i.e., in an interval length of $B_r n_R/k_R$. This is the case since the MBR only entails a wealth loss with respect to the MR if transfers occur under both rules *and* the small target shareholders decide to tender their shares. When transfers occur only under the MR, the welfare gain of the MBR occurs whenever $Y_r - Y_t$ ranges between $B_t n_T/k_T - B_r n_R/k_R$ and $B_t n_T/k_T - B_r n_T n_R/(k_R k_T)$, i.e., in an interval length of $B_r n_R/k_R(n_T/k_T - 1)$. Because of the uniform distribution

of $Y_r - Y_t$ the frequency of welfare gains due to the MBR outweighs on average the frequency of welfare losses.

So far we exclusively focused on the welfare of minority shareholders of R. The model can also be used to study the wealth effects for the controlling blockholder of the acquirer. In fact, we find that the controlling blockholder of R will be unequivocally worse off under the MBR (Bebchuk [1994]).

Proposition 5 *The controlling blockholder of a corporate acquirer suffers a welfare loss under the MBR .*

For a formal proof see Bebchuk [1994]. Propositions 1 and 2 have shown that circumstances in which transfers occur under MBR are a subset of circumstances in which transfers occur under MR. Since r will only purchase a control stake in T if this makes him better off, it suffices to derive the wealth differential if transfers occur under both rules. In this case r suffers in a similar way as R's minority shareholders from the tender option of minority shareholders of T. It can be easily seen that r's wealth loss corresponds to the value of the call option to minority T shareholders.

2.3.4 Model conclusions and hypotheses

The model has highlighted the wealth effects for both controlling and minority shareholders of companies with acquisition intentions under the alternative regulatory designs of the MR and the MBR. The model has shown that a controlling blockholder of a publicly traded firm experiences a wealth loss under the MBR (Proposition 5). In case of an acquisition the blockholder has to compensate minority target shareholders on the same terms as the selling blockholder if they decide to sell off their shares. It is obvious that this wealth loss only occurs when the blockholder faces profitable acquisition opportunities. Companies under blockholders which generally produce relatively high Y_r and B_r (so that [2.1] is frequently satisfied) will experience a greater wealth loss than companies which are unlikely to undertake acquisitions[4]. Proposition 5 thus translates into the following hypothesis[5]:

[4]For companies that abstain from takeovers the wealth effect for minority shareholders upon the adoption of the MBR should be zero (see Table I). However, already a slight nonzero probability of future acquisitions yields a positive wealth effect in response to the MBR.

[5]We abstract here from agency problems between (controlling) shareholders and management. In the absence of a controlling blockholder, management is assumed to act in the interest of its dispersed shareholders. Since atomistic shareholders by definition derive no private benefits of control, management will only proceed with a takeover when the per share cash-flow value of the target block under their management exceeds the reservation value of the incumbent target blockholder, i.e. if $Y_r > Y_t + \frac{n_T}{k_T} B_t$. Management will be indifferent between MR and MBR, since, due to the free-riding behaviour of atomistic shareholders, minority target shareholders will always obtain Y_r.

Hypothesis 1: *A controlling blockholder is reluctant to adhere to the mandatory bid rule. He is less inclined the larger his future acquisition agenda.*

The wealth effects for minority shareholders of corporate acquirers are less clear-cut. Whereas the MBR prevents wealth-decreasing acquisitions, it can incur a wealth loss because it imposes an obligatory tender to the small shareholders of the target. The superiority of either of the two rules for the minority shareholders of bidding companies depends on the size of the blockholder of both bidder and target, the relative bargaining power of the two parties and on the distributional assumptions about Y_r, Y_t, B_t and B_r. Proposition 4 finds that the MBR constitutes ex ante a welfare-increasing regime for the small shareholders of the acquiring company under reasonable distributional assumptions about control and security benefits of the two parties. Again, the wealth loss only occurs if the controlling blockholder is likely to engage in future acquisition activity. We therefore posit the following hypothesis:

Hypothesis 2: *Minority shareholders of potential acquirers experience a wealth increase upon the adoption of mandatory bid rule. The wealth increase is higher the more likely the company undertakes acquisitions in the future.*

The following empirical study will cast light on the validity of these hypotheses. In particular, the empirical analysis will depict the relation between the existence of a controlling blockholder, corporate acquisition activity and minority shareholder wealth following a change in corporate governance regulation in Germany in 1995.

2.4 Empirical analysis of wealth effects

2.4.1 The Takeover Code in Germany

In Germany a voluntary Takeover Code came into effect in October 1995 which (listed and unlisted) companies can decide to sign or not to sign. Drafted by an expert commission (consisting of representatives of banks, listed companies, small shareholders and the Frankfurt stock exchange) the Code relies on the principle of self-regulation. A Takeover Commission ('Übernahmekommission') at the Frankfurt stock exchange supervises the adherence to the rules of the Code.

If a company decides to abide by the Code, it is restrained both in the role of a *potential bidder* and as a *potential target.* Its main element, the mandatory bid rule, imposes a minority buy-out clause on the bidder. If a company purchases more than 50% of another listed company's equity, it is obliged to make an offer to the remaining minority shareholders within the next 18 months. The offer price must not be smaller

than 25% of the price at which the initial shareholding was acquired and should be in adequate relation to the current stock price (Articles 16 and 17). Following severe criticism regarding the laxity of its stipulations the Takeover Commission has reduced the threshold for the mandatory tender offer to 30%. In its revised form, it also prescribes that the offer has to follow immediately upon the acquistion of control. Furthermore, the offer price must be in adequate relation to the highest price in the preceding three months and the 25% discount clause for the offer price has been removed. The new regulations came into effect on 1st January 1998 after the end of the sampling period of this data set. The change in the conditions of the MBR increases the option value to minority shareholders of the target company and decreases the gains to the bidder. The initial laxer conditions therefore form a lower bound for the wealth effects of the MBR. If the study finds significant wealth effects during 1995-1997, then these should be even more pronounced after the introduction of the more stringent condition in 1998.[6]

Secondly, the Code obliges a signatory to abstain from any defensive measures in case it is itself the subject of a public tender offer. The annotations to the Code list as exemplary measures the issue of new shares and significant changes in the company's assets and liabilities (Article 19). This enumeration is by no means exclusive. According to the Takeover Commission the measures generally comprise all formal defense actions, including the imposition of voting right restrictions. A precise delimitation of all the measures subsumed under this category is currently, however, not possible. The Takeover Commission will decide on a case-by-case basis which actions are incompatible with the Code. The acceptance of the Code will, however, clearly limit the span of defensive measures in the event of a takeover bid. Other stipulations regulate the length of the offer period, the appropriate disclosure of offer terms and of purchases of shares subsequent to the offer, and conditions for improved offers of the same bidder.

Approval of the Code is subject to a company's management board. So far the acceptance decision has not been delegated to shareholders' approval at an AGM. Given the constraints the Code imposes on its signatories, what are the benefits of acceptance or, alternatively, what are the sanction mechanisms for non-acceptance? The immediate effect of the compliance declaration is a note of acceptance in the 'Börsenzeitung', the main stock exchange publication. It appears on average two days after the notification of acceptance has reached the Takeover Commission. The special symbol, Ü,

[6]The tightening of the conditions of the MBR has, in fact, been discussed since the introduction of the Code in 1995. Therefore the measured effects in this study also incorporate the expectations of a more stringent tender offer clause.

next to the company's name and stock code designates compliance with the Code. Sanction measures with moral suasion character include press articles which stress the importance of compliance to the attractiveness of Germany's financial system. These articles usually contain lists with the companies that officially abide by the Code, and a 'red list' with 'resistant insurgents'. An often articulated threat is the enactment of a legally binding code if an insufficient number of companies abide voluntarily. In addition, government officials use their influence to pressurize the largest German companies to accept the Code.[7] Even though the Code is based on a private initiative of the Stock Exchange and industry representatives it is given more weight by a joint declaration of German banks not to accompany any raider which has not signed the Takeover Code. The only 'hard' form of penalty, however, is a possible non-admission of companies to the stock market indices DAX and MDAX.[8] Acceptance of the Code is also a prerequisite for a listing in Germany's new stock market segment for growth companies, 'Neuer Markt'. How companies are penalized if they de facto violate the Code in a sale-of-control transaction, is still largely untested ground. So fare, the Takeover Commission has only issued a critical statement concerning a takeover bid of Glunz AG by Future Holding AG in 1996 which violated formal bid requirements of the Code (but not the lack of a mandatory tender offer). The provisions of the Code have been adequately followed in various transfers of control. In line with the assumptions of the model proposed under [2.3] the common feature of these cases has been a purchase of a controlling interest from an incumbent blockholder[9].

2.4.2 Some Conceptual Issues

The objective of the empirical study is to analyse the stock price reaction ensuing the acceptance of the Takeover Code. At first, however, some conceptual issues surrounding the implications of the acceptance decision have to be resolved. First, it is questionable whether the acceptance of the Code represents a credible long-term commitment. The fickleness of Metallgesellschaft which first acceded to the Code, but withdrew its signature after it lost its membership in the DAX might suggest that formal acceptance is of a quite discretionary quality. Metallgesellschaft has been,

[7]Someone no less prominent than Dr Theo Waigel, former German Finance Minister, personally wrote to four resistant major German companies including VW and BMW (in vain!) and urged them to officially accept the Code.

[8]This does, however, not extend to existing members of the DAX or MDAX. Even if they fail to abide, they are not removed from the indices.

[9]Examples include the takeover of Rosenthal by Waterford Wedgwood, Hapag Lloyd by Preussag, AMB by Assicurazioni Generali, and Berlinische Lebensversicherung by Commercial Union.

however, the only company with a capricious stance towards the Code.[10] Not any of the other 268 publicly traded companies which formally abide by the Code, have questioned their commitment to the rules since the implementation of the Code more than three years ago. Therefore we can reasonably assume that the signatories will comply with the provisions of the Code at least in the medium term, i.e., sufficiently long to make a difference in a future control transaction.

A second issue are the welfare effects of the Code which can derive from two potential sources. Firstly, the Code possibly restrains bidding activity through the mandatory bid requirement. Secondly, it prohibits defensive measures in the presence of public tender offers. In general, there are two competing hypotheses concerning the wealth effects of takeover defenses. On the one hand takeover defenses raise the cost of replacing inefficient management and reduce stockholder wealth of target companies[11]. On the other hand, shareholders might secure a higher control premium in the event of a takeover bid. Given the institutional characteristics of German corporate governance, however, it is very unlikely that these wealth effects blur the stock price reaction resulting from the mandatory bid component of the Code. Takeover defenses are only economically significant if there are possible hostile takeover attempts which the managements seeks to avert. The paucity of hostile takeover attempts in Germany (Edwards and Fischer [1994], Franks and Mayer [1997]), however, gives takeover defenses limited relevance. The virtual lack of hostile takeovers is due to the widespread presence of block ownership in Germany (Hommel [1998]). Also, tender offers are not a common means of acquiring control of companies with *dispersed* ownership. Virtually all acquisitions of listed companies with dispersed ownership during 1985-1995 took place through open-market purchases (e.g., Metro AG, Hoesch AG, Otto Stumpf AG). The introduction of more stringent disclosure requirements of shareholdings in 1995 has certainly reduced the extent of share purchases in the open market. During 1995-1997, however, only 2 public tender offers were submitted with the objective to acquire control (see Appendix). In all other transfers of control an acquisition of a share block has preceded the mandatory tender offer. Finally, the range of takeover defenses is limited by German corporation law. Poison pill securities which are common as takeover defenses in the US are prohibited in Germany. These considerations suggest that the abstinence from takeover defenses should have a minor

[10]It might be argued that Metallgesellschaft was relatively immune to the negative public relation campaign which was launched by the stock exchange following its withdrawal from the Code. Due to Metallgesellschaft's massive derivative losses and management turmoil it already enjoyed a very moderate public relations profile.

[11]Malatesta and Walking [1988] find that poison pill defenses reduce stockholder wealth by a statistically significant amount.

impact relative to the imposition of the mandatory bid requirement[12].

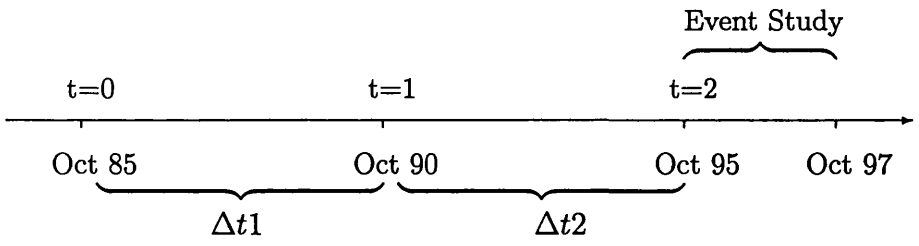
In addition to these a priori theoretical considerations we will also empirically test whether the wealth effect is due to the pre-commitment or the MBR. If the wealth effect is due to the pre-commitment to abstain from takeover defenses, then the effect should be smaller for companies which are immune to takeover threats. This is the case for companies which are majority-controlled. For majority controlled companies the wealth effect should be weaker than for companies under dispersed ownership for which a hostile tender offer is an acute threat.

2.4.3 Data

The data used for estimation consists of variables measured during two time periods, $\Delta t1$ and $\Delta t2$, and at two distinct points in time, $t = 1$, and $t = 2$. This data is used to explain the abnormal stock returns as a result of acceptance decisions of the Takeover Code from 1995-97. The time line below depicts the different sample points and intervals.

FIGURE I

TIME LINE FOR SAMPLING POINTS AND INTERVALS



The estimation presupposes that wealth effects from the acceptance of the Code differ between potential bidders and companies likely to be uninvolved in corporate control transactions. The pre-1995 data is used to determine the characteristics of corporate acquirers. Variables measured in October 1995 are included to proxy for factors which influence a company's acceptance decision of the Code. A subset of these variables and other firm-specific characteristics in 1995 are used to explain the stock price reactions subsequent to a firm's approval of the Code. The event study

[12]In fact, the majority of public statements about the reasons for a company's rejection of the Code has critizised the lack of leeway with respect to corporate control transactions. Georg Obermeier, CEO of VIAG AG, said the Code 'costs a lot of money' since his company pursues a 51% participation model with its non-energy subsidiaries (Süddeutsche Zeitung, 13 November 1997).

focuses on the acceptance decisions between 25 July 1995 and 23 October 1997[13]. A detailed description of the data sources can be found in the Appendix.

Table II lists the summary statistics of the sample at the different sampling points and intervals. The number of acquisitions during the two time intervals October 1985-October 1990 and October 1990-October 1995 are obtained from the M&A Review Database at the University of St. Gallen. The Database comprises all corporate transactions in which a German company has been involved since 1985. For purposes of this study all corporate acquisitions undertaken by domestic companies listed on German stock exchanges were retrieved. In terms of M&A Review Database notation this corresponds to transaction type 0 which designates equity participations in other companies. In addition, an increase of existing equity stakes (transaction type 6) and control contracts ('Beherrschungsvertrag' - transaction type 8) were taken into account[14]. All equity participations exceeding 25% in listed and unlisted companies (there is no indicator for a stock exchange listing) were included in the sample. Purchases of substantial parts of a company's long- or short-term assets do not fall into the category of equity participations and are therefore excluded from the number of acquisitions. The number of acquisitions during October 1985 and October 1990 is obtained for all companies which were listed in October 1990, while the number of acquisitions in the consecutive five year period is retrieved for all companies listed in October 1995. Since the database comprises acquisitions of listed and unlisted companies, acquisitions can be retrieved even if the company has not been listed for the entire preceding five years. In case a company has been subject to a merger, an equity carve-out, or a takeover with a change in business activities during this five-year period, the company is excluded from the sample, if its acquisition track-record in its current form is less than 2 years. For companies with an acquisition history of more than two but less than five years the number is extrapolated to a five-year acquisition figure. Nordag Immobilien AG, for example, has been listed since May 1995, but has been part of the liquor producer Doornkaat AG before it was carved out as a real estate business at the end of 1994. It is therefore excluded from the sample. The 'acquisition king' during 1985-1990 was Deutsche Bank AG with 25 acquisitions replaced by Siemens AG in the subsequent period 1990-1995 with 34 purchases of equity stakes.

[13]Some companies signed the acceptance declaration before the Code entered into force on 1 October 1995. Up to October 31, 1995 113 firms formally agreed to abide by the Code, the number rose to 235 by September 26, 1996. By October 23, 1997 a total of 270 companies on the German stock exchange accepted the Code.

[14]Other categories of corporate transactions include foundations of new subsidiaries, mergers, strategic alliances, cross-holdings and management (resp. leveraged) buy-outs.

Authorized capital is the maximum amount of equity capital by which the management board can increase the current amount of subscribed capital without consent of the company's shareholders. A prerequisite is an authorization by shareholders at the AGM, where a 75% majority is needed for a decree to increase authorized capital. The amount of authorized capital, however, must not exceed half of the current share capital and is only valid for 5 years (§§ 202-206 AkG). The frontrunners in terms of authorized capital have changed between the two sampling points from companies in the chemical sector to companies in telecommunication related industries. Whereas in 1990 BASF was the company with the highest authorized capital (750m DM), Deutsche Telekom AG takes the lead in 1995 with 1431.5m DM of authorized capital, followed by Siemens AG with 800m DM.

The ratios capital gearing and net current assets over total assets are only meaningful for non-financial institutions (including insurance groups). This explains the reduced sample size in both periods. The net current asset ratio can turn negative if short-term liabilities exceed short-term assets. Bluthardt AG and Köln-Düsseldorfer AG with a NCR of -0.52 and -0.32 respectively were two examples of companies in 1995 where short-term debt could not be covered by short-term assets. The capital gearing ratio is greater than 1 if a company is in financial distress with a negative equity position. This was the case with K&M Möbel AG in 1995 where liabilities account for more than 130% of total assets corresponding to a negative nominal equity value of 30%. Overall, the leverage of German companies has slightly increased from 1990 to 1995, though not at the expense of NCR which has equally risen from 22% to 23%.

Despite the criticism of the Takeover Code, an average of 38% of listed companies formally acceded to the regulation by 31 December 1997. Of the 13% of companies included in one of the major stock exchange indices a more substantial fraction of 61% signed the Code. The DAX consists of the 30 stocks with the highest liquidity and market capitalization. The mid-cap index MDAX covers the next 70 securities in terms of turnover and market value. The market capitalization of listed companies averages 1.3bn DM in October 1995, with Allianz worth 63bn DM way up in the lead before Siemens follows with a market value of 43bn DM. Daimler Benz stock has the highest average daily turnover in October 1995 where shares worth about 140m DM change hands each day. Banks only represent 6% of listed companies, but are represented on the supervisory board of 22% of other publicly traded companies in October 1995.

As discussed in the introduction, the ownership structure of German listed companies is characterized by a predominance of blockholdings. As opposed to the US where about 80% of publicly traded companies are widely held (La Porta et al. [1998]) the average free-float in Germany only equals 32% and 71% of companies are directly majority controlled. A more substantial 89.3% of listed companies have an immediate blockholder with a more than 25% shareholding. The widespread presence of direct block ownership, however, does not imply that there is an ultimate controlling individual shareholder. If a company is controlled by another firm it is necessary to identify the owners of the holding company and potential higher-level holding companies. We define companies as 'owner-controlled' if there is an ultimate individual blockholder and the ownership links between the intermediate holding companies exceed 25% shareholdings respectively. In Germany shareholdings of more than 25% confer significant control rights, enabling the holder to block major corporate decisions such as changes in the articles of association, increases in share capital, or mergers. Vereinigte Deutsche Nickelwerke AG, for example, classifies as 'owner-controlled', since it is majority-controlled by Langbein-Pfannhauser Werke AG which in turn is majority-controlled by Michael Schröer. Other companies like Deutsche Centralbodenkredit AG or Frankfurter Hypothekenbank AG are not 'owner-controlled' since despite blockholdings of more than 25% on the first level, their ultimate owner, Deutsche Bank, does not have a controlling shareholder. Controlling shareholders are strictly individuals or families which in addition to a controlling influence possess significant fractional cash-flow rights of more than 20%[15]. Ownership by the State, large cooperatives and trade unions on the ultimate level are not considered controlling blockholdings, since governing officials -likewise managers in companies with dispersed ownership- do not directly possess significant cash-flow rights in the company. With this definition only 59% of listed companies qualify as 'owner-controlled'. This findings are comparable to the results of a study conducted by Schreyögg and Steinmann [1981] which analyses the ownership structure in the 300 largest industrial enterprises in Germany in 1972. They found that 89.7% of companies were owner-controlled at the first level of ownership (i.e., where the sum of block shareholdings exceeded 25%), but only 49.7% were owner-controlled at the ultimate ownership level. The comparatively lower percentage of companies with ultimate owner control can be attributed to a size effect, since the Schreyögg and Steinmann [1981] sample only includes the largest 300 industrial companies, whereas this sample comprises all listed German companies.

[15] Control and cash-flow rights can be separated through the issuance of non-voting equity and a pyramiding structures of subsidiaries.

The excess returns associated with the acceptance of the Takeover Code are cumulated during the 10-day event window $t0 = -2$ to $t1 = 7$:

$$\begin{aligned} \widehat{CAR}10_i &= \sum_{t=t_0}^{t_1} \widehat{\varepsilon}_{it} \\ \widehat{\varepsilon}_{it} &= r_{it} - \widehat{\beta}_{0i} r_{mt} \end{aligned} \tag{2.5}$$

where $\widehat{\beta}_{0i}$ of the market model is estimated with return data from day -280 to day -30 prior to the acceptance of the Code. We use the broad based MDAX with seventy index constituents as an approximation to the market portfolio. The event window covers seven post-event days to allow for publication of the acceptance declaration in the 'Börsenzeitung' and its dissemination by the stock exchange. The event day 0 is the day at which the notification of acceptance reaches the Takeover Commission. Companies for which turnover data is unavailable or which trade with a lower than daily frequency are excluded from the sample. This reduces the sample to 232 companies from a total of 270, which obliged by October 1997.

2.4.4 Estimation

'Once a barbarian - always a barbarian': Characteristics of corporate acquirers

Since the objective of the chapter is to analyse the welfare implications of the MBR for small shareholders of potential raiders, we first have to determine the characteristics of corporate bidders. Like other studies before (Malatesta and Thompson [1985], Schipper and Thompson [1983]) we conjecture that firms carry out continuous acquisition programs. It seems likely that once firms have reached a certain stage of development acquisitions become relatively more important than internal development in ensuring growth. The number of acquisitions during the 5 year-period 1985-1990, $y_{i,\Delta t1}$, is therefore included as an explanatory variable for the acquisition activity in the subsequent period 1990-1995, $y_{i,\Delta t2}$. Further, we assume that the amount of available financing means determines the extent to which firms are able to engage in corporate acquisition activity. We include three variables to capture possible existing and future financing sources for acquisitions. The ratio of existing net current assets to total assets, NCR, in October 1990 should capture the extent to which *currently* available short-term funds can finance future purchases of equity stakes. Authorized capital, AC, and the capital gearing ratio, CGR, are both included to proxy for *future* means of financing. The degree of leverage should proxy for possible constraints to incur new debt given that a high debt ratio makes credit rationing more likely. We would

therefore expect highly indebted companies to undertake fewer acquisitions. Authorized capital limits the amount of seasoned equity offerings which can be issued at management's discretion. A large amount of authorized capital gives the management flexibility in the timing of equity issues to finance a takeover. It can raise new equity capital without calling an AGM and obtaining shareholders' approval. This can be particularly important in the case of takeovers where information leakage can undermine an acquisition attempt because of rising share prices and possibly new competition. The amount of authorized capital should therefore be positively correlated with the number of subsequent takeovers. From the above considerations we obtain the following empirical specification:

$$y^*_{1i,\Delta t2} = \beta_1 y_{1i,\Delta t1} + \beta_2 \mathrm{AC}_{i,t=1} + \beta_3 \mathrm{NCR}_{i,t=1} + \beta_4 \mathrm{CGR}_{i,t=1} + u_{1i,t=1} \qquad (2.6)$$

where $y_{1i,\Delta t2}$ denotes the number of acquisitions during 1990-1995 and

$$\begin{aligned}
y_{1i,\Delta t2} &= 0 \quad \text{if } y^*_{1i,\Delta t2} \leqslant 0 \\
y_{1i,\Delta t2} &= 1 \quad \text{if } 0 < y^*_{1i,\Delta t2} \leqslant \theta_1 \\
y_{1i,\Delta t2} &= 2 \quad \text{if } \theta_1 < y^*_{1i,\Delta t2} \leqslant \theta_2 \\
&\vdots \\
y_{1i,\Delta t2} &= N \quad \text{if } \theta_N \leqslant y^*_{1i,\Delta t2}.
\end{aligned}$$

The number of ordered categories, N, is set equal to 6, where categories 1 to 4 denote the actual number of acquisitions during the 5-year period, category 5 subsumes five to nine acquisitions and 6 captures all observations with ten or more acquisitions[16]. Equation [2.6] is estimated with maximum likelihood as an ordered probit model. Table III below presents the estimation results of alternative specifications with different variable combinations. The estimation results confirm the conjecture 'once a barbarian - always a barbarian', i.e., that firms pursue continual acquisition programs. The regression coefficient β_1 is positive and significantly different from zero at the 99.99% level in all four specifications[17]. Furthermore, we find that access to present and future means of financing has a significant impact on bidding activity. The coefficient estimate β_2, which represents the impact of authorized capital on acquisition activity, is positive and significantly different from zero at the 99.99% level in specification I. Whereas authorized capital is included as an absolute value,

[16]The results are very similar if one assigns a separate category to each specific number of acquisitions. The used re-classification leads to a more equal distribution of observations across categories.

[17]It might be argued that the coefficient estimate is biased, since the sample includes the acquisition history prior to and/or after the stock market listing. The coefficient estimate, however, differs only marginally if the sample is restricted to companies that have been listed during the full ten year period.

leverage and also net current assets are both related to the amount of total assets. This is done to avoid that a size effect is picked up in more than one variable which might lead to multicollinearity.

If included separately, both NCR and CGR are significant and carry the expected signs. The higher the ratio of net current assets to total assets, the more intense the subsequent acquisition activity. Also, the smaller the gearing ratio, the more acquisitions are undertaken in the subsequent five years. Because of the collinearity between NCR and CGR the variables lose explanatory power if they are both included in regression IV. A likelihood ratio test of I vs. IV shows, however, that β_3 and β_4 are jointly different from zero at the 99.99% level. Therefore both NCR and CGR should be included in the model. The estimation results are also robust to alternative distributional assumptions governing the acquisition behaviour. Ordered logistic and Poisson regressions both produce very similar estimates to the ordered probit regression.

'To sign or not to sign': Determinants of compliance

The decision to sign the Takeover Code is subject to the company's board of directors. The management board will sign the Code if and only if it assesses the benefits of signing to be greater than its costs. Outside investors do not observe the discounted net benefit of the decision, but only whether the company submitted its acceptance declaration or not. The decision about compliance is determined both by observable firm characteristics, x_i^{95}, and latent information of the management ε_{2i}. Specifically, the board of company i will accede to the Code ($y_{2i} = 1$), iff

$$y_{2i} = \begin{cases} 1 & \text{whenever } \beta' x_i^{95} + \varepsilon_{2i} > 0 \\ 0 & \text{otherwise.} \end{cases} \tag{2.7}$$

The purpose of this section is to identify observable factors that might influence the decision to abide by the Code. Under [2.4.2] we identified the MBR as the core element of the Code. The model under [2.3] implied that a controlling blockholder of a bidding company will incur a wealth loss under the MBR. Hypothesis 1 therefore states that companies with dominant blockholders should be reluctant to accede to the Code. A dummy variable, OC_i, equal to unity if there is an ultimate controlling blockholder and zero otherwise, should capture the impact of the ownership structure on the compliance decision. Further, Hypothesis 1 posits that a potential 'barbarian' will be less inclined to sign the Code than a company with no acquisition intentions. One of the determinants of the compliance decision should therefore be the probability of becoming a bidder. We therefore create an interaction variable of the predicted acquisition

activity and OC_i. The higher the predicted acquisition activity of an owner-controlled firm, the less likely the company will abide by the Code.[18] We use the estimates of the ordered probit model of acquisition activity and the respective firm characteristics in October 1995 to make out-of-sample predictions about the number of acquisitions during 1995-2000. The predicted scores, $\widehat{y}^*_{i,\Delta t2+1} = X_1^{95}\widehat{\beta}_1$ with X_1^{95} =[BID^{95}, AC^{95}, CGR^{95}, NCR^{95}], of owner-controlled companies are included as explanatory factors for the acceptance decision. It should be noted, however, that the MBR only applies in the case of takeovers of publicly traded companies. We therefore implicitly assume that the number of acquisitions of listed targets is proportional to the overall takeover activity of a company.

Whereas the costs associated with the acceptance of the Code directly derive from the MBR, the benefits are less evident. The benefits of compliance are mainly the absence of pressure from the stock exchange or the government, possibly also the non-admission to one of the major indices. We hypothesize that companies which are members of the DAX or MDAX or potential aspirants to membership are more susceptible to moral suasion from the stock exchange. Companies have an incentive to become an index constituent because this usually implies a higher valuation of their stock (Shleifer [1986]). Although current members of the DAX or MDAX are not directly threatened by expulsion from the index because on non-acceptance, they might be subject to a greater extent of pressure. In addition, one might suppose that banks exert influence on the management board of companies in which they are represented on the supervisory board. This might be the case since major universal banks such as Deutsche Bank and Dresdner Bank are members of the Takeover Commission (Übernahmekommission [1996]) and have also been involved in the draft of the Code. Two dummy variables, MDAX and BS, are therefore included to proxy for the degree of pressure to which a company is subject. Alternatively, we include the average daily turnover, TO, and the market value, MV, (as the two major 'hard' factors for index membership) to also capture the incentives of potential index aspirants to comply.

Another determinant for the acceptance decision might be the behaviour of other firms in the industry. If potential competitors for control comply with the Code, then it is less costly for a given company to accede as well. It is less disadvantaged in a potential contest for a share stake, since all bidders face the same constraint of the mandatory bid requirement. As the model under [3] has shown, adherence to the MBR reduces the maximum price the controlling blockholder of the raider is willing

[18]The predicted acquisition activity per se is not included as an explanatory variable, since the model only allows to make inferences about the acceptance decision of owner-controlled firms.

to pay for a target company share. The more companies in an industry abstain from the Code, the more likely they will outbid the blockholder of an abiding firm, and therefore the higher his wealth loss. These considerations might have guided VW and BMW, which have both not yet signed the Code. In fact, it can be seen that Code compliance is clustered according to industries. Table A.III presents the number of acceptance declarations per industry (divided according to the European NACE classification scheme). A sign test of the null hypothesis of an equal proportion of acceptances and rejections shows that the overall sample is significantly biased towards non-acceptance of the Code. A look at the cross-section of industry behaviour reveals that this seems to be the result of clustering phenomena in specific industries. In only seven of the thirty industries with more than 6 publicly traded companies is the behaviour significantly tilted towards non-compliance. From an industrial organization point of view it is interesting to note that these are mostly industries which are undergoing phases of major restructuring. Not only the food and beverage, but also the pulp and paper industry are currently undergoing a process of industrial concentration in Germany. On the other hand, the banking industry is 'significantly' determined to back the Code, with only nine out of forty banks omitting to sign. Also, the standard deviation of compliance equals 15% and thus highlights a quite substantial amount of cross-sectional variation by industries. As a crude measure of this clustering phenomenon we therefore include the percentage of *other* companies in the industry that accepted the Code, PAI, as an explanatory factor in the estimation of the compliance decision[19]. From the above considerations we obtain the following empirical specification:

$$y_1^* = X_1^{90}\beta_1 + \varepsilon_1 \tag{2.8}$$

$$y_2^* = X_2^{95}\beta_2 + \beta_3(X_1^{95}\beta_1)OC^{95} + \varepsilon_2 \tag{2.9}$$

where y_1^* is defined as in [2.6] above, $y_2 = 1$ if $y_{2i}^* > 0$ and 0 otherwise, X_1^{90} = [BID^{90}, AC^{90}, CGR^{90}, NCR^{90}], X_2^{95} = [1, MDAX^{95}, PAI, OC^{95}, BS^{95}] and X_1^{95} =[BID^{95}, AC^{95}, CGR^{95}, NCR^{95}]. The superscripts denote the sampling time of the observations. The disturbance terms are distributed $(\varepsilon_1, \varepsilon_2) \sim N(0, 0, 1, \sigma_2^2, \rho_{12})$ with ρ_{12} denoting the correlation coefficient between ε_1 and ε_2. The correlation coefficient should capture any time-invariant unobservable firm-or manager-specific factors in relation to acquisition activity, which influence the firm's decision about Code acceptance (e.g., M&A skills of managers). The maximum likelihood estimator for [2.8] is a simplified version of the estimator derived in the Appendix under [2.7.3]. For the likelihood function to be

[19]This presupposes that there is some implicit understanding of future acceptance decisions by other companies.

identified we impose $\sigma_2 = 1$. Table IV presents the estimation results of the bivariate (ordered) probit model.

As put forward in Hypothesis 1, owner-controlled companies are reluctant to adhere to the Code. The dummy variable for owner-control in the first specification carries a negative coefficient estimate which is significant at the 99.99% confidence level. This casts indirect evidence on the fact that firms under managerial control are more prone to abide by the takeover rules than owner-controlled firms. Specification II includes the interaction variable of owner-control and predicted future acquisition activity. The negative and statistically significant coefficient estimate implies that the higher the future takeover activity the less likely is an owner-controlled firm to accept the Takeover Code. The third specification comprises both the dummy variable for owner-control and its interaction with future acquisition activity. Both coefficient estimates are negative and statistically significant suggesting that independently of the predicted takeover activity owner-controlled firms are more hesitant to accept the Code[20]. This might be the case since each firm -independent of its predicted takeover activity during 1995-2000- might envisage an acquisition at some point in the future for which the owner does not want to restrict himself by accepting the Code today[21]. The estimation results further suggest that membership in the DAX or MDAX does have a significant and positive impact on the acceptance decision. A high market capitalization and high daily turnover (not reported) have a similar, but less significant, effect on the net benefits of compliance. The positive and significant coefficient estimate for the percentage of Code acceptance by other firms in the industry highlights the clustering behaviour among firms in the same industry. The costs of compliance are lower if other firms face the same bidding constraints. Finally, pressure from banks in a company's supervisory board does not seem to have been conducive to compliance. In fact, the sign of the coefficient estimate is negative (but statistically insignificant) suggesting -if at all- a contrary effect. The correlation coefficient ρ is negative, but not significant reflecting that unobservable management-specific factors of a company's acquisition activity do not seem to influence the firm's compliance decision.

[20]Note, however, that because of the non-linearity of the probit model, the effect of the dummy variable for owner-control is not a constant shift in the intercept, but that the shift in the intercept varies according to the level of the other explanatory variables.

[21]This indirectly confirms that there are costs associated with withdrawing from an earlier acceptance.

Wealth effects: Excess returns and cross-sectional return regression

As outlined above, we calculate the cumulative abnormal returns from event window $t0 = -2$ to $t1 = 7$ in order to measure the absolute size of the wealth effects associated with the acceptance of the Takeover Code. The average cumulative abnormal return across securities during the 10-day event interval is 0.53%. The variance of cumulative abnormal returns equals

$$Var(\widehat{CAR}_i) = \sum_{t=t_0}^{t_1} \widehat{\sigma}_i^2$$

where $\widehat{\sigma}_i^2$ denotes the MSE of the market model regression. Under the null hypothesis of zero abnormal returns the test statistic J is distributed as follows:

$$J = \frac{\overline{CAR}}{[Var(\overline{CAR})]^{1/2}} \overset{a}{\sim} N(0,1). \tag{2.10}$$

where $\overline{CAR}$ and $Var(\overline{CAR})$ denote the cross-sectional means of $\widehat{CAR}10_i$ and $Var(\widehat{CAR}_i)$ respectively. With a value of 1.46 the test statistic is not significant at conventional confidence levels so that we cannot reject the hypothesis of zero abnormal return for the whole the sample. This is not surprising since the $\overline{CAR}$ averages the stock price effect of potential bidders and companies that are likely to be uninvolved in corporate control transactions. The J-statistic becomes significant in both economic and statistical terms if the sample is restricted to owner-controlled firms. On average, minority shareholders of companies under owner-control experience a 3.21% wealth increase in the ten-day event interval around the acceptance of the Code. For minority shareholders of prospective bidders the wealth increase is higher than for the whole sample (1.80%) and significantly different from zero at the 99.9% confidence level. This finding suggests that minority shareholders of companies with a high predicted takeover activity profit from the Code acceptance independent of their control structure. This further implies that investors anticipate the possibility that prospective bidders under management-control might revert to owner-control in the future. Finally, when restricting the focus to companies that are both owner-controlled and future bidding candidates, we find a statistically significant abnormal return of 5.40%! The cumulative abnormal returns for all the subsamples are significantly greater than the excess returns for the full sample (Table V - Panel B). This finding lends support to Hypothesis 2. Minority shareholders of owner-controlled companies with high acquisition activity profit most from the acceptance of the mandatory bid rule. It is interesting to observe that the alphas and betas for the subsample of owner-controlled prospective bidders are higher than for the full sample - reflecting higher expected returns from potential bidders

The analysis of the cumulative abnormal returns also casts light on the alternative hypothesis that the positive wealth effect results from the abstinence from takeover defenses to which the signatories commit. This hypothesis can be rejected since the average $CAR10$ of majority-controlled companies, which are immune to takeover threats, equals 1.18% (see Table V) and is significantly higher than for the rest of the sample. The hypothesis that the CAR for majority-controlled firms is higher than the CAR of companies under dispersed ownership can be rejected at a higher than 96% confidence level. This finding corroborates the institutional reasons which suggest that the pre-commitment to not defend a hostile bid is of minor importance relative to the MBR requirement.

In the following we focus on the explanation of the cross-sectional variation in excess returns. This allows us to extend the above preliminary evidence on the relation between excess returns and the bidding activity of owner-controlled firms. At the same time we will take account of the potential selection bias which arises from the voluntary acceptance decision. Since outside investors can infer the management's latent information ε_2 by observing the event indicator in [2.7], the disturbance term in the cross-sectional return regression is truncated. This can provoke a bias in the cross-sectional return regression

$$CAR10 = X^{95}\beta_3 + \varepsilon_3 \tag{2.11}$$

where $CAR10$ denotes the cumulative excess returns during the 10-day event interval and $X^{95} = [X_3^{95}, (X_1^{95}\beta_1)]$. The explanatory variables X_3^{95} contain variables from X_2^{95} which are used as factors for a firm's compliance decision. Since outside investors recognize management's incentives, the conditional expectation of ε_3 at the time of the announcement of the acceptance decision equals[22]

$$E(\varepsilon_{3i} \mid y_{2i} = 1) = E\left(\varepsilon_{3i} \mid \frac{\varepsilon_{2i}}{\sigma_2} > -\psi_i\right) = \rho_{23}\sigma_3 \frac{\phi(\psi_i)}{\Phi(\psi_i)}$$

where $\psi_i = [x_{2i}^{95}\beta_2 + \beta_3(x_{1i}^{95}\beta_1)]/\sigma_2$, and $\phi(\cdot)$ and $\Phi(\cdot)$ denote the standard normal density and the cumulative density functions respectively. The ratio $\phi(\psi_i)/\Phi(\psi_i)$ equals the expectation of a standardized normal variate that is truncated below at ψ_i. If $\rho_{23}\sigma_3\phi(\psi_i)/\Phi(\psi_i)$ is ignored in [2.11], the residual of the cross-sectional return regression is correlated with the independent variables X^{95} and OLS and GLS estimators of the explanatory variables are inconsistent. In order to take account of the selection

[22] In the set-up of Eckbo et al. [1990] this expression corresponds to a situation where outside investors are completely surprised by the event.

bias we formulate a model which incorporates the model under [2.8] as the selection mechanism of the cross-sectional return regression. In particular, we specify[23]

$$y_1^* = X_1^{90}\beta_1 + \varepsilon_1 \tag{2.12}$$

$$y_2^* = X_2^{95}\beta_2 + \beta_3(X_1^{95}\beta_1)OC^{95} + \varepsilon_2 \tag{2.13}$$

$$CAR10 = X_3^{95}\beta_4 + \beta_5(X_1^{95}\beta_1) + \varepsilon_3 \text{ observed only if } y_{2i} = 1 \tag{2.14}$$

with the disturbance terms distributed as follows:

$$\begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho_{12}\sigma_2 & \rho_{13}\sigma_3 \\ \rho_{12}\sigma_2 & \sigma_2^2 & \rho_{23}\sigma_2\sigma_3 \\ \rho_{13}\sigma_3 & \rho_{23}\sigma_2\sigma_3 & \sigma_3^2 \end{bmatrix} \right).$$

The first two equations [2.12] and [2.13] correspond to the set-up analysed in Section 2.4.4. The last equation explains the cumulative abnormal event period returns for companies which signed the Code, i.e., it only includes return observations if $y_{2i} = 1$. The explanatory variables in [2.14], X_3^{95} = [1, PAI, MDAX^{95}, OC^{95}] are a subset of the variables determining the acceptance decision of the Code. In particular, variables proxying for the degree of moral pressure from banks in supervisory boards are not included, since they should not affect the variation in excess stock returns. According to Hypothesis 2, both the prospective acquisition activity, $X_1^{95}\beta_1$, and the presence of a blockholder, OC^{95}, should have a positive effect on the size of abnormal returns. Both characteristics are included independently as well as through an interaction term, $OC^{95} \cdot X_1^{95}\beta_1$, in order to draw comparisons between 'owner-' and 'manager-controlled' companies. We also include the percentage of Code acceptance of other firms in the industry, since shareholders should profit if all firms in the industry face the same bidding constraints. For the likelihood function to be identified we impose $\sigma_2 = 1$ and also $\rho_{13} = 0$ since a potential correlation between latent information of acquisition activity and the change in firm value is captured indirectly via ρ_{23}. The problem of cross-sectional dependence should be minor in the present context. First, because of the endogenous timing of the acceptance decision most event dates are sampled from different time periods. Secondly, Bernard [1987] finds that the bias due to cross-sectional dependence is less pronounced for short return intervals. Since daily return data is used for the calculation of excess returns problems in inference should not be serious. In order to avoid the non-trading bias we restrict the analysis to the segments 'Amtlicher Handel' and 'Geregelter Markt' which exhibit higher liquidity than stocks in the 'Freier Markt'.

[23]The estimation primarily aims at identifying the impact of firm-specific variables on cumulative abnormal returns. We use a truncated regression model to correct for the selection bias instead of the latent variable model proposed by Acharya [1993] which is shown to consistently estimate the value of latent information.

The maximum likelihood estimator of the trivariate limited dependent variable model [2.12]-[2.14] is derived in the Appendix under [2.7.3]. The empirical results in Table VII show that the significance of the correlation coefficient, ρ_{23}, justifies the use of the selection model, i.e., there is valuable inside information about the net benefits of compliance. The empirical findings also lend empirical support to Hypothesis 2. We find that excess returns in the wake of acceptance are higher for owner-controlled firms and for companies with high predicted future takeover activity. Specification II shows that minority shareholders of owner-controlled companies experience a wealth increase upon Code acceptance which is higher the greater their future acquisition agenda. This result clearly shows that the benefits of the MBR due to the prevention of wealth-decreasing acquisitions outweigh the costs of the mandatory bid requirement. The MBR indeed acts as a means to prevent the blockholder from (mis)using the funds of minority shareholders for the financing of his personal private benefits of control. These empirical results indirectly attribute a beneficent role to management under dispersed ownership which seems less prone to wealth-decreasing takeovers than management under the control of a dominant blockholder. However, the first specification highlights that the wealth increase of Code acceptance is positively related to future acquisition activity even if we control for differences in the control structure. As put forward in the analysis of the absolute wealth effects above, this reflects a nonzero probability of a change in the control structure from dispersed ownership to ultimate owner-control. Specification III includes the dummy variable for owner-control, the predicted takeover activity as well as their interaction term. Since all coefficient estimates are positive and significant, we conclude that the wealth increase is higher the higher the predicted takeover activity, but that the relation is even more pronounced for owner-controlled firms, i.e., there is both an *additional intercept* and an *additional slope* coefficient for firms under owner-control. Therefore, minority shareholders of companies under owner-control experience a fixed additional wealth effect independent of the firm's acquisition activity, but their gains also increase more strongly in relation to the firm's predicted acquisitions than the welfare gains for minority shareholders of companies with dispersed ownership. The percentage of Code acceptance of other firms in the industry has a positive effect on excess stock returns, which indicates that the costs of compliance are lower if the competitive dynamics in the market for corporate control are determined by a level playing field. Adherence to the MBR decreases the reservation value per target share of the controlling raiding blockholder (see Section 2.3). The fewer potential control contenders abide by the MBR, the smaller the likelihood of a successful takeover for an abiding blockholder. The positive coefficient estimate for the industry acceptance

ratio therefore highlights that on average non-signatories take away wealth increasing acquisition opportunities from companies which have accepted the Code. Membership in one of the major indices, however, does not have a significant impact on abnormal returns suggesting a minimal potential wealth loss associated with pressure from the stock exchange and/or a marginal probability of losing the index status because of non-acceptance.

2.5 Conclusions

The paper has proposed a model that analyses the wealth effects of the adoption of the mandatory bid rule (MBR) on minority shareholders of acquiring companies. The model identifies two opposing wealth effects for minority shareholders of potential 'barbarians'. On the one hand, the MBR redistributes wealth from (minority) shareholders of the 'barbarian' to the minority shareholders of the target by imposing a mandatory tender offer requirement. On the other hand, it protects small shareholders of raiders from acquisitions that do not sufficiently increase the security returns from the takeover. Under reasonable distributional assumptions about control and security benefits under the incumbent controller and acquirer the model suggests that minority shareholders profit from the adoption of the mandatory bid rule. In addition, the model predicts that controlling blockholders of acquiring companies will incur a wealth loss under the MBR.

The introduction of the Takeover Code in Germany in October 1995 is used to study the incentive structure and wealth effects of compliance with the MBR. In line with the predictions of the model the empirical study on the compliance decision reveals that owner-controlled companies with a large number of predicted takeovers are more hesitant to accept the Code. The cross-sectional return study on stock price reactions following the acceptance decision gives evidence of positive wealth effects for companies under owner-control and with a high predicted future acquisition activity. The fact that 'barbarians' under the control of a dominant blockholder show stronger positive stock price reactions than companies under dispersed ownership suggests that inter-shareholder conflicts are potentially more acute than shareholder-management agency conflicts. Stockholders in manager-controlled firms seem to profit less from a restraint in acquisition activity than stockholders in blockholder-controlled firms. This implies that manager-controlled firms act more 'shareholder friendly' in their acquisition strategy than owner-controlled firms which undertake more takeovers out of pure control interests.

An interesting path for further empirical investigation would be to study the intra-industry effects of a firm's acceptance decision, i.e., to analyse the welfare effects for small shareholders of potential target companies in response to the acceptance decision of a potential bidder; or in more concrete terms: What is the effect of BMW's acceptance decision on the stock returns of publicly traded automotive suppliers that could be potential target companies for BMW? From a theoretical point of view it would be interesting to derive the aggregate wealth implications of the mandatory

bid rule for both small shareholders of target and bidding companies. This aggregate welfare analysis could determine whether the MBR does justice to its distributional objective of strengthening the welfare of minority shareholders.

As outlined above, the paper as a whole sheds light on the importance of inter-shareholder conflicts in publicly traded corporations. In particular, the paper suggests that controlling blockholders are more 'barbaric' in their control pursuits than managers in companies under dispersed ownership. The paper therefore belongs to the growing corporate governance literature (La Porta et al. [1998], Bebchuck [1994]) that advocates a stronger focus on agency problems between minority and majority shareholders.

2.6 Tables

TABLE I

CONDITIONS FOR TRANSFERS OF CONTROL

Case	MBR	MR	Parameter conditions	ΔW
1	no	no	$Y_r + \frac{n_R}{k_R}\frac{n_T}{k_T}B_r < Y_t + \frac{n_T}{k_T}B_t$	0
2	no	yes	$Y_r + \frac{n_R}{k_R}B_r < Y_t + \frac{n_T}{k_T}B_t < Y_r + \frac{n_R}{k_R}\frac{n_T}{k_T}B_r$	ΔW_{TN}
3	yes	yes	$Y_r + \frac{n_R}{k_R}B_r > Y_t + \frac{n_T}{k_T}B_t$	ΔW_{TT}

TABLE II

SUMMARY STATISTICS

Variable	Description	Time	Mean	SD	Min	Max	Obs
y^*_{1i}	number of acquisitions	$\triangle$t1	2.68	4.03	0	25	467
		$\triangle$t2	2.30	4.74	0	34	652
AC_i	authorized capital (in m DM)	t=1	18.69	72.34	0.00	750	478
		t=2	29.72	104.73	0.00	1431.5	589
NCR_i	net current assets/total assets (%)	t=1	0.22	0.22	-0.63	0.85	427
		t=2	0.23	0.23	-0.52	0.91	548
CGR_i	liabilities/total assets (%)	t=1	0.30	0.22	0.00	1.05	429
		t=2	0.31	0.24	0.00	1.32	566
y^*_{2i}	=1, if firm signed Code	t=2	0.38	0.49	0	1	708
$MDAX_i$	=1, if member in DAX or MDAX	t=2	0.13	0.34	0	1	705
MV_i	market value (in '000 m DM)	t=2	1.23	4.58	0.00	63.27	639
TO_i	average daily turnover (in m DM)	t=2	3.43	19.43	0.00	141.76	531
$DMAJ_i$	=1, if firm majority-controlled	t=2	0.71	0.45	0	1	605
FFV_i	freefloat of voting equity (%)	t=2	0.32	0.27	0	1	570
BH_i	=1, if blockholder >25%	t=2	0.89	0.31	0	1	605
OC_i	=1, if firm owner-controlled	t=2	0.59	0.49	0	1	614
BS_i	=1, if bank in supervisory board	t=2	0.23	0.42	0	1	605

TABLE III

ORDERED PROBIT REGRESSIONS OF ACQUISITION ACTIVITY

The table presents the estimation results of an ordered probit regression for different versions of [2.6]. The *p-values* of the regression coefficients are reported below the coefficient estimates in parentheses. The Pseudo R^2 is defined as $1 - \ln L / \ln L_0$ where $\ln L_0$ equals the maximized value of the log-likelihood function in a regression with a constant term only. The estimated cut-off values, $\widehat{\theta}_1$ to $\widehat{\theta}_6$, are not reported.

	$y_{i,\Delta t1}$	$AC_{i,t=1}$	$NCR_{i,t=1}$	$CGR_{i,t=1}$	N	lnL	Prob>χ^2	Pseudo R^2
I	0.337 (0.000)	0.004 (0.000)			465	-277.57	0.000	12.82%
II	0.372 (0.000)	0.004 (0.002)	0.769 (0.006)		365	-136.94	0.000	14.47%
III	0.366 (0.000)	0.005 (0.002)		−0.618 (0.021)	369	-140.84	0.000	14.23%
IV	0.370 (0.000)	0.004 (0.003)	0.638 (0.029)	−0.452 (0.111)	365	-134.64	0.000	14.67%

TABLE IV

BIVARIATE (ORDERED) PROBIT MODEL OF ACCEPTANCE DECISION

The table presents the estimation results of the bivariate (ordered) probit regression for different versions of [2.8]. The *p-values* of the regression coefficients are reported below the coefficient estimates in parentheses.

		I	II	III
y^*_{2i}	Ordered probit model	Acquisition activity		
	$y_{i,\Delta t1}$	0.313 (0.000)	0.373 (0.000)	0.391 (0.000)
	$AC_{i,t=1}$	0.002 (0.026)	0.004 (0.006)	0.004 (0.013)
	$NCR_{i,t=1}$	0.544 (0.069)	0.577 (0.058)	0.562 (0.055)
	$CGR_{i,t=1}$	−0.439 (0.094)	−0.279 (0.186)	−0.311 (0.126)
	ρ	−0.234 (0.197)	−0.198 (0.269)	−0.221 (0.232)
y^*_{2i}	Probit model	Acceptance Decision		
	Constant	−0.927 (0.000)	−1.004 (0.000)	−0.820 (0.000)
	$OC_{i,t=2}$	−0.426 (0.000)		−0.412 (0.011)
	$OC_{i,t=2} \cdot \widehat{y}_{i,\Delta t2+1}$		−0.337 (0.000)	−0.223 (0.047)
	$MDAX_{i,t=2}$	0.547 (0.001)	0.798 (0.000)	0.773 (0.001)
	$PAI_{i,t=2}$	2.445 (0.000)	2.389 (0.000)	2.388 (0.000)
	$BS_{i,t=2}$	−0.051 (0.730)	−0.083 (0.612)	−0.187 (0.276)
	Obs	293	287	287
	$\ln L_{1,2}$	-245.20	-197.36	-178.22
	Prob>χ^2	0.000	0.000	0.000

TABLE V

PANEL A: ESTIMATES OF ABNORMAL STOCK RETURNS AROUND ACCEPTANCE DATE

The table presents estimates of [2.5], the cumulative abnormal returns from event window $t0 = -2$ to $t1 = 7$. The market model is estimated with return data from day -280 to day -30 prior to the acceptance of the Code, for which both α and β are reported for the various sub-samples. The event window covers seven post-event days to allow for publication of the acceptance declaration in the 'Börsenzeitung' and its dissemination by the stock exchange. The J-statistic is calculated according to [2.10].

Sample	Criteria	$\widehat{\alpha} * 10^3$	$\widehat{\beta}$	$\overline{CAR10}$	J-statistic	Obs
Full sample		0.067	0.713	0.53%	1.429	232
Companies under owner-control	$OC_i = 1$	0.001	0.696	3.21%	4.769	94
Prospective bidders	$\widehat{y}_{i,\Delta t2+1} \geqslant \widehat{\theta}_1$	0.102	0.821	1.80%	3.530	114
Owner-controlled prospective bidders	$OC_i = 1$ and $\widehat{y}_{i,\Delta t2+1} \geqslant \widehat{\theta}_1$	0.111	0.791	5.40%	6.594	54
Majority-controlled		0.001	0.604	1.18%	2.325	1.25

PANEL B: MEAN COMPARISON TESTS ON CUMULATIVE ABNORMAL RETURNS

The table presents the t-statistics on the differences in the cumulative abnormal returns for bidder and owner-controlled companies respectively. The t-statistics are reported both under the assumption of equal and unequal variances.

Mean comparions tests on CARs: t-statistics	Equal variance	Unequal variance
	Full sample	
Owner-controlled vs manager controlled	3.761	3.524
Prospective bidders vs non-bidders	3.218	3.236
Prospective owner-controlled bidders vs others	5.408	4.358
Majority control vs dispersed ownership	1.760	1.834
	Prospective bidders	
Owner-controlled vs manager controlled	2.931	2.985
	Owner-controlled firms	
Prospective bidders vs non-bidders	3.182	3.756

TABLE VI

TRIVARIATE LDV MODEL FOR CROSS-SECTIONAL RETURN REGRESSION

The table presents estimation results of the trivariate limited dependent variable model as specified in [2.12]-[2.14]. The *p-values* of the regression coefficients are reported below the coefficient estimates in parentheses.

		I	II	III
$y^*_{i,\Delta t2}$	Ordered probit model	Acquisition activity		
	$y_{i,\Delta t1}$	0.355 (0.000)	0.287 (0.000)	0.359 (0.000)
	$AC_{i,t=1}$	0.002 (0.000)	0.003 (0.000)	0.002 (0.000)
	$NCR_{i,t=1}$	0.492 (0.065)	0.543 (0.088)	0.471 (0.115)
	$CGR_{i,t=1}$	−0.481 (0.117)	−0.407 (0.080)	−0.443 (0.179)
	ρ_{12}	−0.142 (0.442)	−0.092 (0.646)	−0.111 (0.531)
y^*_{2i}	Probit model	Acceptance decision - selection mechanism		
	Constant	−0.765 (0.000)	−0.899 (0.000)	−0.897 (0.000)
	$OC_{i,t=2}$	−0.394 (0.010)	−0.453 (0.009)	−0.451 (0.010)
	$OC_{i,t=2} \cdot \widehat{y}_{i,\Delta t2+1}$	−0.213 (0.036)	−0.193 (0.087)	−0.143 (0.107)
	$MDAX_{i,t=2}$	0.541 (0.008)	0.499 (0.000)	0.486 (0.006)
	$PAI_{i,t=2}$	1.938 (0.000)	1.708 (0.000)	1.965 (0.000)
	ρ_{23}	0.789 (0.000)	0.753 (0.000)	0.768 (0.000)
	σ_3	0.094 (0.000)	0.092 (0.000)	0.089 (0.000)
	$\rho_{23}\sigma_3$	0.074 (0.000)	0.069 (0.000)	0.068 (0.000)
CAR10	OLS	Cross-sectional return regression		
	Constant	−0.159 (0.000)	−0.123 (0.000)	−0.168 (0.000)
	$OC_{i,t=2}$	0.035 (0.004)	0.029 (0.034)	0.024 (0.083)
	$\widehat{y}_{i,\Delta t2+1}$	0.028 (0.003)		0.019 (0.013)
	$OC_{i,t=2} \cdot \widehat{y}_{i,\Delta t2+1}$		0.029 (0.019)	0.020 (0.093)
	$MDAX_{i,t=2}$	0.005 (0.276)	0.022 (0.176)	0.008 (0.254)
	$PAI_{i,t=2}$	0.149 (0.008)	0.147 (0.009)	0.133 (0.016)
	Obs	335	335	335
	$\ln L_{1,2}$	-198.17	-197.88	-186.84
	Prob>χ^2	0.000	0.000	0.000

2.7 Appendix

2.7.1 Proofs to Lemmas and Propositions

Proof to Proposition 1: The value of the t's blockholding to r is

$$\frac{k_R}{n_R} k_T Y_r + n_T B_r, \tag{2.15}$$

whereas t values the block at $k_T Y_t + n_T B_t$. The new blockholder of T, r, will pay the fraction k_R/n_R of the transaction price, $(n_R - k_R)/n_R$ will be carried by R's minority shareholders. If r just compensates t for the value of the share block, r will have to pay

$$\frac{k_R}{n_R} k_T Y_t + \frac{k_R}{n_R} n_T B_t. \tag{2.16}$$

In order for a transfer to occur the parties have to agree on a transaction price which will make both parties better off. Multiplying [2.15] and [2.16] by $n_R/k_T k_R$ we obtain the necessary and sufficient condition for a control transfer, namely $Y_r + (B_r n_T n_R)/k_T k_R > Y_t + (B_t n_T)/k_T$. ■

Proof to Proposition 2: (Bebchuck [1994]). Inequality [2.2] is both a necessary and sufficient condition for a transfer of control under the MBR. The transaction price under the MBR has to be greater than $Y_t + (n_T B_t)/k_T$ to make t better off, but cannot be larger than $Y_r + (n_R B_r)/k_R$, since r would incur a welfare loss. The condition is *sufficient* since the acquisition of the target company will have a value to r of at least $Y_r + (n_R B_r)/k_R$; more than $Y_r + (n_R B_r)/k_R$ if minority shareholders of T keep their shares and $Y_r + (n_R B_r)/k_R$ if they choose to tender their shares. Inequality [2.2] is also a *necessary* condition, since otherwise there exists no transaction price which will make both parties better off. Any price lower than $Y_t + (n_T B_t)/k_T$ will make t worse off and any price higher than $Y_r + (n_R B_r)/k_R$ will make r worse off. ■

Lemma 2: In order to derive the expected payoff to the small shareholders of R, we have to consider the two cases in which t and r make a take-it-or-leave-it offer to the respective other party. If r is the party making the take-it-or-leave-it offer, r will offer just t's reservation value per share, $Y_t + (n_T B_t)/k_T$. In the opposite case t will skim the total surplus and demand $Y_r + (n_R n_T B_r)/(k_T k_R)$ per share. The expected payoff for small R shareholders under the MR is a weighted average of the two bargaining scenarios and corresponds to

$$E(P_{MR}) = \theta[\underbrace{\tfrac{n_R-k_R}{n_R}n_T Y_r}_{\text{share of cash-flows to R}} - \underbrace{\tfrac{n_R-k_R}{n_R}k_T(Y_t+\tfrac{n_T}{k_T}B_t)}_{\text{share in acquisition costs}} - \underbrace{\tfrac{n_R-k_R}{n_R}(n_T-k_T)Y_r}_{\text{cash-flows to small T shareholders}} \quad [2.17]$$
$$+(1-\theta)\left[\tfrac{n_R-k_R}{n_R}n_T Y_r - \tfrac{n_R-k_R}{n_R}k_T(Y_r+\tfrac{n_T}{k_T}\tfrac{n_R}{k_R}B_r) - \tfrac{n_R-k_R}{n_R}(n_T-k_T)Y_r\right].$$

Small R shareholders obtain their respective fraction of cash-flows from T, from which we have to subtract their share in the acquisition costs and the security benefits which accrue to the small shareholders of the target. The second term highlights that small R shareholders have to finance r's private benefits although they only participate in the acquisition via security benefits. Under the MBR only the third payoff component changes: small T shareholders now have the option to tender their shares and receive the negotiated transaction price or to remain shareholders and participate in the security benefits of Y_r. The expected payoff under the MBR therefore equals

$$E(P_{MBR}) = \theta\left[\tfrac{n_R-k_R}{n_R}n_T Y_r - \tfrac{n_R-k_R}{n_R}k_T(Y_t+\tfrac{n_T}{k_T}B_t) - \tfrac{n_R-k_R}{n_R}(n_T-k_T)\max\{Y_r, Y_t+\tfrac{n_T}{k_T}B_t\}\right]$$
$$+(1-\theta)\left[\tfrac{n_R-k_R}{n_R}n_T Y_r - \tfrac{n_R-k_R}{n_R}k_T(Y_r+\tfrac{n_R}{k_R}B_r) - \tfrac{n_R-k_R}{n_R}(n_T-k_T)\max\{Y_r, Y_r+\tfrac{n_R}{k_R}B_r\}\right].$$

In the case where t has complete bargaining power small T shareholder will always tender their shares since $Y_r < Y_r+(n_R B_r)/k_R$. Simplifying the second half of $E(P_{MBR})$ and $E(P_{MR})$ we find that in both cases small R shareholders incur a wealth loss of $-n_T B_r(n_R-k_R)/k_R$ if t dominates the bargaining game. In both cases does t skim the surplus from r, so the wealth gain to r is zero. Small T shareholders, however, still have to finance r's private benefits in an order of magnitude of $-n_T B_r(n_R-k_R)/k_R$. The difference between the payoffs under the MBR and MR therefore only corresponds to the difference in the payoffs to small T shareholders if r has complete bargaining power, i.e.

$$\Delta W_{TT} = E(P_{MR}) - E(P_{MBR}) = -\theta\left[\tfrac{n_R-k_R}{n_R}(n_T-k_T)(Y_r - \max\{Y_r, Y_t+\tfrac{n_T}{k_T}B_t\})\right]. \blacksquare$$

Proof to Lemma 3: Since in case 2 no transfers occur under the MBR, the payoff to the minority shareholders of R is zero, i.e. $E(P_{MBR}) = 0$ so that $E(\Delta W_{TN} \mid .) = E(P_{MR})$. Simplifying [2.17] yields

$$\Delta W_{TN} = \tfrac{n_R-k_R}{n_R}\left[\theta[k_T(Y_r-Y_t) - n_T B_t] - (1-\theta)n_T\tfrac{n_R}{k_R}B_r\right]. \blacksquare$$

For transfers of control to occur under the MR, but not under the MR, the double inequality $Y_r + (n_R B_r)/k_R < Y_t + (n_T B_t)/k_T < Y_r + (n_R n_T B_r)/(k_T k_R)$ has to

hold. Transforming the inequality yields $-(n_R k_T B_r)/k_R > k_T(Y_r - Y_t) - n_T B_t > -(n_R n_T B_r)/k_R$. The assumption $B_r > 0$ implies $k_T(Y_r - Y_t) - n_T B_t < 0$ which leaves small R shareholders with an expected welfare loss, $E(\Delta W_{TN} \mid .) < 0$ under the MR. ■

Proof to Proposition 3: We have to show that $|\Delta W_{TN}|$ under the conditions of case 2 exceeds ΔW_{TT} under the conditions of case 3, i.e. $E\,|(\Delta W_{TN} \mid .)| > E(\Delta W_{TT} \mid .)$. We proceed by examining the conditional expectations for given B_t and B_r and random $Y_r - Y_t$. The conditions of case 2 imply that ΔW_{TN} ranges between $-\pi_R(n_T n_R B_r/k_R)$ and $-\pi_R(n_R B_r/k_R)[\theta k_T + (1-\theta)n_T]$ where π_R denotes the fractional equity ownership of minority shareholders in R, $(n_R - k_R/n_R)$. In case 3 ΔW_{TT} can vary from 0 to $\pi_R\theta(n_R B_r/k_R)(n_T - k_T)$. In order for $|E(\Delta W_{TN} \mid .)|$ to outweigh $E(\Delta W_{TT} \mid .)$ for all possible realizations of $Y_r - Y_t$, the following inequality has to hold:

$$\left|-\theta\frac{n_R}{k_R}k_T B_r - (1-\theta)\frac{n_R}{k_R}n_T B_r\right| > \theta(n_T - k_T)\frac{n_R}{k_R}B_r.$$

The inequality is satisfied if $\theta < 1/2$. This is true for all possible combinations of B_t and B_r. ■

Proof to Proposition 4: Both B_r and B_t are distributed on $[0;\alpha_r]$ and $[0;\alpha_t]$ respectively, with density functions f_r and f_t. The difference $Y_r - Y_t$ is uniformly distributed on $[-\omega_0,\omega_1]$ where $\omega_0 \geqslant \alpha_r n_R n_T/(k_R k_T) - \alpha_t n_T/k_T$ and $\omega_1 \geqslant \alpha_t n_T/k_T$. Defining $Y_r - Y_t \equiv \Delta Y$, we can calculate the conditional expected values in [2.3]. The positive wealth effect of the MR in situations in which the transfers occur under both rules equals:

$$\begin{aligned}
&P(\Delta Y > \tfrac{n_T}{k_T}B_t - \tfrac{n_R}{k_R}B_r)\cdot E(\Delta W_{TT} \mid \Delta Y > \tfrac{n_T}{k_T}B_t - \tfrac{n_R}{k_R}B_r)\\
&= \int_0^{\alpha_r}\int_0^{\alpha_t}\int_{\frac{n_T}{k_T}B_t - \frac{n_R}{k_R}B_r}^{\frac{n_T}{k_T}B_t}\left[\theta\tfrac{n_R - k_R}{n_R}(n_T - k_T)(\tfrac{n_T}{k_T}B_t - \Delta Y)\right]\tfrac{1}{\omega_0+\omega_1}d\Delta Y\, f_t dB_t f_r dB_r\\
&= \int_0^{\alpha_r}\int_0^{\alpha_t}\tfrac{n_R - k_R}{n_R}\tfrac{1}{2}\tfrac{1}{\omega_0+\omega_1}(n_T - k_T)\tfrac{n_R^2}{k_R^2}\theta B_r^2\, f_t dB_t f_r dB_r.
\end{aligned} \tag{2.18}$$

The negative wealth effects of the MR in situations where transfers occur only under

the MR equals:

$$P(\tfrac{n_T}{k_T}B_t - \tfrac{n_R}{k_R}B_r > \Delta Y > \tfrac{n_T}{k_T}B_t - \tfrac{n_R}{k_R}\tfrac{n_T}{k_T}B_r)E(\Delta W_{TN} \mid \tfrac{n_T}{k_T}B_t - \tfrac{n_R}{k_R}B_r > \Delta Y > \tfrac{n_T}{k_T}B_t - \tfrac{n_R}{k_R}\tfrac{n_T}{k_T}B$$
$$= \int_0^{\alpha_r}\int_0^{\alpha_t}\int_{\frac{n_T}{k_T}B_t-\frac{n_R}{k_R}\frac{n_T}{k_T}B_r}^{\frac{n_T}{k_T}B_t-\frac{n_R}{k_R}B_r} \tfrac{n_R-k_R}{n_R}\left[\theta(k_T\Delta Y - n_T B_t) - (1-\theta)n_T\tfrac{n_R}{k_R}B_r\right]\tfrac{1}{\omega_0+\omega_1}d\Delta Y f_t dB_t f_r dB_r$$
$$= \int_0^{\alpha_r}\int_0^{\alpha_t} -\tfrac{n_R-k_R}{n_R}\tfrac{1}{2}\tfrac{1}{\omega_0+\omega_1}(n_T-k_T)\tfrac{n_R^2}{k_R^2}\left[\theta\left(\tfrac{n_T+k_T}{k_T}+\tfrac{2n_T}{n_T-k_T}\right)+\tfrac{2n_T}{k_T}\right]B_r^2\, f_t dB_t f_r dB_r. \tag{2.19}$$

Since the last term in square brackets is greater than one, the absolute value of (2.19) exceeds (2.18), i.e., the negative relative wealth effects of the MR outweigh the wealth gain in situations where transfers occur under both rules. The MBR therefore entails positive ex ante wealth effects for small shareholders of R. It can also easily be seen that the wealth increase is higher, the smaller the blockholding of the target company, k_T/n_T, and the smaller the size of the controlling blockholder of the raider, k_R/n_R. ■

2.7.2 Annotations to Data

TABLE A.I

TENDER OFFERS IN GERMANY DURING 1995-97 WITH INTENT TO ACQUIRE CONTROL

Date	Bidder	Target	Ownership (pre-bid)	Ownership (post-bid)
11/05/95	Caradon plc	Weru AG	Caradon (11%) BBV Holding (6%)	Caradon (51%)
03/09/96	Future Holding AG	Glunz AG	Fam Glunz (16%) IBM Pensionskasse (5%) PDFM (6%)	minuscule acceptance

TABLE A.II

DATA DESCRIPTION AND DATA SOURCES

Variable	Description	Data Source
y_{1i}^*	number of acquisitions	M&A Review Database University of St. Gallen Transaction type 0 (purchase of share stake) Transaction type 6 (increase of equity stake) Transaction type 8 (control agreement)
y_{2i}^*	=1, if firm signed Code	Übernahmekommission der Deutschen Börse
AC_i	authorized capital	Hoppenstedt Aktienführer 1991, 1996 Publication deadline: 30 September of previous year
NCR_i	net current assets/total assets	Datastream International Account Item No. 104/723 (October 1995) Annual reports 1990, 1995 Hoppenstedt Aktienführer 1991, 1996
CGR_i	liabilities/total assets	Datastream International Account Item No. 731 (October 1995) Annual reports 1990, 1995 Hoppenstedt Aktienführer 1991, 1996
$MDAX_i$	member of DAX or MDAX	Börsenzeitung October 1995
MV_i	market value ('000 m DM)	Datastream International Datatype MV (October 1995)
TO_i	average daily volume (m DM)	Datastream International Datatype VO (daily average in 1995)
BS_i	=1, if bank in supervisory board	Hoppenstedt Handbuch der Gro unternehmen
$DMAJ_i$	=1, if firm majority-controlled	Hoppenstedt Aktienführer 1996
OC_i	=1, if firm owned by an ultimate controlling individual blockholder	Hoppenstedt Aktienführer 1996 Wer gehört zu wem? (Commerzbank 1994) Hoppenstedt Handbuch der Gro unternehmen

TABLE A.III

ACCEPTANCE DECLARATIONS BY INDUSTRY

The table lists the number of acceptance declarations of the Takeover Code in each two-digit NACE category in which more than 6 companies were listed during October 1995-December 1997. In order to test for the clustering of acceptance decisions in an industry a median-based sign-test is used. Under the null hypothesis of $H_0^i := P(X_i) = 0.5$, where X_i denotes the number of acceptance decisions in a specific industry $i = 1, ..., 30$, the random variable $\widetilde{X}_i$ is distributed binomially $B(n_i, 0.5)$. The null hypothesis is rejected if $X_i \leqslant k_{\alpha/2}$ or $X_i \geq k_{1-\alpha/2}$, where $k_{\alpha/2}$ and $k_{1-\alpha/2}$ are the greatest respectively the smallest integers which satisfy $\sum_{m=0}^{k_{\alpha/2}} \binom{n_i}{m} 0.5^{n_i} \leqslant \alpha/2$ and $\sum_{m=k_{1-\alpha/2}}^{n_i} \binom{n_i}{m} 0.5^{n_i} \leqslant \alpha/2$ respectively. Numbers marked with * indicate industries in which the null hypothesis can be rejected at the 5% significance level.

Industry	NACE	$\overline{S}$	S	$\%\overline{S}$	%S	N
Manufacture of wood, straw and plaiting	20	6*	1	85.7%	14.3%	7
Office machinery and computers	30	4	3	57.1%	42.86%	7
Automotive supplies and transport equipment	35	6	2	75.0%	25.0%	8
Health and social work	85	5	4	44.4%	55.6%	9
Clothing and dyeing of fur	18	4	6	40.0%	60.0%	10
Pulp, paper and paper products	21	8*	2	80.0%	20.0%	10
Electrical machinery and apparatus	31	6	4	60.0%	40.0%	10
Radio, television and communication equipment	32	6	4	60.0%	40.0%	10
Medical, precision and optical instruments	33	5	5	50.0%	50.0%	10
Furniture, jewelry, musical instruments, etc.	36	8*	2	80.0%	20.0%	10
Land transport and pipelines	60	8*	2	80.0%	20.0%	10
Auxiliary activities to financial intermediation	67	6	5	54.5%	45.5%	11
Fabricated metal products	28	8	5	61.5%	38.5%	13
Automotive industry (motor vehicles and trailers)	34	7	6	53.8%	46.2%	13
Retail trade and repair of household goods	52	7	6	53.8%	46.2%	13
Rubber and plastic products	25	10	4	71.4%	28.6%	14
Non-metallic mineral products	26	8	6	57.1%	42.9%	14
Other mining and quarrying	14	11	6	64.7%	35.3%	17
Construction	45	16*	4	80.0%	20.0%	20
Wholesale and commission trade	51	18*	3	85.7%	14.3%	21
Basic metal	27	16*	6	72.7%	27.3%	22
Electricity, gas, steam and hot water supply	40	18*	5	78.3%	21.7%	23
Manufacture of textiles	17	14	10	58.3%	41.7%	24
Chemicals and chemical products	24	14	16	46.7%	53.3%	30
Insurance and pension funding	66	13	20	39.4%	60.6%	33
Financial intermediation	65	9	31*	22.5%	77.5%	40
Real estate activities	70	25	15	62.5%	37.5%	40
Machinery and equipment	29	26	16	61.9%	38.1%	42
Food products and beverages	15	45*	12	78.9%	21.1%	57
Other business activities	74	36	26	58.1%	41.9%	62
Mean	$\overline{X}$			62.8	37.2%	610
Standard deviation	SD			15.1%	15.1%	

2.7.3 Derivation of Maximum Likelihood Functions

The specification of the three-equation model estimated under [2.4.4] consists of an ordered probit regression (2.20), a probit regression (2.21) and a continuous OLS regression (2.22) which is selected if $y_2 = 1$, i.e. if a company has signed the Takeover Code. The set-up allows for potential correlation between the disturbance terms ε_1, ε_2, and ε_3.

$$
\begin{aligned}
y_1^* &= X_1^{90}\beta_1 + \varepsilon_1 && (2.20)\\
y_2^* &= X_2^{95}\beta_2 + \beta_3(X_1^{95}\beta_1) + \varepsilon_2 && (2.21)\\
CAR10 &= X_3^{95}\beta_4 + \beta_5(X_1^{95}\beta_1) + \varepsilon_3 \text{ observed only if } y_{2i} = 1 && (2.22)
\end{aligned}
$$

$$
\begin{aligned}
y_{1i} &= 0 \quad \text{if } \theta_{y_{1i}+1} < y_{1i}^* \leqslant \theta_{y_{1i}+2}\\
y_{1i} &= 1 \quad \text{if } \theta_{y_{1i}+1} < y_{1i}^* \leqslant \theta_{y_{1i}+2}\\
&\vdots\\
y_{1i} &= j \quad \text{if } \theta_{y_{1i}+1} < y_{1i}^* \leqslant \theta_{y_{1i}+2}
\end{aligned}
$$

$$
\begin{aligned}
y_{2i} &= 1 \text{ if } y_{2i}^* > 0, \qquad 0 \text{ otherwise}\\
\begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{bmatrix} &\sim N\left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho_{12}\sigma_2 & \rho_{13}\sigma_3 \\ \rho_{12}\sigma_2 & \sigma_2^2 & \rho_{23}\sigma_2\sigma_3 \\ \rho_{13}\sigma_3 & \rho_{23}\sigma_2\sigma_3 & \sigma_3^2 \end{bmatrix} \right)
\end{aligned}
$$

The matrix of observations on the explanatory variables X can be decomposed into $[x_{il}]_{1\leqslant i\leqslant n;1\leqslant l\leqslant m}$ where i indexes the n sample observations and l the number of independent variables m. Similarly, $y_1 = [y_{1i}]_{1\leqslant i\leqslant n}$. The maximum likelihood function of the model consists of two parts: one part which is the result a bivariate probability distribution if the Code is not signed, and a second component resulting from a trivariate probability distribution if the Code is signed and excess stock returns are observed.

Case 1: $y_{2i} = 0$ (Code not signed) The joint probability of the normally distributed random variables ε_1 from (2.20) and ε_2 from (2.21) equals

$$
\begin{aligned}
\text{Prob}(\varepsilon_2 &\leqslant -X_2^{95}\beta_2 - \beta_3(X_1^{95}\beta_1)\,, \theta_{y+1} - X_1^{90}\beta_1 < \varepsilon_1 \leqslant \theta_{y+2} - X_1^{90}\beta_1)\\
&= \int_{-\infty}^{-X_2^{95}\beta_2 - \beta_3(X_1^{95}\beta_1)} \int_{\theta_{y+1}-X_1^{90}\beta_1}^{\theta_{y+2}-X_1^{90}\beta_1} \underbrace{f_{\varepsilon_1|\varepsilon_2}(\epsilon_1,\epsilon_2) f_{\varepsilon_2}(\epsilon_2)}_{=f_{\varepsilon_1,\varepsilon_2}(\epsilon_1,\epsilon_2)} d\epsilon_1 d\epsilon_2
\end{aligned}
$$

where $f_{\varepsilon_2}(\epsilon_2)$ stands for the density function of ε_2, and $f_{\varepsilon_1,\varepsilon_2}(\epsilon_1,\epsilon_2)$ and $f_{\varepsilon_1|\varepsilon_2}(\epsilon_1,\epsilon_2)$ denote the joint density and conditional density function of the random variables ε_1 and ε_2 respectively. The conditional distribution of ε_1 given ε_2 is normal as well: $\varepsilon_1 \mid \varepsilon_2 \sim N(\mu_{1|2}, \sigma^2_{1|2})$ where $\mu_{1|2} = \rho_{12}\varepsilon_2/\sigma_2$ and $\sigma^2_{1|2} = 1 - \rho^2_{12}$. The density function $f_{\varepsilon_2}(\epsilon_2)$ and the conditional density function $f_{\varepsilon_1|\varepsilon_2}(\epsilon_1,\epsilon_2)$ are equal to

$$f_{\varepsilon_1|\varepsilon_2}(\epsilon_1,\epsilon_2) = \tfrac{1}{\sigma_{1|2}}\phi\left(\tfrac{\epsilon_1-\mu_{1|2}}{\sigma_{1|2}}\right) \qquad \text{and} \qquad f_{\varepsilon_2}(\epsilon_2) = \tfrac{1}{\sigma_2}\phi\left(\tfrac{\epsilon_2}{\sigma_2}\right),$$

so that

$$\begin{aligned}\text{Prob}(&\varepsilon_2 \leqslant -X_2^{95}\beta_2 - \beta_3(X_1^{95}\beta_1),\ \theta_{y+1} - X_1^{90}\beta_1 < \varepsilon_1 \leqslant \theta_{y+2} - X_1^{90}\beta_1) \\ &= \int_{-\infty}^{-X_2^{95}\beta_2-\beta_3(X_1^{95}\beta_1)} \left[\Phi\left(\tfrac{\theta_{y+2}-X_1^{90}\beta_1-\mu_{1|2}}{\sigma_{1|2}}\right) - \Phi\left(\tfrac{\theta_{y+1}-X_1^{90}\beta_1-\mu_{1|2}}{\sigma_{1|2}}\right)\right] \tfrac{1}{\sigma_2}\phi\left(\tfrac{\epsilon_2}{\sigma_2}\right) d\epsilon_2.\end{aligned}$$

Case 2: $y_{2i} = 1$ (Code signed)

The joint probability of the normally distributed random variables ε_1 from (2.20), ε_2 from (2.21) and ε_3 from (2.22) is

$$\begin{aligned}Prob(\varepsilon_2 \ &> \ -X_2^{95}\beta_2 - \beta_3(X_1^{95}\beta_1)\ , \theta_{y+1} - X_1^{90}\beta_1 < \varepsilon_1 \leqslant \theta_{y+2} - X_1^{90}\beta_1, \varepsilon_3) \\ &= \int_{-X_2^{95}\beta_2-\beta_3(X_1^{95}\beta_1)}^{\infty} \int_{\theta_{y+1}-X_1^{90}\beta_1}^{\theta_{y+2}-X_1^{90}\beta_1} f_{\varepsilon_1,\varepsilon_2,\varepsilon_3}(\epsilon_1,\epsilon_2,\epsilon_3) d\epsilon_1 d\epsilon_2 \\ &= f_{\varepsilon_3}(\epsilon_3) \int_{-X_2^{95}\beta_2-\beta_3(X_1^{95}\beta_1)}^{\infty} f_{\varepsilon_2|\varepsilon_3}(\epsilon_2,\epsilon_3) \int_{\theta_{y+1}-X_1^{90}\beta_1}^{\theta_{y+2}-X_1^{90}\beta_1} f_{\varepsilon_1|\varepsilon_2,\varepsilon_3}(\epsilon_1,\epsilon_2,\epsilon_3) d\epsilon_1 d\epsilon_2.\end{aligned}$$

where $f_{\varepsilon_3}(\epsilon_3)$ stands for the density function of ε_3, $f_{\varepsilon_2|\varepsilon_3}(\epsilon_2,\epsilon_3)$ denotes the conditional density function of ε_2 given ε_3, $f_{\varepsilon_1,\varepsilon_2,\varepsilon_3}(\epsilon_1,\epsilon_2,\epsilon_3)$ denotes the joint density of $\varepsilon_1, \varepsilon_2$, and ε_3, and $f_{\varepsilon_1|\varepsilon_2,\varepsilon_3}(\epsilon_1,\epsilon_2,\epsilon_3)$ the conditional density of ε_1 given ε_2 and ε_3. The conditional distribution of ε_2 given ε_3 is normal as well: $\varepsilon_2 \mid \varepsilon_3 \sim N(\mu_{2|3}, \sigma^2_{2|3})$ where $\mu_{2|3} = \rho_{23}\sigma_2\varepsilon_3/\sigma_3$ and $\sigma^2_{2|3} = \sigma^2_2(1-\rho^2_{23})$. The conditional distribution of ε_1 given ε_2 and ε_3 likewise equals $\varepsilon_1 \mid \varepsilon_2, \varepsilon_3 \sim N(\mu_{1|2,3}, \sigma^2_{1|2,3})$ where

$$\begin{aligned}\mu_{1|2,3} &= \frac{(\rho_{12}-\rho_{13}\rho_{23})\sigma_3\varepsilon_2 + (\rho_{13}-\rho_{12}\rho_{23})\sigma_2\varepsilon_3}{\sigma_2\sigma_3(1-\rho^2_{23})} \\ \sigma^2_{1|2,3} &= 1 - \frac{[\rho^2_{12} - 2\rho_{12}\rho_{13}\rho_{23} + \rho^2_{13}]}{1-\rho^2_{23}}.\end{aligned}$$

The density functions necessary to compute the probabilities which enter the likelihood functions are

$$\begin{aligned}f_{\varepsilon_1|\varepsilon_2,\varepsilon_3}(\epsilon_1,\epsilon_2,\epsilon_3) &= \tfrac{1}{\sigma_{1|2,3}}\phi\left(\tfrac{\varepsilon_2-\mu_{1|2,3}}{\sigma_{1|2,3}}\right), \\ f_{\varepsilon_2|\varepsilon_3}(\epsilon_2,\epsilon_3) &= \tfrac{1}{\sigma_{2|3}}\phi\left(\tfrac{\epsilon_1-\mu_{2|3}}{\sigma_{2|3}}\right), \\ \text{and} \quad f_{\varepsilon_3}(\epsilon_3) &= \tfrac{1}{\sigma_3}\phi\left(\tfrac{CAR10-X_2^{95}\beta_4-\beta_5(X_1^{95}\beta_1)}{\sigma_3}\right),\end{aligned}$$

so that

$$Prob(\varepsilon_2 > -X_2^{95}\beta_2 - \beta_3(X_1^{95}\beta_1)\ , \theta_{y+1} - X_1^{90}\beta_1 < \varepsilon_1 \leqslant \theta_{y+2} - X_1^{90}\beta_1, \varepsilon_3) =$$
$$f(\epsilon_3)\int_{-X_2^{95}\beta_2-\beta_3(X_1^{95}\beta_1)}^{\infty}\left[\Phi\left(\frac{\theta_{y+2}-X_1^{90}\beta_1-\mu_{1|2,3}}{\sigma_{1|2,3}}\right)-\Phi\left(\frac{\theta_{y+1}-X_1^{90}\beta_1-\mu_{1|2,3}}{\sigma_{1|2,3}}\right)\right]\frac{1}{\sigma_{2|3}}\phi\left(\frac{\epsilon_2-\mu_{2|3}}{\sigma_{2|3}}\right)d\epsilon_2.$$

Combining the above probabilities for the two cases we obtain the log-likelihood function $L^*_{1,2,3} = \ln L =$

$$\sum_{i=1}^{n}(1-y_{2i})\ln\left[\int_{-\infty}^{-x_{2i}^{95}\beta_2-\beta_3(x_{1i}^{95}\beta_1)}\left[\Phi\left(\frac{\theta_{y_i+2}-x_{1i}^{90}\beta_1-\mu_{i,1|2}}{\sigma_{1|2}}\right)-\Phi\left(\frac{\theta_{y_i+1}-x_{1i}^{90}\beta_1-\mu_{i,1|2}}{\sigma_{1|2}}\right)\right]\frac{1}{\sigma_2}\phi\left(\frac{\epsilon_{2i}}{\sigma_2}\right)d\epsilon_{2i}\right.$$
$$y_{2i}\ln\left[f(\epsilon_{3i})\int_{-x_{2i}^{95}\beta_2-\beta_3(x_{1i}^{95}\beta_1)}^{\infty}\left[\Phi\left(\frac{\theta_{y_i+2}-x_{1i}^{90}\beta_1-\mu_{i,1|2,3}}{\sigma_{1|2,3}}\right)-\Phi\left(\frac{\theta_{y_i+1}-x_{1i}^{90}\beta_1-\mu_{i,1|2,3}}{\sigma_{1|2,3}}\right)\right]\frac{1}{\sigma_{2|3}}\phi\left(\frac{\epsilon_{2i}-\mu_{i,2|3}}{\sigma_{2|3}}\right.\right.$$

The integrals are calculated using Monte-Carlo integration:

$$\int_{-\infty}^{a}W(z)\phi(z)dz \approx \frac{1}{R}\sum_{r=1}^{R}W(z_r)\cdot\Phi(\tfrac{a-\mu}{\sigma})$$

where R denotes the number of drawings z_r from a normal distribution with density $\phi(z)$ which is truncated below a. As in Hajivassiliou and McFadden [1998] the truncated standard normal variate on the interval $[-\infty, a]$ is generated through a mapping q from a uniform (0,1) random variable u according to: $q(a,u) = \Phi^{-1}(\Phi(a)\cdot u)$. The maximization of the ln-likelihood function is carried out through numerical optimization procedures. Both the numerical optimization routines of Broyden, Fletcher, Goldfarb and Brown (requiring only first derivatives) and the Goldfeld-Quandt Quadratic Hill Climbing Algorithm (requiring first and second derivatives) are used.

Chapter 3

'Awakening of the Mute'- Takeover Regulation and the Voting Premium

3.1 Introduction

So far, the literature on the voting premium has largely slighted the relationship between take-over regulation and the price differential between voting and non-voting shares. A variety of papers (c.f. [Zingales [1995], Rydqvist [1996]) have established that the voting right of dispersed shareholders becomes valuable when it is crucial for a transfer of control. The degree to which atomistic shareholders are pivotal in control changes, however, depends on the prevalent take-over regulation. This paper focuses on how a change in corporate governance rules affects the value of the voting right, as measured by the price differential between voting and non-voting stock. The paper employs a data set of German dual-class shares during the ten-year period 1988-1997 to furnish evidence on the determinants of the voting premium before and after the introduction of a voluntary Takeover Code in Germany in 1995. The Takeover Code contains the mandatory bid rule (MBR) as its core element. The paper argues that the mandatory bid rule affects the voting premium in two ways in the presence of concentrated ownership. First, it changes the way in which minority shareholders participate in transfers of control pre- and post- 1995. In the absence of the mandatory bid rule, voting minority shareholders are forced into a position of '*mute consent*' whenever the majority block changes hand. The mandatory bid requirement, however, induces their '*awakening*': the acquirer has to make a tender offer to minority voting shareholders at a price not smaller than the price paid to the incumbent blockholder. The empirical study confirms that majority control has a negative impact on the voting premium before the structural break in 1995, and a

positive one thereafter. Secondly, the acceptance of the mandatory bid rule changes the control value of signatory companies. Since the MBR reduces the extent to which the value of control can be enlarged through a pyramiding structure of subsidiaries, the voting premium is significantly smaller for companies which have chosen to abide by the Takeover Code.

The paper argues that the value of the voting right results from two factors: the value of control benefits the voting right confers and the probability that the voting right is crucial for a transfer of control. When the *value of control benefits* rises with the amount of assets under control, there are several ways to increase private control benefits without enhancing the amount of outstanding equity. The generic principle is to recruit investors who commit capital but do not share in the control of the company. This article considers three means of separating control from cash-flow rights: debt, non-voting preference shares, and a pyramiding structure of subsidiaries. The paper analyses how these variables relate to the observed price differential between voting and non-voting stock.

Apart from the amount of control benefits the voting right confers to a potential new controller, it is decisive whether an atomistic shareholder is *pivotal for a transfer of control* to a new shareholder. Since control benefits are exclusively consumed by the party in control, the price difference has to reflect the price a potential aspirant for control would be willing to pay to atomistic shareholders to establish control over the company. Whether small shareholders are able to capture a share of this price largely depends on the practice of control transfers, the prevalent ownership structure and corporate governance regulation. In the US and other economies with an Anglo-Saxon system of corporate governance ownership is usually dispersed and competition for control intense (see Allen and Gale [1995]). This is the institutional setting of studies on the voting premium carried out by Zingales [1994, 1995a], Rydqvist [1996] and Nicodano [1997]. In these studies voting rights are valuable because they can make a difference to the outcome of a control contest. Outside shareholders may be able to extract some of the winner's private benefits of control and sell their shares at a price higher than their post-takeover price. The intensity of competition in the market for corporate control is therefore the key determinant for the voting premium in these models. Given the paucity of competition for corporate control in Germany (Franks and Mayer [1997]), this paper casts transfers of corporate control in an alternative institutional framework where control can also be acquired through negotiated sales of share stakes. Even if control is contested minority common stockholders will not fare better than preference shareholders under a change in control. The incumbent

controller will bargain exclusively with the outside control aspirants about his controlling interest. Small voting shareholders are only pivotal for a transfer in control if there is no controlling incumbent blockholder and control is contested.

This changes under a regulatory regime which imposes the mandatory bid rule on transfers of control. In 1995 Germany experienced a regulatory change through the launch of a voluntary Takeover Code, which obliges its signatories to adhere to the mandatory bid rule. The mandatory bid rule stipulates that a party which purchases a controlling interest of another listed company's voting equity is obliged to make an offer to the remaining target shareholders at a price not smaller than the price paid for the controlling block. So even if there is no competition for control, can small ordinary shareholders capture a share of private control benefits. This is the case if the negotiated takeover price is higher than the value of security benefits under the new controlling party. As opposed to the regulatory structure before 1995, a controlling incumbent blockholder is a prerequisite for a potential differential payoff in favour of small voting shareholders in a transfer of control. The empirical study in this paper provides supporting evidence for this hypothesis and shows that majority control carries a significant and positive effect during 1995-1997, and a negative one during 1988-1994.

Since acceptance of the Code is voluntary, it is also possible to analyse how the value of the voting right changes in response to an individual compliance decision. Adherence to the Code implies that subsidiaries are likely to be acquired with a higher fractional equity ownership than necessary for control. This reduces the extent to which the value of control can be enlarged through a pyramiding structure with less than fully controlled subsidiaries. The maximum separation of control and cash-flow rights is no longer likely to be attainable. The empirical results lend support to this hypothesis: the voting premium is significantly smaller for companies which signed the Takeover Code. This also holds true when taking into account the endogeneity of the acceptance decision through a non-linear instrumental variable estimation.

The paper proceeds as follows. The first part discusses the theoretical rationales for the determinants of the voting premium. In a first step, we derive factors proxying for the value of corporate control. Then, the paper proceeds to analyse how minority shareholders participate in the different modes of corporate governance in Germany pre- and post- 1995. The second part presents the empirical evidence on the hypotheses derived in the first part. After presenting the data set of German companies with dual-class shares and the institutional background of preference shares in Germany,

the empirical study seeks to capture how the determinants of the voting premium changed between the two subperiods 1988-1994 and 1995-1997. Finally the effect on an individual compliance decision with the Takeover Code is examined.

3.2 Rationales for the source of the voting premium

The market prices of ordinary and preference shares reflect the value of the shares to the marginal investor. Since it is unlikely that the marginal investor is a controlling shareholder, the shareprices reflect the value of the shares to the small shareholder uninvolved in the control of the company. The voting premium therefore has to reflect the potential future control value associated with an ordinary share. The voting right becomes valuable if it becomes indispensable to a new control structure of the company. The value of corporate control itself depends on the amount of private benefits the controlling shareholder derives with a given capital investment. The value of a voting right of an atomistic shareholder is thus the result of two factors: (a) the (future) amount of *private control benefits* the voting share confers and (b) the probability that the voting share becomes *crucial in a transfer of corporate control.* The next two sections will analyse empirical proxies for both these components of the voting premium

3.2.1 The value of control benefits

The literature on corporate control issues (see Grossman and Hart [1988], Harris and Raviv [1988] and Zingales [1995b]) has long emphasized the importance of private benefits of control. Examples for these benefits which are exclusively consumed by the party in control are excessive salaries, self-dealing or synergies favouring other branches of business of the controller. Given the nature of control benefits it seems reasonable to assume that these benefits are proportional to the total amount of assets under control (Nicodano [1997]). The larger the amount of controlled assets, the greater is the social prestige, and the more abundant are the opportunities to divert profits and consume perquisites.

There are several mechanisms by which to increase the ratio of control to cash-flow rights for voting shareholders. The general principle is to increase the proportion of investors who are willing to commit capital but abstain from control rights. In the following we consider three means of increasing the ratio of control to cash-flow rights for voting shareholders: debt, non-voting equity and pyramiding. All three

instruments increase assets under control, without diluting the control rights of existing voting shareholders. Debtholders and nonvoting shareholders receive fixed future interest and dividend payments for relinquishing control rights. Pyramiding is an indirect way of increasing the ratio of control to cash-flow rights by building a structure of majority-controlled subsidiaries. Minority shareholders in subsidiaries contribute funds to increase the amount of assets under control, while voting shareholders of the holding company remain in control of the subsidiaries' assets through the interfirm majority stakeholdings. All three mechanisms increase the value of the voting shares by increasing control rights. The ratio of control to cash-flow rights is termed the 'private benefit multiplier' (PBM), since it reflects the units of assets under control per unit of voting equity.

Debt Debtholders are the classic example of investors who refrain from exercising control in favour of fixed schedules of interest rate payments in the future. If B denotes the amount of debt outstanding and S the firm's voting equity, then the private benefit multiplier of debt is given by $(B+S)/S$. As opposed to equityholders, bondholders only gain control of the firm's assets if the firm value shrinks below the value of debt and equityholders file for bankruptcy. Whereas low levels of leverage unequivocally raise the PBM, an increasing debt ratio increases the likelihood of bankruptcy and therefore the probability of a shift in control to bondholders. One would therefore expect increasing returns to control at moderate levels of gearing, and decreasing returns at high debt to equity ratios. This paper uses the capital gearing ratio to proxy for the increase in private control benefits due to debt issuance[1].

Non-voting stock A similar instrument to separate control from cash-flow rights are non-voting preference shares, a hybrid security with elements of both debt and equity claims. Preference shares usually carry a higher dividend right than ordinary voting stock as a compensation for the lacking voting rights. The amount of preferred shares outstanding, S^{nv}, has a similar effect on the PBM, namely $(S^{nv}+S)/S$. The limits to the multiplier effect are determined by the respective national corporation law, which usually provides for a maximum percentage of non-voting to voting stock. In Germany companies are only allowed to issue 50% of their equity as non-voting

[1]Because of the possiblity of negative equity values in accounting we use $B/(B+S)$ instead of $(B+S)/S$. The former ratio stays positive even for moderate levels of negative equity positions (i.e., as long as $-E < B$, which is satisfied in this sample). The discontinuity of $(B+S)/S$ at very high levels of debt (where the ratio changes from a very large positive to a negative value) does not appropriately capture the multiplier effect. The use of $(B+S)/S$ as its squared value would be even more questionable.

stock[2]. Since the difference between ordinary and non-voting preference shares serves as a measure for the value of corporate control, the voting premium should be higher the larger the fraction of non-voting equity.

Pyramiding As Nicodano [1997] first pointed out in the context of the voting premium, a third way of increasing the amount of assets under control with a fixed equity investment is the creation of a pyramiding structure of subsidiaries. Consider a fully integrated company A with its assets entirely financed by voting equity S_1. The majority shareholder of company A decides to acquire control of another fully equity-financed company B with an equity position of S_2. The investor has two options of how to arrange a new control structure. We assume that a percentage equity investment of $\overline{x}_{j,j+1}$ is necessary for control. The subscript $j, j+1$ denotes a controlling stake of a layer j company in a subordinate layer $j+1$ company and $j = 0$ stands for the ultimate holding company or investor[3]. First the investor could acquire a fraction $\overline{x}_{01}$ of equity S_2 thus controlling $S_1 + S_2$ with a corresponding equity investment of $\overline{x}_{01}(S_1 + S_2)$. Alternatively company A could acquire a controlling interest of $\overline{x}_{12}S_2$. Company A would then hold the amount of original assets S_1 plus an equity stake of $\overline{x}_{12}S_2$. Whereas the amount of controlled assets remains unchanged, the control of the integrated business group A and B now only requires an equity investment of $\overline{x}_{01}(S_1 + \overline{x}_{12}S_2)$ as opposed to $\overline{x}_{01}(S_1 + S_2)$. The ratio of controlled assets to equity participation increases from $1/\overline{x}_{01}$ to $(S_1 + S_2)/[\overline{x}_{01}(S_1 + \overline{x}_{12}S_2)]$. The key to the increase in the PBM are external investors on the level of the subsidiary who commit capital but do not share the control of the company. The multiplier effect for alternative control structures where each subsidiary is controlled through a fractional equity investment of $\overline{x}_{j,j+1}$ generalizes to

$$\widetilde{PBM} = \frac{\sum_{i=0}^{m-1} \sum_{k=1}^{K_{i+1}} S_k^{i+1}}{\sum_{i=0}^{m-1} \prod_{j=0}^{i} \overline{x}_{j,j+1} \sum_{k=1}^{K_{i+1}} S_k^{i+1}}$$

where m stands for the number of layers of the holding structure and K_{i+1} denotes the number of subsidiaries on a specific layer i. The stronger the vertical structure of the business group, i.e., the longer the chain of subsidiaries owning subsidiaries, the higher the PBM. It can be shown that $\partial\widetilde{PBM}/\partial S_{k_0}^{i_0+2} > \partial\widetilde{PBM}/\partial S_{k_0}^{i_0+1}$ (see Appendix), i.e., the more real assets are placed in higher-order hierarchical layers instead of horizontal ones, the higher the leverage to private benefits of control. If the

[2]See Rydqvist (1992) for a detailed overview of the significance and regulation of non-voting shares in different countries.

[3]This notation implies that a subordinate company $j+1$ cannot own a stake in a company of the same level $j+1$ or of a higher hierarchical layer j. In fact, the data on the subsidiary structure of the sample companies only specifies these hierarchical interlacings.

company chooses a higher equity participation than $\overline{x}_{j,j+1}$, the multiplier effect will shrink, i.e., $\partial \widetilde{PBM}/\partial x_{j,j+1} < 0$.

In order to determine the multiplier effect on the value of control for a company with a *given* structure of subsidiaries, it is simply necessary to add the equity position of each subsidiary taking account of the fact that equity positions of subsidiary companies have to be subtracted from the amount of controlled assets. The following formula is applied to determine the degree of control leverage:

$$PBM = \frac{\sum_{i=0}^{m-1} \sum_{k=1}^{K_{i+1}} S_k^{i+1} - \sum_{i=1}^{m-1} \sum_{k=1}^{K_{i+1}} x_{i,i+1}^k S_k^{i+1}}{x_{01} S_1^1} \quad \text{where } x_{i,i+1}^k > \overline{x}. \qquad (3.1)$$

In contrast to $\widetilde{PBM}$ which determines the multiplier effect of alternative hypothetical control structures, the basis for the calculation of the actual PBM is the equity capital of the respective holding companies which already incorporates the equity positions of its subsidiaries. The numerator of PBM, which captures the amount of controlled assets, therefore removes the double counting of equity participations and real assets. Control of the holding structure implies control of the ultimate holding company which is achieved through an equity investment of $x_{01}S_1^1$. In a sense, the formula for the de facto multiplier 'reverses' the procedure by which the hypothetical $\widetilde{PBM}$ is constructed. The formula also allows for different ownership fractions $x_{i,i+1}^k$ of subsidiaries as long as they exceed the necessary control quota, $\overline{x}$. If a subsidiary is entirely controlled by a holding company, i.e., $x_{i,i+1}^k = 1$, it is excluded from the PBM calculation, since its net contribution to the PBM is zero. Given the above considerations the voting premium should be higher the larger the extent of a corporate hierarchical structure.

The above considerations suggest that the voting premium should positively depend on the multiplier mechanisms for private benefits of control. In particular we derive the following hypotheses:

Hypothesis 1 *Both the private benefit multiplier due to pyramiding and the ratio of non-voting equity to overall equity should be positively correlated with the voting premium.*

Hypothesis 2 *The amount of capital gearing should have a non-linear effect on the voting premium. For low levels of leverage the price differential between voting and non-voting stock should rise, for higher levels of leverage the relation should reverse because of an increasing risk of control change to debt claimants.*

3.2.2 Corporate control transfers and minority shareholders

Apart from the potential control value with which an ordinary share is vested, it is decisive whether the voting right of an atomistic shareholder is relevant for a transfer in corporate control. The corporate governance framework and the corporate ownership structure together determine the mode of corporate control transfers across different countries. In Germany negotiated sales of share stakes and acquisition of shares in the open market have been the predominant mechanism for corporate control transactions (Franks and Mayer [1997]). Public tender offers, though subject of general guidelines issued by the 'Börsensachverständigenkommission' (Stock Exchange Commission) in 1979 have never achieved any practical significance except for going-private transactions prior to 1995.

Contrary to the Anglo-Saxon practice, the German market for corporate control is characterized by a paucity of hostile takeovers. Edwards and Fischer (1994) indirectly attribute the rarity of hostile takeovers to the difficulty of replacing incumbent management after a change in ownership structure. The management board can only be dismissed by a majority vote of the supervisory board. Members of the supervisory board in turn can only be replaced before the end of their five-year appointment with a 75% majority vote of shareholders. Edwards and Fischer (1994) argue that the widespread existence of higher than 25% blockholdings can render it imperatively costly for potential raiders to acquire the necessary 75% majority. In addition, political influence of trade unions and management of target companies can undermine takeover attempts in Germany. In the hostile acquisition attempt of Thyssen by Krupp in 1997, it was mainly political pressure which thwarted the takeover bid. The CEO of Thyssen, Dieter Vogel, successfully recruited support from the head of the federal state of North-Rhine Westphalia to avert the takeover bid and launch merger talks instead.

In the following section the wealth implications of a corporate control transaction for minority shareholders are derived under the two different regulatory scenarios in Germany pre- and post 1995. The cardinal difference between the two regulatory scenarios is the protection of minority shareholders through a mandatory bid requirement. It is crucial whether the respective regulatory guidelines provide for a mandatory tender offer to the minority voting shareholders if a shareholding passes a certain threshold (mandatory bid rule) or whether the acquirer can purchase a controlling interest without consideration to minority shareholders (market rule). The mandatory bid rule (MBR) implies the principle of non-partiality or non-differentiated

bids, since it requires that all target shareholders be offered a price not lower than the price at which the initial equity position was acquired.

The following set-up will be used to study the implications of the corporate governance regimes pre- and post- 1995. Assume that there are two contenders for the corporate control of a company. Each of the two parties produces a certain cash-flow Y_i and derives private benefits of control B_i, where $i = 1, 2$. While private benefits are only enjoyed by the party in control, the cash flow is divided equally among shareholders according to their fractional equity ownership. There is symmetric information between the parties and investors about Y_i and B_i. For means of simplicity we assume that both contenders intend to acquire 100% of the voting equity[4]. The total number of shares (voting and non-voting stock) of the company equals N, of which N^v are voting and N^{nv} non-voting shares respectively.

'Mute consent': Practice of control changes in Germany prior to 1995

Corporate governance in Germany prior to 1995 was characterized by a moderate protection of minority shareholders. In contrast to corporate governance rules in the UK, there was no requirement to submit a public tender offer to all shareholders after a shift in majority control (market rule). In the following we will consider the payoffs to both minority voting and nonvoting shareholders if control is acquired: (a) through a sale-of-control transaction, and (b) by way of share purchases in the open market.

Negotiated block sales In this case contender 1 is an incumbent blockholder who has a controlling interest of $\overline{x}$ per cent of voting stock in the company. The aspirant for control thus has to bargain over the transfer of the control stake. A sale of control comes about if the contender pays a price of at least $B_1/\overline{x}N_v + Y_1/N$ per voting share in the block, i.e., iff the reservation value of the contender exceeds the reservation value of the incumbent: $(B_2 - B_1)/N_v > \overline{x}(Y_1 - Y_2)/N$. The surplus is divided between the two parties according to their relative bargaining power. Independent of the division of surplus, atomistic holders of ordinary and preference shares are excluded from the sale-of-control transaction. Because of their free-riding behaviour (Grossman and Hart [1980]) they will *both* obtain

$$\Pi^v = \Pi^{nv} = Y_2/N \tag{3.2}$$

per share, where Π^v and Π^{nv} denote the payoffs to voting and non-voting shareholders respectively.

[4]Similar results can be obtained if both contenders only acquire a controlling interest of $\overline{x}$ per cent of voting stock and the offer is allocated pro rata.

Share purchases in open market. In the absence of an incumbent blockholder party 2 can undertake successive share purchases in the open market. If this is possible without revealing a corporate control objective, a share can be acquired at a price of Y_1/N in the open market. Without any prospect of a change in control the price for an atomistic voting share corresponds to the value of cash-flows generated under the current management. Once it becomes certain that the new blockholder strives for the control of the company, the share price of *both* voting and non-voting stock immediately reflects this prospect and changes to Y_2/N, i.e.,

$$\Pi^v = \Pi^{nv} = Y_2/N \tag{3.3}$$

(Grossman and Hart [1980]). In both cases atomistic holders of ordinary shares do not gain to a larger extent from a transfer of control than preference shares. Because of their free-riding behaviour both classes of shares will just be compensated with the level of security benefits they obtain under the respective management. This changes if *control is contested* and there is competition in the acquisition of outstanding dispersed shares. This has been the setting of other papers which have investigated the determinants of the voting premium Zingales [1994] and [1995a], Rydqvist [1996], Nicodano [1997]. If there is competition for control, the price of ordinary atomistic shares does not only have to reflect the security benefits under the likely winning party, say Y_2/N, but also the reservation value of the inferior party, $(Y_1/N + B_1/N^v)$ (Harris and Raviv [1980]). The payoffs to voting and nonvoting shareholders are therefore

$$\Pi^v = \max\{Y_2/N, (Y_1/N + B_1/N^v)\} \tag{3.4}$$

$$\Pi^{nv} = Y_2/N. \tag{3.5}$$

If $Y_2/N < (Y_1/N + B_1/N^v)$, a differential payment results in favour of voting shares. In Germany, however, the relevance of this scenario is limited, since competition for control is moderate and takeover battles similar to the Anglo-Saxon model are virtually unknown.

Proxies for the likelihood of differential payoff to voting and non-voting stock The above analysis has shown that voting shares only receive a superior payment in a transfer of control if there is no blockholder with a controlling interest and control is contested. Both in Zingales [1994, 1995a] and Rydqvist [1996] the probability of a contested acquisition is proxied by the existing ownership structure of a company. To capture the likelihood with which small shareholders become pivotal in a potential takeover contest Zingales [1994, 1995a] used the (Relative) Shapley value (Milnor and Shapley [1978]). Other proxies used for ownership stability are the size

of the largest shareholder (Rydqvist [1996]) or a dummy variable for majority control (Zingales [1994]). For the purposes of this paper we include dummy variables for majority control and qualified majority control, i.e., an equity ownership of more than 75%, to capture the possibility of contested control. The latter variable is particularly important in the German context, since a 75% majority is de facto required to replace the incumbent management.

Hypothesis 3 *Market rule: In the pre- 1995 period the voting premium is (weakly) negatively correlated with majority-control.*

Not only ownership concentration of voting shares, but also the ownership structure of preference shares could affect the voting premium. Bergström and Rydqvist [1992] analyse a scenario where the outside contestant wants to acquire 100% of *both* voting and non-voting shares. Because in this set-up both non-voting and voting stock are pivotal to private benefits of control, but the bidder can price discriminate between the two classes, it is possible that a premium is paid to non-voting stock. The premium is large if there is a small percentage of non-voting stock outstanding and most of this is concentrated in the hands of the incumbent blockholder. Another rationale is put forward by Megginson [1990] who applies the Jensen and Meckling [1976] argument to the differential treatment of voting and non-voting shareholders. He uses the amount of inside ownership of non-voting stock as a proxy for management's disincentive to discriminate against non-voting shareholders. One might similarly argue that the incumbent blockholder is more inclined to undertake actions in favour of non-voting shareholders (e.g. early reimbursement of dividend arrears, conversion of preference into ordinary shares) the more non-voting stock he owns. In order to take account of these potential effects we include the amount of holdings in non-voting stock of the largest shareholder in the company.

Hypothesis 4 *The percentage ownership of preference shares by the largest holder of voting stock has a negative impact on the voting premium.*

'Awakening of the mute': Regulatory shift in 1995

In 1995 the structure of corporate governance regulation in Germany experienced an important change. Parallel to initiatives of the EU Commission to draft an EU Takeover Directive the German stock exchange commission introduced a voluntary Takeover Code. Modelled after the UK City Code the Takeover Code stipulates that a public tender offer has to be made to all target shareholders after a share package

of more than 50%[5] has been newly acquired (mandatory bid rule). The acceptance of the Code is voluntary and only imposes a private contractual obligation upon the signatories. Even though the Code is based on a private initiative of the Stock Exchange and industry representatives it increases the probability that a corporate control transfer involves the mandatory bid rule. This is given more weight by a joint declaration of German banks not to accompany any raider which has not signed the Takeover Code.

Negotiated block sale. Under the mandatory bid rule atomistic shareholders have the right to participate in the sale on the same terms as the selling blockholder. As opposed to the market rule, a transfer of control only occurs if $(B_2 - B_1)/N^v > (Y_1 - Y_2)/N$, since the acquirer has to make the same offer to all voting shareholders. Despite decreasing the likelihood of a control transfer the mandatory bid rule introduces the possibility of a superior payoff to voting minority shareholders. The incumbent and the control aspirant play a Nash-bargaining game. The incumbent carries a relative bargaining power θ (where $0 \leqslant \theta \leqslant 1$) with respect to the contender who has the reciprocal bargaining power of $(1 - \theta)$. The transaction price will therefore be a weighted average of the contender's reservation value of $B_2/N^v + Y_2/N$ per voting share and the incumbent's reservation value of $B_1/N^v + Y_1/N$ per voting share. The payoff for minority holders of ordinary shares equals

$$\Pi^v = \max\{Y_2/N, \theta[B_2/N^v + Y_2/N] + (1-\theta)[B_1/N^v + Y_1/N]\}, \quad (3.6)$$

$$\Pi^{nv} = Y_2/N \quad (3.7)$$

i.e., they can either decide to tender their shares and receive $\theta[B_2/N^v + Y_2/N] + (1 - \theta)[B_1/N^v + Y_1/N]$ or to remain a minority shareholder with a payoff of Y_2/N. Holders of preference shares are exempted from the mandatory bid rule (Übernahmekommission [1996]) and will therefore only obtain Y_2/N, i.e., the level of security benefits under the new management. Clearly, in this case atomistic holders of ordinary shares are better off than holders of non-voting stock. A nonzero probability that a potential raider abides by the Takeover Code is sufficient to raise the value of voting above non-voting stock.

Share purchases in open market. If there is no controlling blockholder and no competition for control, owners of preference and ordinary shares will both obtain the

[5] Following severe criticism regarding the laxity of its stipulations the Takeover Commission has reduced the threshold for the mandatory tender offer to 30%. The new regulations came into effect on 1st January 1998 after the sampling period of this data set.

level of cash-flow under the new controlling party, Y_2/N. In the absence of competition this will also be the price paid in the mandatory tender offer since this will be the price paid for the last shares acquired when surpassing the critical threshold level of 50%. If there is more than one contender for control the payoffs equal Π^v and Π^{nv} given by [3.4] and [3.5] respectively. In the case of dispersed ownership the mandatory bid rule therefore does not affect the payoffs to minority voting and nonvoting shareholders.

Proxies for the likelihood of differential payoff to voting and non-voting stock. Table IV contrasts the possible differential payoffs to minority voting and non-voting shareholders under the two regulatory regimes, market and mandatory bid rule, and with respect to the two mechanisms for control transfers, sale of share stakes and open share purchases. Under the mandatory bid rule transfers of control through a block trade will always involve the participation of holders of ordinary shares and may lead to a premium in favour of voting stock. The existence of a majority blockholding is thus a prerequisite for participating in the bargaining surplus in a transfer of control. The mandatory bid rule has, however, no effect on the differential payoff to voting and non-voting shareholders under dispersed ownership and uncontested purchases in the open market. The difference to the pre- 1995 scenario (market rule) consists of the new possibility for voting shareholders to receive a differential payment in a sale-of-control transaction. Given the low level of competitiveness in the German market for corporate control, we would expect this effect to outweigh any superior payoff through contested open market purchases.

Hypothesis 5 *Mandatory bid rule: During the post- 1995 period the presence of a majority owner is positively related to the voting premium.*

Effect of acceptance of Takeover Code on voting premium of signatory

The previous paragraph highlighted how the mandatory bid rule augments the value of atomistic voting stock by increasing the likelihood that minority voting target shareholders participate in the transfer of control. On the other hand, the mandatory bid rule can decrease the control value of voting stock by restricting the multiplier effect due to pyramiding.

If a company decides to sign the Takeover Code it is obliged to adhere to the mandatory bid rule in the role of a potential bidder. This means that it is likely that the company has to acquire more than $\overline{x}\%$ of the target's equity to establish control. As analysed under [??], any fractional equity ownership in excess of $\overline{x}$ reduces the private benefit multiplier. Adherence to the Code therefore implies freezing the

contribution of a hierarchical ownership structure to PBM at its current level. If the value of control also depends on future possibilities to increase the PBM, then the acceptance of the Code reduces the current value of private benefits of control. If the voting premium reflects the discounted value of future private benefits of control, then, *ceteris paribus*, the voting premium should shrink after acceptance of the mandatory bid rule.

At the same time, the acceptance of the Code restrains the company in the role of a potential target. The management board is obliged to abstain from any defensive measures which might thwart a public tender offer to which the company is subjected. Since, however, German corporate law prohibits defensive instruments such as poison pill securities, the significance of this stipulation is de facto very limited. We therefore posit the following hypothesis:

Hypothesis 6 *Companies which signed the Takeover Code exhibit a lower voting premium.*

3.3 Empirical evidence

3.3.1 Data and summary statistics

Voting premium

The voting premium is calculated as an average of the shareprices of the ten first trading days in October each year. According to the listing history of dual-class shares the sample would have to consist of 627 observations (Table A. II.) and 88 companies during October 1988 to October 1997. The shareprices could, however, only be retrieved for 601 companies years and 84 companies. The shareprices are taken from 'Datastream' and are adjusted for stock splits, etc. Share prices and dividend payments are adjusted if the par value of voting and non-voting shares differs. The voting premium VP_{it} is defined as

$$VP_{it} = \frac{P_{it}^{v} - P_{it}^{nv}}{P_{it}^{nv}} \tag{3.8}$$

where P_{it}^{v} (P_{it}^{nv}) is the price of a voting (non-voting preference) share of company i. Table II shows that the average premium in the sample is 26.34%, Kötizer Leder exhibits the minimum premium of -57.3% in October 1990 and Hartmann & Braun the maximum premium of 280.9% in October 1988. The voting premium of Kötizer Leder declined from -5% to -57.3% when Adolf Merckle increased his stake from 25.1% to 50% in 1990 (through an additional 24.9% holding of his investment vehicle Meru

Vermögensverwaltungs GmbH). The voting stock of Hartmann & Braun appreciated in the wake of Mannesmann's takeover in 1988. While ownership structure is certainly one of the principal determinants of the variation in the voting premium, the following sections will show that other factors such as the value of control rights as well as index membership also account for a sizeable fraction of the cross-sectional and time series variation. The preference shares of business software house SAP, for instance, which as the more liquid category form part of the DAX 30, trade at a premium to their voting counterparts. Overall, the level of the voting premium is comparable with the level found in Canada (23.3%) and Switzerland (20%). It is, however, higher than the level observed in the US (5%), Sweden (12%), and the United Kingdom (13.3 %), but significantly smaller than levels observed in Israel (45.5%) and Italy (81%).

Table II presents other general characteristics of this sample. The concentration of ownership in German dual-class companies is reflected by the fact that 73% are majority controlled, and a substantial 27.5% are controlled with a qualified majority of 75%. These characteristics are in line with the general ownership structure of German publicly traded companies, of which 70% are majority-controlled (see Chapter 2). The maximum number of blockholders (with shareholdings higher than 5%) is five. Blockholdings of preference shares are less frequent, but do exist. The average size of preference share stakes owned by the largest voting stockholder (higher than 5%) is 5%.

As in Italy, preference shares are prevalent in both large companies and small and mid-sized companies, and not concentrated among small companies like in the US (Zingales [1995]). Dual-class share companies with a large market capitalization are BMW and VW (car manufacturers), RWE (electricity), MAN (manufacturing) and SAP (software), which are all constituents of the DAX 30, the index encompassing the 30 largest German companies in terms of market capitalization and daily stock turnover. About 24% of dual-class share companies are a member of either the DAX 30 or the MDAX, which comprises the 70 next largest companies with respect to market value and trading volume. The liquidity of the two share classes decides which of the two classes is included in the index. In 11.3% of dual-class share companies preference shares are members of the indices since they are more liquid than ordinary shares. Examples of companies with preference shares as index members are Escada, Fresenius, RWE, and GEA.

Ownership structure

The sample consists of all German companies with both ordinary and non-voting preference shares traded on the German stock exchanges in the official list, the regulated and the free market during 1988 to 1997. Firms are only included in the sample if they have bearer ordinary and preference shares outstanding, companies with registered shares in either of the two categories are excluded from the sample. Table A.V. describes the data and documents its sources. The data on the ownership structure is obtained from 'Hoppenstedt Aktienführer', which lists the main holders of ordinary and preference shares of companies listed on the official list, the regulated market and of companies with the most liquid shares in the free market. The handbook is published yearly and its deadline for publication is 30 September of each year. Also, with the introduction of the 'Wertpapierhandelsgesetz' (WpHG) in 1995 shareholdings of voting stock higher than 5%, 25%, 50%, and 75% have to be reported to the supervisory board, the 'Bundesaufsichtsamt für den Wertpapierhandel', within seven days after exceeding or falling short of one of these thresholds (§ 21 WpHG). As a transitory regulation the law required to report all of the existing significant shareholdings at the day of the annual shareholders' meeting after 1 April 1995 (§ 41 WpHG). Since shareholders have responded with significant delay to the disclosure requirement[6], the data cannot be used to reconstruct the exact time of ownership changes during 1995 and 1996. But the data was used to cross-check the ownership structure as of the end of September in each year. The ownership data is used as presented by 'Hoppenstedt Aktienführer', with slight alterations with respect to shareholders which are majority owned by the same parent company. Whenever a company is majority controlled by a holding company, the shareholdings of the subsidiary are fused with the shareholdings of the holding companies in the dual-class company. For example, in 1996 Colonia Versicherungs AG features two main shareholders: Vinci BV with a holding of 46% and Kölner Verwaltungsgesellschaft für Versicherungswerte with 30% of voting stock. Since the latter company is a subsidiary of Vinci BV, we classify Colonia as majority-controlled.

Private benefit mulitpliers

The data on the holding structure of the dual-class companies in the sample is taken from 'Hoppenstedt Aktienführer'. The stock exchange guide lists all significant share-

[6] In 1995, the Bundesaufsichtsamt für den Wertpapierhandel received 1100 notifications according to § 41 (200 according to § 21), in 1996 the number of firm-time notifications was still 1080 (500 according to § 21). Only in 1997 did the number of § 41 notifications reduce to merely 6 (360 according to § 21).

holdings of companies up to the third hierarchical layer of holdings with their respective equity positions and quota of shareholding. Whenever the equity position in a subsidiary is denominated in a foreign currency it is converted to DM with an exchange rate at 30 September of each year. The total equity position of each subsidiary is stated in nominal terms, since the equity holding is consolidated at its nominal value in the balance sheet of the holding company. In order to remain consistent in terms of nominal valuation the equity position of the holding company is also included with its nominal value implying that the market-to-book ratio remains stable across the holding structure. A controlling interest of a company is assumed to exist if a company owns more than 25%, respectively 50% of another company's stock. This threshold of 25%, the so-called 'blocking minority' ('Sperrminorität'), is chosen because several major corporate decisions, changes of the corporate charter such as increases or decreases of share capital or a merger, require a 75% majority of voting shareholders. A 50% majority conveys de facto control over a company, since it is sufficient for AGM decisions of a more operative nature like dividend payments, the discharge of the management board and the election of members of the supervisory board. In this sample the average ratio of control to cash-flow rights equals 1.41 if we assume control is accomplished with a higher than 25% shareholding. This means that a nominal equity participation of 1 DM in a dual-class company grants on average control rights over equity with a nominal value of 1.41 DM. The ratio decreases to 1.172 if we require a 50% shareholding for control. The ratio equals one for companies with no or only fully owned subsidiaries. Heidelberger Zement exhibits the maximum 'control leverage' with a control cash-flow ratio of 5.997.

Table II also shows the degree by which private benefits are multiplied through capital gearing and the issuance of preferred share capital. In this sample the capital gearing ratio averages 38.6% and varies between 3.2% and 172%, where the latter figure arises because of a negative equity value. On average the voting share capital corresponds to about 70% of total share capital in the sample of German dual-class shares during 1988-1997.

Dividends

As opposed to preferred stock in the US, German preference shares are more of a residual claim (equity) than a fixed claim (debt). This is because preference shareholders participate -besides their minimum guaranteed dividend- in further profit distribution. As an example, Lufthansa pays a minimum of 5% of par value to preference shareholders, but if ordinary shareholders receive a dividend of 6% of par value, this

dividend payment will also have to be extended to preference shareholders. The preferential dividend consists purely in a *lower bound guarantee* with the same full upside dividend potential as ordinary shares. The paragraphs below outline the legal provisions and the various statutory amendments of the dividend regimes for preference shares.

Legal provisions According to § 139 I AktG the dividend privilege must consist in a priority dividend which is paid to preference shareholders before profit is distributed to holders of ordinary shares. The preference shareholders thus assume an intermediary position between debtholders whose claims are senior to those of preference shareholders and holders of ordinary shares. The priority dividend is cumulative, i.e., if it is not or not fully paid in one year, it has to be paid at the expense of profits of subsequent years with the same priority vis-a-vis ordinary shares, and together with the current priority dividend. The cumulative preferred dividend constitutes a material precept of profit distribution: if the company shows accounting profits, they have to be distributed to satisfy current and postponed dividend priorities (Bezzenberger [1991]).

Apart from dividend rights, holders of preference shares are equipped with a contingent voting right. The voting right enters into force if the priority dividend m_i has not been fully paid during one year and the arrears not been fully repaid during the following year together with the full priority for that year. For example, if in year t preference shareholders obtain no dividend, they gain the voting right at the AGM in $t+2$ if in year $t+1$ a dividend of less than $2m_i$ is paid.

Statutory amendments Besides these compulsory characteristics, the corporate charter can specify the size and additional features of the dividend rights of preference shares. All German preference shares currently participate beyond their priority dividend in the distribution of profits. Very often the corporate charter grants an additional dividend to preference shares in excess of the amount distributed to ordinary shares. The current dividend regimes of preference shares can broadly be classified into three categories depending on the relation of priority and excess dividends: (a) no additional dividend: after payment of the priority dividend m_i, ordinary shares receive the same amount, and the remainder is equally split between the two categories; in this case, the priority dividend only constitutes a differential dividend in case of insufficient profits where ordinary shares receive less than m_i; (b) constant additional dividend: after payment of the priority dividend m_i, ordinary shares receive the same amount, after which profit is distributed such that preference shares always receive an

excess dividend x_i with respect to ordinary shares; (c) variable additional dividend: same as (b), except that the additional dividend x_{ki} varies according to the dividend ordinary shares receive, d_{it}^{v}, i.e., the sequence $(x_{ki})_{k=1,..,l}$ determines the additional dividend for growing d_{it}^{v}. Table I summarizes the three dividend regimes and their empirical relevance. The most common dividend regime is a combination of a minimum and an additional dividend. In eight companies does the additional payment vary according to the amount distributed to ordinary shares. Five of the eight preference shares with a varying additional dividend carry a progressive dividend scheme where $x_{ki} < x_{k+1,i}$, in the remaining three cases the additional dividend decreases the higher the dividend distributed to ordinary shares, i.e. $x_{ki} > x_{k+1,i}$ (see also Table A.IV). The additional dividend never exceeds the priority dividend. In category II the additional dividend equals on average 2.1% of the stock's nominal value, i.e., less than half of the average minimum dividend of 5%. In roughly 20% of dual-class shares no additional dividend is paid, which is compensated through a higher priority dividend of 5.8% on average.

Dividend payments Table A.III shows the percentage of cases in which preference and ordinary shareholders received differential and identical dividend payments respectively during 1988-1997. A differential dividend payment in favour of preference shares can occur in three cases: (1) preference shares obtain an additional dividend with respect to ordinary shares, $d_{it}^{nv} = d_{it}^{v} + x_{it}$, if the dividend to ordinary shares exceeds the minimum dividend, $d_{it}^{v} > m_i$; (2) the minimum dividend is paid to preference shares, $d_{it}^{nv} = m_i$, but there is insufficient profit for ordinary shares to obtain an identical amount, $d_{it}^{v} < m_i$; and (3) preference shares obtain cumulated minimum dividend payments for more than one year, $d_{it}^{nv} = \sum_t m_i$, but there is insufficient profit for ordinary shares to obtain an identical amount, $d_{it}^{v} < \sum_t m_i$. The first case occurs most frequently, in 64% of the company years. Both classes of shares receive the same dividends if (1) there is insufficient profit to distribute any dividends, $d_{it}^{v} = d_{it}^{nv} = 0$, and (2) if there is no statutory provision for an additional dividend and the dividend to ordinary shares exceeds the minimum dividend, $d_{it}^{nv} = d_{it}^{nv} \geq m_i$. Identical dividends to both classes of shares are paid in 28% of company years, whereby 12% result from the absence of an additional dividend and 16% from dividend omissions. The voting right, which emerges after two years of unpaid minimum dividend, was effective in 11% of the company years in the sample (Table II).

While accounting for some of the price differential between voting and non-voting shares, the different dividend regimes for preference and ordinary shares should not constitute the prime source of the price differential. This is because the dividend

guarantee is defined in terms of the par value, which in this sample corresponds on average to 26.63% of market value. The minimum dividend makes up on average 1.07% of the market value of preferred stock, the additional dividend only 0.37% of the market value. This is marginal compared to a price differential between voting and non-voting stock which equals on average 26% of the market value of preferred stock.

Economic significance and relative performance of dual-class shares

Although the first preference shares were introduced in Germany in the late 1930s, they only reached practical significance during the economic upswing in the eighties. In 1980 only 6.3% or 29 out of the listed companies on German stock exchanges were preference shares; the number increased to 17% or 90 listed companies in 1989. Table A.I. depicts that by the end of 1997 a total of 110 listed companies had preference shares outstanding, of which 71 list both ordinary and preference shares. A substantial increase in the number of companies with dual-class shares occurred during 1990, as Table A.II. shows. Fourteen companies entered the sample either through an initial public offering with dual-class shares or through a listing of a formerly unlisted class. The number of companies with dual-class shares has remained relatively constant over the subsequent seven years.

Figures 1 and 2 show cumulative return indices for both preference and ordinary shares during the 1988-1997 period. The indices include only return observations for companies in which both classes of shares were simultaneously listed, i.e., at each point in time the two return indices for the two classes of shares include the same number of companies. If only one of the two classes of shares is listed, the company is excluded from the index. The shares enter the index portfolios with an equal weight. In Figure 1 the return index only encompasses the capital gains of the two classes of shares, i.e.,

$$I_t^{nv,v} = \prod_{t=t_0}^{T} \frac{1}{N} \sum_{i=1}^{N} (1 + r_{it}^{nv,v})$$

where $r_{it}^{nv,v} = (P_{it}^{nv,v} - P_{it-1}^{nv,v})/P_{it-1}^{nv,v}$. It is striking that ordinary shares underperform preference shares in terms of capital gains by nearly 21% even though they are already disadvantaged in terms of dividend payments. The return indices in Figure 2 include dividends and are calculated as above but with $r_{it}^{nv,v} = (P_{it}^{nv,v} - P_{it-1}^{nv,v} + d_{it}^{nv,v})/P_{it-1}^{nv,v}$. The inclusion of dividend payments widens the return gap between the two classes of shares. The graph shows that preference shares outperform ordinary shares by 46% over the sample period. The difference between the buy-and-hold returns of the

specification:

$$VP_{it} = \beta_0 + \beta_1 PYR_{it} + \beta_2 CG_{it} + \beta_3 (CG_{it})^2 + \beta_4 NV_{it} + \beta_5 DA_{it} + \beta_6 DI_{it} + \beta_7 VR_{it} + \beta_8 IX_{it} + \mu_i + \varepsilon_{it} \quad (3.9)$$

The econometric analysis consists of a fixed effects panel data model with heteroskedasticity and serial correlation consistent standard errors[8] (Arellano [1990, 1993]). The fixed effects model seems an appropriate specification since the paper focuses on the specific set of German dual-class shares during 1988-1997 and not on a randomly drawn sample from a large population (Baltagi [1995]). Furthermore there are no time-invariant variables which would warrant a random-effects model. For a formal comparison of the random and fixed effects models the Hausman test is performed. This paper uses the forward orthogonal deviations operator (Arellano and Bover [1995] and Arellano [1993]) to obtain robust standard errors[9]. The transformed system is also the basis for an extended model which is used to obtain the Hausman test statistic which is robust to heteroskedasticity and serial correlation of arbitrary forms (Arellano [1993]). Table III presents the results of the estimation under alternative specifications. Specification I and II include variables proxying for the degree of control leverage and differences in dividend rights. They only differ in the definition of the private benefit multiplier due to subsidiaries. Whereas specification I assumes a 25% shareholding as the critical level to confer control, specification II requires majority control. The two regressions show that the ratio of controlled equity to invested equity increases the value of the voting right and therefore the voting premium. This finding provides supportive evidence for Hypothesis 1. Both the economic and statistical significance are superior if only shareholdings of more than 50% are included in the private benefit multiplier. This suggests that majority control implies a higher control value than a qualified minority holding of 25%. On average, a 1 unit increase in the private benefit multiplier of pyramiding results in an 8% increase in the voting premium. The result can be interpreted in line with the finding of Megginson [1990] that subsidiaries exhibit a smaller voting premium than the sample average. In the light of this paper's rationale, the finding might result from the fact that subsidiaries exhibit a lower degree of control leverage than holding companies. The impact of capital gearing, CG_{it}, on the voting premium shows the expected behaviour and supports Hypothesis 2: for levels of gearing below 41.27% the voting premium increases in II,

[8] Heteroskedasticity consistent estimation leads to a fairly sizeable change in the estimated standard errors of the slopes (especially for the coefficient estimate of IX_{it}), whereas a further correction for serial correlation changes the standard errors only slightly.

[9] The constant term is elimated by transforming the data with the forward orthogonal deviations operator.

for higher levels the premium decreases. Contrary to the above conjectures, the ratio of non-voting stock to total equity is negatively correlated with the voting premium, though the coefficient estimate is insignificant. An explanation for this result might be an enhanced liquidity of preference shares which accompanies a higher fraction of nonvoting stock. The higher liquidity increases the value of nonvoting stock and reduces the voting premium.

The differential dividend payments to voting and non-voting stock have both an economically and statistically significant impact on the voting premium. If dividend arrears of more than one year are paid to preference shareholders, the voting premium decreases on average by about 27%. This is a substantial increase given that the average differential dividend only equals 3.5% in these company years. In years where the voting right is effective, i.e., where dividend arrears of at least two years are accumulated, the voting premium is on average 13.8% lower. For company years in which voting stock is put on par with non-voting stock in terms of dividends, the voting premium is on average 8% higher. Almost as economically significant as payments of dividend arrears is membership in a stock market index, IX_{it}. If the preference share is a member of the DAX or MDAX, i.e., it is more liquid than the ordinary share, the price differential is about 27% lower on average (specification III and IV). An indication that the ratio of non-voting stock to total equity might proxy for liquidity instead of control value gives the comparison of I and III. The standard errors of the coefficient estimate are higher in III than in I confirming the correlation between NV_{it} and IX_{it}. The Hausman test for specifications I and II does not reject the hypothesis of no correlation between individual effects μ_i and regressors. Therefore the coefficients from the fixed and random effects model (not reported) do not differ systematically. For specifications III and IV the Hausman tests comes closer to rejection of the null hypothesis of no correlation between individual effects and regressors. The difference between the coefficient estimates of the fixed and random effects model (not reported) is restricted to the ratio of non-voting stock and the dummy variable for an identical dividend to preference and ordinary shares, DI_{it}. The standard errors of the random effects model are substantially smaller than the standard errors of the fixed effects model (except for the dividend dummy variables) suggesting a rather low power for the test. The fixed effects estimator seems more appropriate, since despite the low power, the hypothesis of no correlation is rejected at the 10% significance level. The random effects model is therefore likely to suffer from inconsistency due to omitted variables.

Transfers of corporate controls pre- and post 1995

In order to analyse the impact of the regulatory change on the payoff to minority voting shareholders (Hypotheses 3-5), the econometric set-up additionally includes ownership variables, i.e., dummy variables for simple majority control SM_{it} ($x_0^v > 0.5$) or qualified majority control QM_{it} ($x_0^v > 0.75$). Furthermore, we include the percentage ownership of non-voting stock of the largest voting shareholder, ON_{it}[10]:

$$VP_{it} = \beta_0 + \beta_1 SM_{it} + \beta_2 ON_{it} + \beta_3 CG_{it} + \beta_4 (CG_{it})^2 + \beta_5 NV_{it} + \beta_6 DA_{it} + \beta_7 DI_{it} + \beta_8 VR_{it} + \beta_9 IX_{it} + \mu_i + \varepsilon_{it} \quad (3.10)$$

The regressions are run for the subperiods 1988-1994 and 1995-1997 in order to compare the coefficient estimates before and after the introduction of the Takeover Code (Table IV). A structural break between the two subperiods is confirmed by the Chow test, which rejects the hypothesis of equal parameter estimates for the two periods at the 99.9% confidence level for both specifications. As put forward in Hypotheses 3 and 5, the coefficient estimates for majority and qualified majority control change from a negative sign during 1988-1994 to a positive sign during 1995-1997. Under the mandatory bid rule minority shareholders of voting stock are able to capture a fraction of the bargaining surplus of the controlling blockholder through the tender option. Before the new regulatory structure, however, a majority shareholder thwarted any competition for control and therefore led to a lower value of voting stock. The latter finding is in line with international evidence for Sweden, Italy and the US which establishes a firm negative link between majority control and the value of the voting right in the absence of a mandatory bid rule. The fact that the coefficient estimates are small and not significant for simple majority ownership highlights the presumption that competition for control is less pronounced in Germany than in the Anglo-Saxon capital markets. Anticipation of the new corporate governance rules might also have blurred the effects of majority control prior to 1995. A third possible explanation for this finding might be the instability of ownership structure over time. Current majority control might not be a good proxy for possible competition for control, since the majority position might easily dissolve in the near future or vice versa. Franks and Mayer [1997] report that in the 4 year period 1988-1991 about 4% of companies with concentrated ownership became widely held, and for 8% the reverse was true. The difference in the coefficient estimates for simple and qualified majority control in I and II highlights the value of a qualified minority block of 25% which can be used to block statutory changes. The small economic and statistical significance of simple majority

[10]The private benefit multiplier due to pyramiding was only retrieved for the 1991-1994 period.

control suggests that there might still be competition for a 25% block of votes. Only a qualified majority of more than 75% thwarts competition for control and results in a statistically significant 7% decrease in the voting premium. The Hausman test highlights that the random effects estimator (not reported) seems equally applicable for I and II, since the hypothesis of no correlation between individual effects and regressor cannot be rejected.

Majority control gains in economic and statistical significance in the post 1995 period where the presence of a majority owner increases the voting premium by 32.8% (simple majority) and 28.9% (qualified majority) respectively. The overall explanatory power for the second subperiod is correspondingly higher, and explains up to 42.40% of the variation of the voting premium in specification IV. Shareholdings of non-voting stock by the largest voting stockholder have a negative and statistically significant effect on the voting premium. A 1% increase in the holding of non-voting stock, decreases the voting premium by an amount of 0.6% to 1.3%. This lends support to Hypothesis 4 and suggests that the main blockholder acts more strongly in the interests of its non-voting shareholders (e.g., through prompt repayment of dividend arrears, conversion decisions or bargaining over a takeover price for preference shares), the higher its own non-voting equity stake. The economic significance is, however, minor which might reflect the small legal leeway to discriminate between the two classes of shares. It is also noteworthy that the impact of index membership of preference shares on the voting premium doubles from 1988-1994 to 1995-1997. This might be a reflection of the growing demand for index shares from index funds which have multiplied in Germany during the last years. This result could therefore extend Shleifer [1986]'s finding of significant positive abnormal stock return after inclusion in the S&P 500 to long-term evidence of positive valuation effects due to index membership. The remaining coefficient estimates are similar to the ones during the subperiod 1991-1994 (Table III). An exception is the coefficient estimate of the ratio of non-voting stock which becomes positive (though not significant) during 1995-1997 indicating that it might proxy for the control value (Hypothesis 1) rather than for liquidity differences. The dummy variables for dividend payments lose significance in the post- 1995 period. This might be due to the short time period in which expectations about dividend payments might weaken the valuation differential between years with superior and equal dividend to preference shares. For specifications III and IV the fixed effects estimator is preferred to the random effects model, since the hypothesis of no correlation between individual effects and regressors is rejected at the 99.99% confidence level. The difference between the coefficient estimates of the fixed and random effects model (not reported) is large, although there is no change in the signs of the coefficient esti-

mates. The random effects coefficient estimates for majority control, capital gearing and index membership of preference shares are only half in absolute size compared to those of the fixed effects estimator. The coefficient estimate of the voting right dummy, however, becomes more than twice as large as in the fixed effects model. The standard errors of the random effects model are substantially smaller than the standard errors of the fixed effects model suggesting a rather low power for the test. The fact that the hypothesis of no systematic variation between the two estimators is nevertheless significantly rejected, points to serious inconsistency of the random effects estimates. This finding is corroborated by a correlation of -0.68 between the individual firm-specific effects and the linear function of regressors, $Corr(u_i, \overline{x}_i\widehat{\beta})$, in the regression for simple majority control and of -0.61 in the regression for qualified majority control.

Effect of acceptance of Takeover Code on voting premium of signatory

The endogeneity of the acceptance decision of the Takeover Code allows the testing of the impact on the voting premium of the signatory in both a time series and cross-sectional dimension (Hypothesis 6). We include the dummy variable 'TC_{it}' equal to one if the company signed the Code and zero otherwise in the econometric specification. The regression makes use of the full sample of observations during 1988-1997[11].

$$VP_{it} = \beta_0 + \beta_1 TC_{it} + \beta_2 ON_{it} + \beta_3 CG_{it} + \beta_4 (CG_{it})^2 + \beta_5 NV_{it} + \beta_6 DA_{it} + \beta_7 DI_{it} + \beta_8 VR_{it} + \beta_9 IX_{it} + \mu_i + \varepsilon_{it} \quad (3.11)$$

The econometric results in Table IV provide evidence in favour of Hypothesis 6. The coefficient estimate for the dummy variable 'TC_{it}' carries a negative coefficient estimate, which is statistically significant at the 99.99% significance level. The acceptance of the Code is on average associated with a substantial 14.6% decline in the voting premium. This result lends further indirect support to the multiplier effect of pyramiding analysed in section [3.2.1]. It also provides an additional explanation for the outperformance of preference shares (see Figure 1 and 2). Returns to preference shares start to exceed returns to ordinary shares between 1994 and 1995. The underperformance of ordinary shares thus coincides with the introduction of the Takeover Code and might at least partially result from lower expected control benefits.

Because of the voluntary nature of the Code one might suspect that unobservable characteristics of the acceptance decision are correlated with unobservable factors of

[11] Because of the period-specific effects of the ownership variables we omit the dummy variables for majority control.

the voting premium, resulting in an inconsistent estimate for TC_{it}[12]. This objection can be refuted on two accounts. First, the dummy variable TC_{it} is only semi-endogenous in the sense that companies could decide about acceptance only since the introduction of the Code in 1995, i.e., the non-acceptance during 1988-1994 must be considered exogenous. Second, we construct an instrumental variable (IV) estimator for the acceptance decision in order to analyse a potential inconsistency resulting from the endogeneity during the 1995-1997 period. Hoffmann-Burchardi [1999] shows that companies which are constituents of major stock market indices and companies in industries with a high overall acceptance rate have been more inclined to sign the Code. On the other hand, companies with a controlling blockholder were found to be more reluctant to accept the Code. Using membership in the DAX or MDAX, the percentage of acceptance per industry, and the presence of controlling shareholder together with the other exogenous variables in [??] we construct an IV estimator for TC_{it} during 1995-1997. We find that the coefficient estimate of the nonlinear IV estimator equals -15.34% and is still significant at the 99% confidence level. The difference in the coefficient estimates between the IV estimator and the OLS estimator is very small pointing to only minor inconsistency of the OLS estimates. If it all, taking account of the partial endogeneity of the acceptance decision strengthens rather than impairs the empirical support in favour of Hypothesis 6. The fact that the coefficient estimate for index membership of preference shares becomes insignificant could result from collinearity between Code acceptance and index membership. The Hausman test statistic indicates no systematic difference between the fixed and random effects estimator for this specification.

3.4 Conclusion

The chapter has investigated the determinants of the voting premium, the price differential between voting and non-voting shares. It shows that the price differential is a reflection of the value of controlled assets per unit invested in voting stock and the way in which minority voting and non-voting shareholders participate in transfers of control. Both factors are influenced by the existing regulation of corporate governance. The chapter studies how a change in corporate governance rules in Germany in 1995 affects the voting premium through these two channels. The German stock exchange introduced a voluntary Takeover Code in 1995 which contains the mandatory bid rule.

[12] One might argue that private information of the management about future takeover activity detains management to sign the Takeover Code. At the same time, management makes use of this information by buying voting stock and by short-selling non-voting stock thus increasing the voting premium.

The mandatory bid rule stipulates that a party which purchases a controlling interest of another listed company's voting equity is obliged to make an offer to the remaining target shareholders.

In a first step, the chapter shows how mechanisms to separate control from cash-flow rights translate into a higher voting premium. Non-voting stock, debt and a pyramiding structure of subsidiaries are all instruments that increase the available capital stock without diluting control rights. The amount of controlled assets increases per unit of voting stock. In a second step the article seeks to cast light on the relationship between takeover regulation and the voting premium. The chapter focuses on the regulatory change from two different points of view: first, the effect on the voting premium as a result of an individual acceptance decision and second, the overall change in the payoff to minority voting and non-voting shareholders in corporate control transactions.

First, acceptance of the Code affects the premium through its effect on the amount of controlled assets. The mandatory bid rule imposes a takeover bid for 100% of the target's stock. Equity participations in subsidiaries are thus likely to surpass the threshold which is required for control. This reduces the extent to which a pyramiding structure of subsidiaries can be used to increase the control value of voting stock. The empirical analysis lends support to this hypothesis, since it shows that the coefficient estimate of the dummy variable for acceptance of the Code carries a negative sign.

Second, the chapter studies how the differential payoff to voting and non-voting minority shareholders changes in sale-of-control transactions with and without a mandatory bid requirement. The mandatory bid rule requires a tender offer to minority shareholders after a change in majority control. In the absence of the mandatory bid rule shareholders of voting and non-voting stock experience identical payoffs when a majority block changes hands. The existence of a majority shareholder tends to preclude any superior payoff for voting minority shareholders. Under the mandatory bid rule, however, voting minority shareholders can participate in a sale-of-control transaction on the same terms as the controlling blockholder. Through the mandatory bid rule the minority voting shareholders are equipped with the option to sell their shares to the new controlling party at the same price as the blockholder. Small voting shareholders are able to free-ride on the bargaining efforts of the controlling blockholder. The presence of a majority shareholder can therefore be beneficial to minority voting shareholders. In order to test for the effect of the two regulatory scenarios, we study how the voting premium is related to majority control in Germany

during the two subperiods 1988-1994 and 1995-1997. In fact, the empirical analysis shows that the coefficient estimate for majority control changes from a negative to a positive sign from the first to the second subperiod. This reflects the change in the way in which minority voting and non-voting shareholders participate in corporate control transactions under the new regulatory structure.

3.5 Tables and Figures

TABLE I

DIVIDEND REGIMES OF PREFERENCE SHARES

The table juxtaposes the different divident regimes of preference shares with and without additional dividends. The priority dividend is denoted by m_i, the excess dividend by x_i and the dividend to ordinary shares by d^v_{it}.

	Payoff for preference shares d^{nv}_{it}	Number of firms	Average dividend in % of par value	
I	Dividend regime with no additional dividend			
	$d^{nv}_{it} = (m_i \mid d^v_{it} \leqslant m_i) + (d^v_{it} \mid d^v_{it} > m_i)$	16	$\bar{m} = 5.8$	$\bar{x} = 0$
	Dividend regimes with additional dividend			
II	$d^{nv}_{it} = (m_i \mid d^v_{it} \leqslant m_i) + (d^v_{it} + x_i \mid d^v_{it} > m_i)$	62	$\bar{m} = 5.0$	$\bar{x} = 2.1$
III	$d^{nv}_{it} = (m_i \mid d^v_{it} \leqslant m_i) +$ $\sum_{k=1}^{l}(d^v_{it} + x_{ki} \mid d^v_{ki} \geqslant d^v_{it} > d^v_{k-1,i})$ where $d^v_{0i} \equiv m_i$	8	$\bar{m} = 5.0$	$x_{ki} \in [1;4]$

FIGURES I AND II

Figure 1 and 2 show cumulative return indices for both preference and ordinary shares during the 1988-1997 period. The indices include only return observations for companies in which both classes of shares were simultaneously listed, i.e., at each point in time the two return indices for the two classes of shares include the same number of companies. If only one of the two classes of shares is listed, the company is excluded from the index. The shares enter the index portfolios with an equal weight. In Figure 1 the return index only encompasses the capital gains of the two classes of shares, i.e.,

$$I_t^{nv,v} = \prod_{t=t_0}^{T} \frac{1}{N} \sum_{i=1}^{N} (1 + r_{it}^{nv,v})$$

where $r_{it}^{nv,v} = (P_{it}^{nv,v} - P_{it-1}^{nv,v})/P_{it-1}^{nv,v}$. The return indices in Figure 2 are calculated as above but include dividend payments, i.e., $r_{it}^{nv,v} = (P_{it}^{nv,v} - P_{it-1}^{nv,v} + d_{it}^{nv,v})/P_{it-1}^{nv,v}$.

FIGURE I

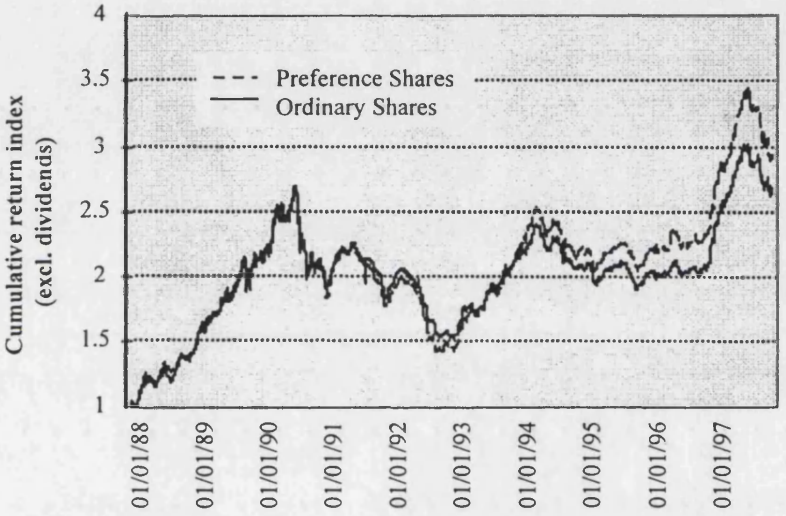


FIGURE II

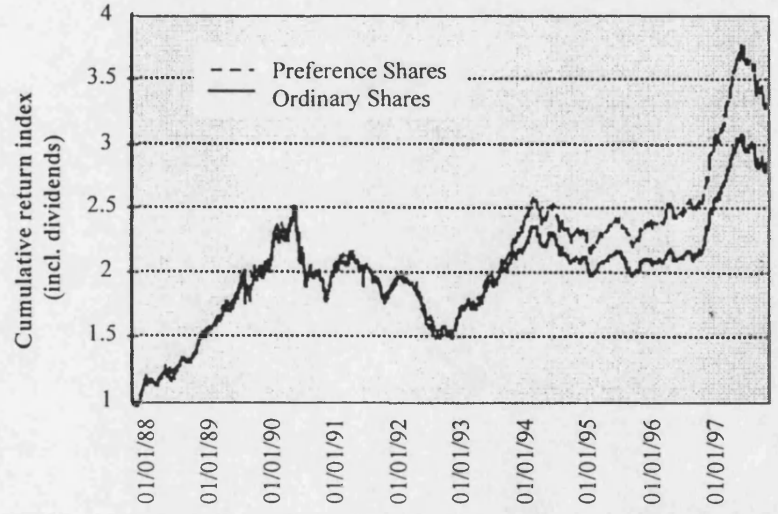


TABLE II

SUMMARY STATISTICS

Variable		Mean	SD	Min	Max	Obs
Voting premium	VP	0.263	0.456	-0.573	2.809	601
Simple majority control	SM	0.730	0.444	0.000	1.000	764
Qualified majority control	QM	0.275	0.447	0.000	1.000	764
Blockholding of preferred stock of largest voting stockholder	ON	0.049	0.167	0.000	0.980	763
Capital gearing	CG	0.386	0.263	0.000	1.720	684
Control/Cash-flow with $\overline{x}_{i,i+1} > 0.25$	$PY_{0.25}$	1.410	0.704	1.000	5.997	332
Control/Cash-flow with $\overline{x}_{i,i+1} > 0.5$	$PY_{0.5}$	1.172	0.428	1.000	5.896	332
Ratio of preferred to total equity	NV	0.283	0.177	0.000	0.500	796
Acceptance of Takeover Code	TC	0.077	0.267	0.000	1.000	880
Preferred member of M(DAX)	IX	0.113	0.316	0.000	1.000	880
Payment of dividend arrears	DA	0.056	0.230	0.000	1.000	625
Equal nonzero dividend to preferred and ordinary stock	DI	0.115	0.320	0.000	1.000	625
Voting right effective	VR	0.109	0.312	0.000	1.000	705

TABLE III

SOURCES OF PRIVATE BENEFIT MULTIPLIERS FOR SUBPERIOD 1991-1994

The table presents the coefficient estimates of a fixed-effects panel data model for the voting premium in the subperiod 1991-1994. The standard errors are robust to heteroskedasticity and autocorrelation of arbitrary forms. The *p-values* are reported below the coefficient estimates in parentheses. The Hausman test, also robust to heteroskedasticity and autocorrelation, is obtained as a Wald test in an extended model as suggested by Arellano [1993]. The first set of explanatory variables capital gearing CG, nonvoting stock NV and the private benefit multiplier due to pyramiding PY is designed to capture the degree to which a company has exploited means to separate control from cash-flow rights. Two dummy variables take account of differences in dividend payments between the two classes of stock: DA equals one if the preference share is paid dividend arrears of more than one year, and zero otherwise, and DI equals one if preference and ordinary shares receive the same nonzero dividend, and zero otherwise. The specification also includes the dummy variable VR for the years in which the voting right of preference shares is effective. In order to capture liquidity differences between the two classes of stock we include a dummy variable IX if the preference share is a member of a stock market index.

		I	II	III	IV
Capital Gearing	CG	0.975	1.016	0.975	1.016
		(0.053)	(0.045)	(0.054)	(0.046)
	$(CG)^2$	−1.160	−1.231	−1.160	−1.233
		(0.019)	(0.013)	(0.019)	(0.013)
Nonvoting stock	NV	−1.226	−1.254	−1.225	−1.255
		(0.076)	(0.168)	(0.180)	(0.169)
Pyramiding					
$\overline{x} = 0.25$	$PY_{0.25}$	0.045		0.046	
		(0.076)		(0.072)	
$\overline{x} = 0.5$	$PY_{0.5}$		0.082		0.084
			(0.005)		(0.004)
Dividends					
$d_{it}^{nv} = \sum m_i$	DA	−0.266	−0.292	−0.266	−0.294
		(0.068)	(0.044)	(0.069)	(0.044)
$d_{it}^{nv} = d_{it}^{v} > 0$	DI	0.079	0.096	0.079	0.097
		(0.000)	(0.000)	(0.000)	(0.000)
Voting right	VR	−0.138	−0.132	−0.137	−0.132
		(0.051)	(0.054)	(0.051)	(0.056)
Liquidity	IX			−0.270	−0.290
				(0.000)	(0.000)
Obs		208	208	208	208
R^2 (in %)		15.30	16.67	16.02	17.50
Prob>F		0.000	0.000	0.000	0.000
Hausman test		1.32	1.37	1.73	1.84
Prob>F		0.242	0.221	0.093	0.072

TABLE IV

POSSIBLE DIFFERENTIAL PAYOFF TO MINORITY ORDINARY AND PREFERENCE SHAREHOLDERS UNDER DIFFERENT TAKEOVER REGULATIONS

Possible differential payoff under	Type of control transfer			
	sale of share stake		open market purchases	
	uncontested	contested	uncontested	contested
Market Rule	no	no	no	yes
Mandatory Bid Rule	yes	yes	no	yes

TABLE V

IMPACT OF THE TAKEOVER CODE ON THE VOTING PREMIUM

The table presents the coefficient estimates of a fixed-effects panel data model for the voting premium in the subperiods 1988-1994, 1995-1997 and for the full sample 1988-1997. The standard errors are robust to heteroskedasticity and autocorrelation of arbitrary forms. The *p-values* are reported below the coefficient estimates in parentheses. The Hausman test, also robust to heteroskedasticity and autocorrelation, is obtained as a Wald test in an extended model as suggested by Arellano [1993]. The first two sets of specifications (I-IV) are designed to demonstrate the changing role of minority voting and non-voting shareholders in transfers of control before and after the introduction of the mandatory bid rule in 1995. In addition to the specifications of Table III, the regressions include variables of ownership structure, simple majority control SM ($x_0^v > 0.5$) and qualified majority control QM ($x_0^v > 0.75$), and the percentage holding of non-voting stock by largest voting stockholder (x_0^{nv}). Specification V encompasses observations of the full sample period and includes a dummy variable for companies which signed the Takeover Code.

Time period		1988-1994		1995-1997		Full sample
		I	II	III	IV	V
Ownership						
$x_0^v > 0.5$	SM	−0.006 (0.894)		0.328 (0.043)		
$x_0^v > 0.75$	QM		−0.070 (0.053)		0.289 (0.025)	
x_0^{nv}	ON	−1.318 (0.008)	−1.333 (0.007)	−0.613 (0.000)	−0.861 (0.000)	−0.269 (0.025)
Takeover Code	TC					−0.146 (0.000)
Capital Gearing	CG	0.429 (0.025)	0.335 (0.067)	0.945 (0.037)	0.846 (0.034)	0.470 (0.005)
	$(CG)^2$	−0.624 (0.000)	−0.559 (0.001)	−1.063 (0.013)	−0.911 (0.018)	−0.561 (0.002)
Non-voting stock	NV	−0.841 (0.089)	−1.073 (0.035)	0.007 (0.994)	0.399 (0.709)	−0.462 (0.142)
Dividends						
$d_{it}^{nv} = \sum m_i$	DA	−0.227 (0.048)	−0.233 (0.042)	−0.054 (0.338)	−0.038 (0.544)	−0.124 (0.054)
$d_{it}^{nv} = d_{it}^{v} > 0$	DI	0.104 (0.024)	0.118 (0.020)	0.039 (0.699)	0.033 (0.661)	0.057 (0.284)
Voting Right	VR	−0.037 (0.646)	−0.046 (0.589)	−0.049 (0.599)	−0.054 (0.563)	−0.183 (0.001)
Liquidity	IX	−0.122 (0.286)	−0.123 (0.296)	−0.214 (0.000)	−0.210 (0.000)	−0.011 (0.844)
Obs		286	286	181	181	490
R^2 (in %)		11.79	13.36	31.86	42.40	23.57
Prob>F		0.000	0.000	0.000	0.000	0.000
Hausman test		1.09	1.27	4.26	6.66	1.27
Prob>F		0.373	0.252	0.000	0.000	0.2531

3.6 Appendix

3.6.1 Annotations to multiplier effects

Effect of vertical versus horizontal concatenation of subsidiaries: The derivative of $\widetilde{PBM}$ with respect to the equity position of a given subsidiary $S_{k_0}^{i_0+1}$ equals

$$\frac{\partial \widetilde{PBM}}{\partial S_{k_0}^{i_0+1}} = \frac{\sum_{i=0}^{m-1} \prod_{j=0}^{i} \overline{x}_{j,j+1} \sum_{k=1}^{K_{i+1}} S_k^{i+1} - \prod_{j=0}^{i_0} \overline{x}_{j,j+1} \sum_{i=0}^{m-1} \sum_{k=1}^{K_{i+1}} S_k^{i+1}}{D^2}$$

where D^2 corresponds to the denominator of the derivative. Correspondingly,

$$\frac{\partial \widetilde{PBM}}{\partial S_{k_0}^{i_0+2}} = \frac{\sum_{i=0}^{m-1} \prod_{j=0}^{i} \overline{x}_{j,j+1} \sum_{k=1}^{K_{i+1}} S_k^{i+1} - \overline{x}_{i_0+1\ i_0+2} \prod_{j=0}^{i_0} \overline{x}_{j,j+1} \sum_{i=0}^{m-1} \sum_{k=1}^{K_{i+1}} S_k^{i+1}}{D^2}$$

It can be easily seen that $\partial \widetilde{PBM}/\partial S_{k_0}^{i_0+2} > \partial \widetilde{PBM}/\partial S_{k_0}^{i_0+1}$. ■

3.6.2 Annotations to Data

TABLE A.I.

TIME SERIES OF GERMAN DUAL-CLASS SHARE COMPANIES FROM 1988-1997

The table provides an overview of the number of dual-class share companies in Germany during 1988-1997. It lists the entries and exits of companies to and from dual class share companies during the sample period. The abbreviations in the 'Type' column denote the respective modes of entry and exit: Companies *enter* the sample of dual-class shares if previously unlisted ordinary shares are introduced on the stock exchange (LO), previously unlisted preference shares are introduced on the stock exchange (LP) or in case of an initial public offering with both classes of shares (LO/LP). Companies *exit* the sample if the company is fully acquired by another company and both classes of shares are delisted (TO) or preference shares are converted into ordinary shares (CV).

Date	Number	Entry	Type	Exit	Type
31/12/87	40				
		-		-	
31/12/88	40				
		BMW	LP	Massa	CV
		Bluthardt	LO/LP		
		Hugo Boss	LO		
		GEA	LO/LP		
		Hertel	LO		
		VK Mühlen	LP		
		Westag & Getalit	LP		
31/12/89	46				
		B.U.S. Berzelius	LO/LP		
		Deutsche Beteiligungs-AG	LO		
		Hornblower Fischer	LO/LP		
		Kunert	LO		
		Macrotron	LP		
		MLP	LO		
		NAK Stoffe	LP		
		Nordstern Allg. Vers.	LP		
		Pegasus Beteiligungen	LO/LP		
		SAP	LP		
		Sartorius	LO/LP		
		SEMA Group Systems	LO		
		Sixt	LO		
		Südzucker	LP		
31/12/90	60				
		Glunz	LO		
		Heidelberger Zement	LP		
		KIH	LO		
		Knürr-Mechanik	LO		
		New-York Hbg. Gummi	LP		
		Pongs & Zahn	LP		
		Rhön-Klinikum	LO		
		SPAR Handels-AG	LO		
31/12/91	68				

... CONTINUATION TABLE A.I.

TIME SERIES OF GERMAN DUAL-CLASS SHARE COMPANIES FROM 1988-1997

Date	Number	Entry	Type	Exit	Type
31/12/91	68				
		F. Reichelt	LP	Wanderer Werke	CV
		Walter Bau	LO/LP		
31/12/92	69				
		Heilit & Woerner	LO/LP	Friedrich Deckel	TO
				Hartmann & Braun	TO
				YMOS	CV
31/12/93	67				
		Adolf Ahlers	LP		
		Ehlebracht	LP		
		Fröhlich Bau	LP		
		Wella	LO		
31/12/94	71				
		Moenus	LP	Deutsche Babcock	CV
		NORDAG	LO/LP	NAK Stoffe	CV
31/12/95	71				
		Metro 1	LP	Asko	TO
		Compudent	LO	Deutsche Beteiligungen	CV
		Biotest	LO	Kaufhof	TO
		FMC	LP	Lufthansa	CV
		Gerry Weber	LO	Stuttgarter Hofbräu	CV
		Vogt Electronic	LO	Tarkett Pegulan	CV
				FAG Kugelfischer	CV
31/12/96	70				
		Deinböck	LO/LP	Bluthardt	CV
		Fresenius	LO	Leffers	CV/TO
		Henkel	LO	VK Mühlen	CV
		Möbel Walther	LO		
31/12/97	71				

TABLE A.II.

NUMBER OF DUAL-CLASS SAMPLE COMPANIES DURING TRADING DAYS IN 1988-1997

Time	Number of dual-class shares traded	Time	Number of dual-class shares traded
3-14/10/88	40	1-14/10/93	68
2-13/10/89	41	3-14/10/94	71
1-12/10/90	59	2-13/10/95	71
1-14/10/91	68	1-14/10/96	69
1-14/10/92	69	1-14/10/97	71
		Total	627

TABLE A.III.

TIME SERIES OF DIVIDEND PAYMENTS TO PREFERENCE SHARES FROM 1988-1997

The table shows the percentage of cases in each year during the sample period 1988-1997 in which voting and non-voting preference shares received differential and identical dividends respectively. The dividend payment to preference shares can exceed the dividend payment to ordinary shares in three cases: 1. preference shares obtain an additional dividend with respect to ordinary shares, $d_{it}^{nv} = d_{it}^{v} + x_{it}$, if the dividend to ordinary shares exceeds the minimum dividend, $d_{it}^{v} \geq m_i$; 2. preference shares obtain the cumulated minimum dividend arrears for more than one year, $d_{it}^{nv} = \sum_t m_i$, but there is insufficient profit for ordinary shares to obtain an identical amount, i.e. $d_{it}^{v} < \sum_t m_i$. 3. the minimum dividend is paid to preference shares, $d_{it}^{nv} = m_i$, but there is insufficient profit for ordinary shares to obtain an identical amount, $d_{it}^{v} < m_{it}$. Both classes of shares receive the same dividends if 1. there is insufficient profit to distribute any dividends ($d_{it}^{v} = d_{it}^{nv} = 0$, and 2. if there is no statutory provision for an additional dividend and he dividend to ordinary shares exceeds the minimum dividend, i.e.$d_{it}^{v} = d_{it}^{nv} \geq m_i$.

Year	I. Differential dividend			II. Identical dividend		Total
	$\Delta d_{it} = x_{it}$	$\Delta d_{it} \leqslant \sum_t m_i$	$\Delta d_{it} \leqslant m_i$	$\Delta d_{it} = 0$		
	$d_{it}^{v} \geq m_i$ $d_{it}^{nv} = d_{it}^{v} + x_{it}$	$d_{it}^{v} < \sum_t m_i$ $d_{it}^{nv} = \sum_t m_i$	$d_{it}^{v} < m_{it}$ $d_{it}^{nv} = m_i$	$d_{it}^{v} \geq m_i$ $d_{it}^{nv} \geq m_i$	$d_{it}^{v} = 0$ $d_{it}^{nv} = 0$	
1988	0.64	0.08	0.00	0.18	0.10	1.00
1989	0.61	0.10	0.02	0.20	0.07	1.00
1990	0.68	0.04	0.04	0.17	0.08	1.00
1991	0.75	0.01	0.01	0.10	0.12	1.00
1992	0.69	0.03	0.01	0.10	0.17	1.00
1993	0.59	0.01	0.01	0.10	0.28	1.00
1994	0.56	0.08	0.04	0.10	0.21	1.00
1995	0.67	0.03	0.03	0.08	0.19	1.00
1996	0.55	0.13	0.06	0.11	0.15	1.00
1997	0.62	0.07	0.07	0.08	0.16	1.00
Pooled	0.64	0.06	0.03	0.12	0.16	1.00

TABLE A.IV.

REGIMES FOR VARYING ADDITIONAL DIVIDENDS

The table shows the structure of varying additional dividend regimes. The additional dividend can either decrease with the dividend paid on ordinary shares (I. degressive additional dividend) or increase (II. progressive additional dividend).

Code	Name	Nominal share value	Minimum dividend (in % of par value)
(I) Degressive additional dividend: $x_{ki} > x_{k+1i}$			
KSB3	KSB	50	0.04
	$(0.02 \mid 0.04 < d_{it}^v \leqslant 0.1) + (0.015 \mid 0.1 < d_{it}^v \leqslant 0.14) + (0.01 \mid d_{it}^v > 0.14)$		
KKK3	Kühnle, Kopp &Kausch	50	0.04
	$(0.02 \mid 0.04 < d_{it}^v \leqslant 0.1) + (0.015 \mid 0.1 < d_{it}^v \leqslant 0.14) + (0.01 \mid d_{it}^v > 0.14)$		
WKM3	WKM Terrain- u. Bet.	5	0.07
	$(0.02 \mid 0.05 < d_{it}^v \leqslant 0.09) + (0.11 - d_{it}^v \mid 0.09 < d_{it}^v < 0.11)$		
(II) Progressive additional dividend: $x_{ki} < x_{k+1i}$			
ASK3	ASKO	50	0.05
	$(0.02 \mid 0.05 < d_{it}^v \leqslant 0.16) + (0.03 \mid 0.16 < d_{it}^v \leqslant 0.24) + (0.04 \mid d_{it}^v > 0.24)$		
BIN3	Binding Brauerei	50	0.04
	$(0.01 \mid 0.04 < d_{it}^v \leqslant 0.12) + (0.02 \mid d_{it}^v > 0.12)$		
LEF3	Leffers	50	0.05
	$(0.01 \mid 0.05 < d_{it}^v \leqslant 0.12) + (0.02 \mid d_{it}^v > 0.12)$		
STG3	Stuttgarter Hofbräu	50	0.04
	$(0.01 \mid 0.04 < d_{it}^v \leqslant 0.08) + (0.02 \mid d_{it}^v > 0.08)$		
PEG3	Tarkett Pegulan	50	0.06
	$(0.01 \mid 0.06 < d_{it}^v \leqslant 0.12) + (0.02 \mid d_{it}^v > 0.12)$		

TABLE A.V.

DATA DESCRIPTION AND SOURCES

Variable	Description	Source
Voting premium	Percentage discount of ordinary shares over preference shares	Datastream International
Majority control	Dummy=1 if firm is majority controlled, 0 otherwise	Hoppenstedt Aktienführer 1989-1998
Qualified majority	Dummy=1 if firm is controlled with a qualified majority of 75%, 0 otherwise	Hoppenstedt Aktienführer 1989-1998
Blockholding of preferreds	Percentage shareholding of preferred shares by largest shareholder of ordinary shares	Hoppenstedt Aktienführer 1989-1998
Capital gearing	Ratio of debt over total assets	Annual reports Hoppenstedt Aktienführer 1989-1998 Datastream International
Control/Cash-flow with $\overline{x} > 0.25$	Ratio of total equity under control to equity investment in holding company (Ass.: control in a subsidiary is achieved with a share stake of more than 25%)	Hoppenstedt Aktienführer 1992-1995
Control/Cash-flow with $\overline{x} > 0.5$	Ratio of total equity under control to equity investment in holding company (Ass.: control in a subsidiary is achieved with a shareholding of more than 50%)	Hoppenstedt Aktienführer 1992-1995
Ratio of preferreds	Ratio of preferred equity to total equity	Datastream International
Acceptance of Takeover Code	Dummy=1 if company has signed the Takeover Code, 0 otherwise	Übernahmekommission der Deutsche Börse
Preferred member of M(DAX)	Dummy=1 if preferred share is member of either MDAX or DAX, 0 otherwise	Börsenzeitung of September 1988-1997
Payment of dividend arrears	Dummy=1 if accumulated dividend arrears are paid to preference shares, 0 otherwise	Datastream International and Börsenzeitung
Zero dividend to preferred	Dummy=1 for dividend omission 0 otherwise	Datastream International and Börsenzeitung

Chapter 4

Clustering of Initial Public Offerings, Information Revelation and Underpricing

4.1 Introduction

While underpricing and long-term underperformance of initial public offerings (IPOs) have received considerable attention in the literature, the timing of the IPO decision has only recently been the subject of theoretical investigation. This is surprising since there exists ample empirical evidence that the market for IPOs is subject to dramatic swings. 'Hot' phases with an unusually high volume of offerings and severe underpricing alternate with 'cold' periods which are characterized by lower issuance activity and less pronounced underpricing. In addition, there seems to be some evidence on inter-industry variation in the timing of IPO decisions. This chapter develops a model to examine the driving forces for these evident swings in issuance activity.

The modeling of clustering behaviour has become increasingly important in financial economics (see Devenow and Welch [1996] and Brunnermeier [1997] for an overview). This chapter is related to herding models with information externalities by focusing on the revelation of a common-value component in the wake of price determination. A common value factor might represent the prospects for a specific industry or the overall state of the economy. The IPO price of one firm serves as a feed-back mechanism to other IPOs since it can reveal information about the common value factor and therefore change the value of other firms. In the presence of costly information acquisition and asymmetric information between a risk-averse owner-entrepreneur and risk-neutral investors, news about the common value factor can contribute to the clustering of IPOs in two ways. First, the risk of remaining private can increase in the wake of new information and induce the entrepreneur to

sell-off his firm to risk-neutral investors. Second, investors might refrain from renewed information production and free-ride on the implicit information conveyed by the price of a previous IPO. Because investors do not incur information production costs their valuation might increase to a larger extent than the entrepreneur's private valuation and therefore lead to a higher probability of a second IPO.

4.1.1 Empirical evidence on IPO clustering

The IPO activity of biotechnology firms at the London Stock Exchange in the 1990s provides some anecdotal evidence on the bunching of issues according to industries. The IPO of British Bio-Technology in mid 1992 was followed by the flotation of Enviromed, Anagen and Celsis International in 1993. Another recent example is the wave of IPOs of fashion designers. After the successful IPO of Italian designer house Gucci, US competitor Donna Karan launched its stock market floatation in June 1996, followed by Ralph Lauren which went public in mid 1997.

In a recent paper Helwege and Liang [1996] document that in the US 575 firms went public in the hot issue year of 1983, whereas in the cold issue year of 1988 the number of firms shrunk to a quarter of the 1983 figure. Underpricing (the price run-up from the issue price to the secondary market price) averaged 14.6% in 1983 and only 6.6% in 1988. Ljungqvist [1997] also reports that a positive macroeconomic climate raises the average amount of underpricing. Furthermore, there exists evidence that hot issue markets typically arise from the bunching of IPO activity in a few industries (Ritter [1984], Helwege and Liang [1996]). The fact that four of the two-digit SIC categories[1] represent over a half of the volume of the 1983 sample, indicates that hot IPO markets are, at least to some extent, related to industry-specific shocks (Helwege and Liang [1996]).

Table A.I and A.II give further evidence that issuance activity is clustered in both a time series and cross-sectional dimension. The tables depict the number and percentage of IPOs in two-digit SIC categories in the US during 1975-1984 respectively. Both tables manifest a strong bunching of IPOs in 1983 and to a smaller extent in 1981 and 1984. Table A.I. shows that the sign test of an equal proportion of IPOs during the 10-year period can be rejected for almost all industries during 1983. Similarly the percentage of IPOs in 1983 is for most industries more than two standard deviations away from the cross-sectional sample average. Cross-sectional differences are more evident in Table A.II. Electrics and gas (SIC 49) as well as food and kindred

[1]Two-digit SIC categories represent the second level of the US industrial classification scheme comprising 81 industrial subsections, see Appendix A.I.

products (SIC 20) exhibit substantial cross-sectional deviations from the sample means in 1980 and 1975, 1976 and 1978 respectively. Similarly, a large percentage of IPOs in fabricated metal products (SIC 34) took place during 1978-1980 counter to the overall inter-industry concentration in 1983. Other industries with industry-specific timing behaviour are transportation equipment (SIC 37) and oil and gas extraction (SIC 13) and to a smaller extent wholesale of non-durable products (SIC 51) as well as instruments and related products (SIC 38).

4.1.2 Overview

While these examples might suggest irrational herding behaviour, this chapter explains the clustering of IPOs by the release of positive industry (or economy-wide) information in the wake of an IPO.[2] The chapter develops a theoretical model which is used to analyse a sequence of going-public decisions[3]. It identifies conditions under which the likelihood of a second IPO increases after a firm first in the industry has gone public ('hot issue markets'). The model features two firms in an industry, which are owned by utility-maximising risk-averse entrepreneurs. The entrepreneur goes public if the utility he derives from the risky cash-flows of the firm are smaller than the (safe) proceeds he obtains by selling the firm to risk-neutral investors (who individually purchase only an arbitrarily small fraction of the firm's stock). Since it is assumed that the entrepreneur first sells his firm to an underwriter who can diversify risk over time, the entrepreneur does not bear any risk which might arise because of insufficient demand for the issue[4].

The overall firm value depends -in a multiplicative way- on a firm-specific and an industry-wide factor. The owner-entrepreneur only knows the realization of the firm-specific factor, but has no private information about industry prospects. Investors know neither the firm quality nor the industry prospects, but can purchase a noisy signal about the absolute firm value, the product of the industry- and firm-specific component. In this setting investors can be better informed about the state of the industry than the entrepreneur. This does not seem an unreasonable assumption, since investors such as managed funds or banks who consistently monitor the competitive

[2]An example for the practical significance of industry information for the clustering of IPOs provides a quotation from Neil Austin, new issue specialist with KPMG: "The Granada/Forte bid focused attention on the sector and this has helped the successful debuts of Macdonald Hotels and Millennium & Copthorne in April [1996]".

[3]While the basic model assumes that the ordering of the IPO decision is exogenous, the last part of the paper shows that the results can also hold if timing is endogenous.

[4]The last part of the paper relaxes this assumption and considers the case in which the entrepreneur is exposed to the volume-related risk as well.

dynamics of industries can be reasonably believed to have superior knowledge about future prospects of the industry. Also, investors are more likely to obtain information from other firms in the industry, from which the entrepreneur is shielded because of competitive considerations. The link from the first IPO to a second in the industry is established via information production of investors before the first IPO. The players use the secondary market price of the first issue to update their beliefs about the industry and, in particular, about the value of the second firm. There are two effects at place which determine the emergence of 'hot issue markets'.

First, the rise of hot issue markets depends on how the riskiness of the firm changes in response to news conveyed about the state of the industry ('variance effect'). If news about industry prospects are different from the prior belief of the entrepreneur, the variance of his firm value might increase and the entrepreneur becomes more inclined to go public. For example, if the a priori prospects of the industry are rather poor (there is an 80% probability of the industry being bad, and a 20% probability of the industry being good), but subsequent information reveals a 50% probability of the industry being good, the variance of the industry factor increases and risk-induced selling pressure mounts. In a similar vein, Stoughton, Wong and Zechner [1997] assume that the number of firms traded publicly affects the variance of investors' estimate of the total market size. Whereas in their set-up bunching can occur if the market variance shrinks, the present chapter argues that a rise in the firm value's variance increases the risk of remaining private and induces the entrepreneur to sell off his firm to risk-neutral investors.

Second, it depends on whether the expected IPO proceeds rise to a larger extent than the expected private firm value ('expected value effect') after the first IPO. This can be the case if the level of information costs no longer justifies further information production and investors free-ride on the available signal realisation after the first IPO. The marginal benefit of further information collection is particularly small, if investors can rely on the informational outcome of the first IPO, i.e. if signal precision is relatively high. This 'informational free-riding behaviour' can increase the market valuation more than the entrepreneur's private valuation. The entrepreneur no longer has to compensate investors for information acquisition through a lower issue price. Also, the level of participation increases compared to informed bidding, since all investors, not only investors with positive signals, purchase a share in the IPO. In this respect the chapter is related to Maksimovic and Pichler [1996] where an IPO is needed to raise the required finance in order to start full-scale production, but has the disadvantage of providing valuable information to potential entrants in the

industry. Clumping of IPOs in their model occurs if other firms follow with an IPO to take advantage of bigger growth opportunities. In this model a second IPO also becomes more likely in the wake of favourable industry news, but rather through higher proceeds the entrepreneur can obtain by exploiting the superior informational state in which investors are detained from information production. Contrary to other models of IPOs with asymmetric information between firm insiders and investors along the lines of Myers and Majluf [1984] the reduction of adverse selection is not the central element in triggering hot issue markets (e.g. Korajczyck, Lucas and McDonald [1991]).

Finally, the model offers an explanation for why hot issue markets often coincide with more pronounced underpricing than cold issue markets. Because of the empirical evidence put forward by Jegadeesh et al [1993], which is not supportive of the signalling role of underpricing (e.g. Allen and Faulhaber [1989]), underpricing in this model is either directly or indirectly due to information collection costs. Underpricing arises if the secondary market price is (on average) higher than the price of the primary issue. This comes about if the private information accrued by investors during the IPO is better than prior expectations about the firm value. Equally risk-induced selling pressure is triggered by unexpectedly positive industry information. So, both the clustering and underpricing phenomena result from the same underlying fact, i.e. positive surprise about industry prospects.

The model highlights the importance of an underlying or common value component between firms (e.g. the overall state of the industry or the business cycle) in provoking clustering phenomena like hot issue markets. Combined with asymmetric information and costly information acquisition the price determination for one firm can - through news about the common value factor- change the value of other firms in the industry or economy. This feed-back mechanism can trigger hot issue markets because it changes the valuation of firm-owners and investors in different ways. The valuation differential of the two parties subsequent to news about a common value factor is the prime feature which differentiates this model from other analyses of the timing and pricing of IPOs.

This chapter is primarily concerned with IPOs as an instrument of primary equity issuance, not as a means to a capital increase as in Maksimovic and Pichler [1996]. However, the findings of the chapter could easily be extended to a round of secondary financing where the owner-entrepreneur has to decide between raising funds via equity issuance in the stock market or private financing. Analogously, this decision will be influenced by the variability of the firm's private value ('variance effect') as well as investors' valuation ('expected value effect'). If a previous stock market floatation in

the same industry has increased the uncertainty of the industry's prospects by way of positive news, the entrepreneur will be more inclined to finance the firm's expansion through a secondary issue than through private ressources. This decision will be enforced if investors abstain from information production, so that the entrepreneur can exploit the favourable informational state to increase IPO revenues.

The chapter proceeds as follows. The first part outlines the general set-up of the model. It describes the strategy space of investors and entrepreneurs for both a potential first and second IPO. The second part derives pooling equilibria for the first firm's IPO decision if one of the two entrepreneurs is exogenously assigned to first decide about going public. The third part then focuses on the impact the first firm's IPO decision has on the going-public decision of a second firm in the industry. Equilibrium conditions are derived for which the likelihood of a second IPO increases after the first firm has gone public. The last section covers possible extensions to the basic model. Most importantly it shows that the results of former propositions also hold in case of an endogenous ordering of the IPO decision if additional restrictions are imposed on the coefficients of relative risk-aversion of the two entrepreneurs. Also, it is shown that hot issue markets can still arise in the presence of informed bidding even if the variance of IPO proceeds is taken into account. Given the importance of the 'variance effect' the last part considers whether the effect also arises for alternative distributional assumptions about the firm value.

4.2 The model

4.2.1 Firms

There are two firms in an industry which can be either of high or low value. The value of the firm V_i with $i \in \{1, 2\}$ depends both on the overall prospects of the industry and on the quality of the firm's projects. Both the firm and the industry may be of two types: $I = 1$ (good prospects) with probability α or $I = 0$ (bad prospects) with probability $1 - \alpha$. The firm characteristics can similarly be $F_i = 1$ (high quality) with probability ε and $F_i = 0$ (low quality) with probability $1 - \varepsilon$. The drawings for the value of the firm F_i are independently and identically distributed. Furthermore the distribution of industry prospects is independent of the distribution of firm characteristics. The overall firm value is given by the product of industry and firm specific characteristics, i.e. $V_i = I \cdot F_i$. The firm can therefore only be of high value $V_i = 1$ if both the firm-specific and industry-wide factor are favourable. In all other three cases the overall value of the firm is zero either because of bad firm

characteristics, low industry prospects or both. Thus the firm is of high value $V_i = 1$ with probability $\alpha\varepsilon$ and of low quality $V_i = 0$ with probability $1 - \alpha\varepsilon$.

4.2.2 Timing

The timing structure consists of two periods in which the two firms decide sequentially about an IPO. Firm 1 is exogenously chosen to first decide about going public in period 1. The information set of the players is denoted by Θ_i where $i \in \{1, 2\}$ stands both for the respective firm and period. In the first round the information set of the players consists of the *a priori* expectations about firm and industry characteristics as outlined in 4.2.1, i.e. $\Theta_1 = \Omega$. The IPO of each firm is associated with four dates. If the entrepreneur decides to undertake an IPO at $t_1 = 1$ he sets a price p_1 for his firm, and investors decide whether to produce information about the value of the firm at $t_1 = 2$. At $t_1 = 3$, trading commences in the secondary market and the number of participants in the IPO, δ_1, is revealed. A new management takes over the firm at $t_1 = 4$[5], and the quality of firm 1 is made public.[6]

Both the number of participants in the IPO and the quality of the first firm allow the players to update their expectation about industry prospects and the value of the second firm in the industry. They have a new information set, Θ_2, depending on the type of the first firm, F_1, and the number of participants in the IPO, δ_1. The information set Θ_2 therefore consists of a specific realization of the tuple $\{F_1, \delta_1\}$. The sequence of events from $t_2 = 1$ to $t_2 = 4$ is repeated for a potential second IPO. Figure 1 shows the time structure of the model for the first and second firm's IPO decision.

The equilibrium concept employed is a Perfect Bayesian Equilibrium which implies backward induction of the players' optimal strategies. Thus, investors' information production decision is derived before analysing the going-public decision of the entrepreneur. First, conditions for pooling equilibria are derived under which the first firm will go public. Second, equilibrium conditions are determined under which it is more likely for the second firm in the industry to go public after an IPO in the first period.

[5]IPOs are often associated with equity sales by controlling shareholders (see Pagano et al [1996]).

[6]It is not necessary to assume that the agents learn the true quality of the firm shortly after secondary trading starts. In effect, the revelation of firm type changes the factor by which the players update their information on the prospects of the second firm. Since the entrepreneur has an informational advantage about the quality of his firm he can advance his informational leap even further if information about the quality of the first firm is revealed. In this sense, this paper focuses on a special case with the maximum amount of asymmetric information between the entrepreneur and investors. The results of this paper hold even more so in the more general informational setting.

4.2.3 Investors

There are n risk-neutral, perfectly competitive investors who neither know the quality of the firms nor the prospects of the industry. Investors can, however, purchase a noisy signal S about the overall firm value, $V_i = F_i \cdot I$, at cost c. The signal can be either good ($S = G$) or bad ($S = B$) with the following degree of precision:

$$\begin{aligned} P(S_{ik} &= G \mid V_i = 1) = 1, \qquad k \in \{1, \ldots, n\} \\ P(S_{ik} &= G \mid V_i = 0) = \gamma, \qquad \gamma < 1 \end{aligned}$$

It is assumed that investors only purchase a share if they obtain a good signal. The informational set-up of this model is based on Chemmanur (1993) with the main difference being that firm value is a composite of industry and firm prospects. The information production decision is derived in its general form, which allows for different informational preconditions in the first and second period. We assume that the number of shares equals the number of investors, i.e. the value of the firm is divided into n shares[7]. Investors will only acquire information if the benefits of additional information at least outweigh its costs. If p_i is the issue price of the firm's shares then *uninformed* bidding will yield the following aggregate payoff for the n investors[8]

$$P(V_i = 1 \mid \Theta_i)(1 - p_i) + P(V_i = 0 \mid \Theta_i)(-p_i). \tag{4.1}$$

With probability $P(V_i = 1 \mid \Theta_i)$ the firm value is 1 and investors gain $(1 - p_i)$. Otherwise the value of the firm is 0 and investors incur a loss amounting to the price they paid for the firm. The benefit of informed compared to uninformed bidding is that informed investors only purchase a zero-value firm if they mistakenly receive a good signal, which happens with probability γ. The payoff from *informed bidding* is therefore

$$P(V_i = 1, S = G, \Theta_i)(1 - p_i) + P(V_i = 0, S = G, \Theta_i)(-p_i) - c$$

where c denotes the aggregate information production costs of the n investors. Restating this expression in terms of known conditional probabilities, we obtain

$$P(V_i = 1 \mid \Theta_i)(1 - p_i) + \gamma P(V_i = 0 \mid \Theta_i)(-p_i) - c. \tag{4.2}$$

By setting the payoff from uninformed bidding [4.1] equal to the payoff from informed bidding [4.2] one obtains the minimum IPO share price which will induce informed

[7]It seems reasonable to assume that the number of shares to be sold is determined prior to the IPO and that it should take the number of potential investors into account.

[8]Note that the n investors are here considered in their aggregate; for an individual investor the condition (and also subsequent expressions) have to be divided by n.

bidding. This price $\underline{p}_i$ is given by

$$\underline{p}_i = \frac{c}{(1-\gamma)P(V_i = 0 \mid \Theta_i)}. \tag{4.3}$$

This is the price where the costs of information production exactly offset the benefit from not purchasing the stock if the investor receives a bad signal. The lower price bound for informed bidding is higher the greater the costs of information production. The lower the probability of the firm being of zero value and the lower the precision of the signal, the higher the lower bound for informed bidding. For p_i higher than $\underline{p}_i$, informed bidding is strictly preferred, as the loss from bidding for a bad firm increases. On the other hand, the maximum price the firm can charge for its stock is given at the point where the benefits from participating in the IPO with a good signal is equal to the payoff from not bidding which is 0. Therefore the maximum price which the firm might charge for its stock is

$$\bar{p}_i = \frac{P(V_i = 1 \mid \Theta_i) - c}{P(V_i = 1 \mid \Theta_i) + \gamma P(V_i = 0 \mid \Theta_i)}. \tag{4.4}$$

The upper price limit for informed bidding is higher the more likely the firm is of high value and the smaller the error probability of obtaining a bad firm despite a good signal. The smaller the information production costs the higher the maximum price that the firm can charge in the presence of informed bidding. In order for informed bidding to occur the following parametric restriction on the cost and precision of the signal has to hold:

$$c < (1-\gamma)P(V_i = 1 \mid \Theta_i)P(V_i = 0 \mid \Theta_i) \equiv c_i \tag{4.5}$$

This condition is more likely to hold if the costs of information production, c, are small, the precision of the signal is high (γ small) and $P(V_i = 1 \mid \Theta_i)$ is close to $1/2$ implying a high risk of uninformed bidding. The condition is equivalent to postulating that $\underline{p}_i < E(V_i \mid \Theta_i) < \bar{p}_i$. If condition (4.5) holds, then there are three possible regions of investor behaviour depending on the price of the IPO: for $\underline{p}_i \leqslant p_i \leqslant \bar{p}_i$ investors buy a signal and purchase a share in the IPO if they receive a good signal. If $p_i > \bar{p}_i$, they will refrain from participating in the IPO, since they expect to make a loss. For $p_i < \underline{p}_i$ the price is too low to warrant information production, hence investors engage in uninformed bidding.

If condition (4.5) does not hold, investor behaviour can only fall into the two categories of uninformed bidding or no bidding. The maximum issue price the entrepreneur can charge is the price where the payoff from uninformed bidding is equal to the payoff from no bidding, i.e. the firm's a priori expected value $E(V_i \mid \Theta_i)$.

4.2.4 Entrepreneurs

The two firms are fully owned by utility maximizing, risk averse entrepreneurs. The owner-entrepreneurs face the choice between remaining private and going public. The proceeds from going public depend on the firm's price setting strategy which is influenced by the size of information production costs.

Remain private

Entrepreneurs are assumed to exhibit a mean-variance utility function where ρ stands for the coefficient of risk aversion. If the entrepreneur of a high-quality firm decides to remain private, he will obtain the following expected utilities $E(U_i^P)$ conditional on the quality of his firm

$$E(U_i^P \mid F_i = 1, \Theta_i) = P(I = 1 \mid \Theta_i) - \rho P(I = 1 \mid \Theta_i) \cdot P(I = 0 \mid \Theta_i). \quad (4.6)$$

$$E(U_i^P \mid F_i = 0, \Theta_i) = O. \quad (4.7)$$

Because of the normalisation of the firm value to $V_i \in \{0, 1\}$ and the composite nature of the overall firm value the expected utility for a high-quality firm reduces to the above probability terms. The entrepreneur knows the quality of the firm's projects F_i, but has no inside information about industry prospects. The owner of a high-quality firm faces some uncertainty about the realization of the industry-wide factor which manifests itself in the variance term of his utility function. The expected utility of an entrepreneur with a low-quality firm is zero independent of industry-wide prospects, since the firm value is a product of the industry and firm-specific factor.

Going public

Uninformed bidding. If the entrepreneur decides to float his firm, there are three possible optimal prices depending on the size of information production costs. If $c > c_i$, information production costs will impede investors from collecting information. The highest price the entrepreneur can charge will be the firm's *a priori* expected value. His expected utility from an IPO under *uninformed bidding* amounts to

$$E(U_i^{IPO} \mid c > c_i, \Theta_i) = P(V_i = 1 \mid \Theta_i). \quad (4.8)$$

independent of firm quality. Since investors do not produce information, all n investors will purchase the stock and there is no variance associated with the quantity of shares sold.

Informed bidding. If $c < c_i$, then the entrepreneur faces two choices: he can either set $\bar{p}_i$ in which case only investors with positive signals will purchase shares, or he can set $\underline{p}_i$ in which case investors will refrain from acquiring information and all n investors purchase shares. In order to derive the expected utility in the former case, we first have to determine the expected number of investors purchasing shares. Although the entrepreneur knows the quality of his firm, the number of participants in the IPO, δ_i, is a random variable for him. His action at $t_i = 0$ will therefore depend upon his expectation of the number of shares purchased, conditional on his firm type and industry prospects. The entrepreneur knows that n investors purchase information and that with probability γ zero-value firms can be mistaken for high-value firms. The expected number of investors X mistakenly purchasing a low-value firm is thus given by the mean of the binomial distribution $B(n, \gamma)$, $E(X) = n\gamma$. Even the owner of a low-quality firm can still expect proceeds of $\gamma\bar{p}_i$ from the flotation if his firm is mistaken for a high-value firm. The entrepreneur of a bad firm keeps a fraction of $(1-\gamma)$ shares, but since the type of his firm is revealed these shares will be worthless and the variance is reduced to zero. Thus, if the entrepreneur sets $\bar{p}_i$ and investors engage in *informed bidding*, the expected utility for a firm with high and low quality projects respectively is given by

$$E(U_i^{IPO} \mid F_i = 1, p = \bar{p}_i, \Theta_i) = \bar{p}_i \cdot P(I = 1 \mid \Theta_i) + \gamma\bar{p}_i \cdot P(I = 0 \mid \Theta_i) \quad (4.9)$$

$$E(U_i^{IPO} \mid F_i = 0, p = \bar{p}_i, \Theta_i) = \gamma\bar{p}_i. \quad (4.10)$$

Induced uninformed bidding. If the entrepreneur, on the other hand, sets a price equal to $\underline{p}_i$, he will *induce uninformed bidding* in which case all n investors purchase a share. The expected utility from induced uninformed bidding is therefore

$$E(U_i^{IPO} \mid p = \underline{p}_i, \Theta_i) = \underline{p}_i \quad (4.11)$$

for both high- and low-quality firms. Equating equations (4.9) and (4.11) we find that firms will induce informed bidding iff

$$c < \frac{(1-\gamma)P(V_i = 1 \mid \Theta_i)P(V_i = 0 \mid \Theta_i)[P(I = 1 \mid \Theta_i) + \gamma P(I = 0 \mid \Theta_i)]}{P(V_i = 1 \mid \Theta_i) + P(V_i = 0 \mid \Theta_i)[\gamma + (1-\gamma)(P(I = 1 \mid \Theta_i) + \gamma P(I = 0 \mid \Theta_i))]} \equiv c_i^* \quad (4.12)$$

It can be easily seen that $c_i^* < c_i$, so that one can differentiate three different optimal prices depending on c. For small information production costs, the firm will set $\bar{p}_i$ in which case only investors who receive positive signals will purchase the stock. With rising costs of information production, the firm has to set a lower price in order to compensate investors for the higher information production costs. At $c = c_i^*$, it

becomes no longer optimal for the firm to induce investors to produce information since the proceeds from the IPO will be greater in the presence of uninformed bidding. This is because without information production all investors will purchase a share in the IPO and not only investors who received positive signals. With $c > c_i$, the maximum price the firm will be able to set is $E(V_i \mid \Theta_i) = P(V_i = 1 \mid \Theta_i)$.

4.2.5 Equilibrium conditions for first IPO with informed bidding

An IPO of a first firm in the industry only has implications for the going-public decision of a second firm in the industry when investors will engage in informed bidding. We will therefore only derive equilibrium conditions for an IPO with information acquisition. One of the two firms in the industry is exogenously chosen to first decide about an IPO. The firm undertakes an IPO if the expected utility the entrepreneur derives from an IPO is greater than the utility he derives as the owner of the firm. Since there are no costs of mimicing a high-quality firm (and no benefits from separation), there is no scope for separating equilibria. The following proposition states the conditions under which an entrepreneur decides to take his firm public in the first period.[9]

Proposition 1 *There exists a pooling equilibrium where good and bad firms choose to go public in the first period and investors produce information iff* $c < c_1^*$ *and*

$$\alpha(1-\alpha)\rho > \frac{\alpha\gamma(1-\epsilon) + c[\alpha + \gamma(1-\alpha)]}{\epsilon\alpha + \gamma(1-\epsilon\alpha)}. \tag{4.13}$$

In the going-public equilibrium IPO proceeds are always smaller than the expected private value of a high-quality firm, α, which is reflected by the fact that the right hand side of the inequalities, the difference between expected firm value and IPO price is always positive. This difference, however, shrinks the higher the probability of the firm being good, since a high ε reduces the informational asymmetry between entrepreneurs and investors. The trigger of the IPO is the risk-aversion of the entrepreneur, ρ, and the variance of the firm value, $\alpha(1-\alpha)$. A firm is more likely to go public the higher ρ, and $\alpha(1-\alpha)$. The maximum variance is obtained when α is 0.5, i.e. when uncertainty about industry prospects is at its peak.

[9]Proofs to this and other Propositions and Lemmas are relegated to the Appendix, except for straightforward applications of Bayes' Rule.

4.2.6 Secondary market trading

For purposes of this model it is useful to differentiate between observed and expected underpricing. In the former case issues are on average not (over-) underpriced, but (over-) underpricing occurs for issuers of (zero) high-value firms. This is the case if $c < c_1^*$, where dependent on the number of bidders the secondary market price is higher or lower than the issue price. Expected underpricing, however, requires that $p_1 < E(V_1)$ on average. For $c_1^* < c < c_1$, the entrepreneur induces uninformed bidding by setting $\underline{p}_1$, and issues will be on average underpriced, since $\underline{p}_1 < E(V_1)$. In case c is prohibitively high ($c > c_1$), investors will engage in uninformed bidding and bid no more than $E(V_1)$ in which case neither observed nor expected underpricing results.

Since we assume information production for the first IPO, we can only consider cases with observed underpricing. After the IPO the number of participants in the IPO (which are the ones that obtain $S = G$), δ_1, becomes public knowledge. The secondary market price of the firm will then equal V_i conditional on the aggregate of the information produced by all investors.

Lemma 1 *In a pooling equilibrium, where investors only participate in the IPO if they find $S = G$, and all investors receive good signals δ_1, then the secondary market price of the first firm will be*

$$\Pi_1 = E(V_1 \mid n = \delta_1) = \frac{\alpha\varepsilon}{\alpha\varepsilon + (1 - \alpha\varepsilon)\gamma^n}.$$

If however, investors receive less than n good signals, the firm cannot be of high value and the secondary market price $E(V_1 \mid n > \delta_1) = 0$.

This Lemma derives directly from Bayes' Rule. The precision structure of the signal implies that high-value firms are always recognized as such, but zero-value firms can be mistaken for a high-value firm. Once one bad signal is obtained by an investor, the market infers that the respective firm can no longer be of a high-value. It can be shown that

Lemma 2 *If all investors obtain good signals the secondary market price is higher than the issue price so that underpricing $S_1 > \overline{p}_1$ results in an equilibrium in which $n = \delta_1$.*

The higher the information production costs and the lower the signal precision the larger the extent of underpricing. The impact of c is, however, by far stronger than the impact of γ. Information production costs unequivocally increase the extent of

underpricing, whereas an increase in γ has dual implications: it not only decreases $\bar{p}_1$, but also the secondary market price, since the quality of private information is doubtful. Information production costs have less and γ more impact on the level of underpricing the higher the probability of the firm being of high value. With increasing prospects of the IPO firm being of high value, c loses in significance and the quality of the signal becomes more important. On average, of course, there is no underpricing, since in all other cases in which $n > \delta$ issues will be overpriced. So, in the case of informed bidding, observed underpricing only arises with positive information shocks.

4.3 Implications for the second firm's IPO decision

After investors learn the type of the first firm at $t_1 = 4$, they can use this information together with the number of participants in the IPO, δ_1, to update their beliefs about the probabilities of $V_2 = 1$ and $V_2 = 0$. Depending on the type of the first firm and the number of participants in the IPO we obtain four possible informational outcomes depending on the combination of F_1 and δ_1: 1. $\Theta_{21} \equiv \{n = \delta_1, F_1 = 1\}$, 2. $\Theta_{22} \equiv \{n > \delta_1, F_1 = 1\}$, 3. $\Theta_{23} \equiv \{n = \delta_1, F_1 = 0\}$, and 4. $\Theta_{24} \equiv \{n > \delta_1, F_1 = 0\}$. The four cases and the respective adjusted expectations of the investors and the entrepreneur about the value of the second firm are juxtaposed in Table I.

Since for Θ_{23} and Θ_{24} the expected value remains unchanged after the first IPO, these cases do not lead to a higher probability of a second firm going public. In Θ_{22} the entrepreneur will be indifferent between going public or remaining private, since in both cases his payoff will be zero. The case which deserves further consideration is the one where all investors obtain positive signals and the firm is revealed as a high-quality firm, $F_1 = 1$. In this case investors and the entrepreneur of a high-quality firm update their beliefs about the expected value of the second firm to $E(V_2 \mid \Theta_{21}) = P(V_2 = 1 \mid \Theta_{21}) = \alpha\varepsilon/(\alpha + (1-\alpha)\gamma^n)$ and $E(V_2 \mid F_2 = 1, \Theta_{21}) = P(I = 1 \mid \Theta_{21}) = \alpha/(\alpha + (1-\alpha)\gamma^n)$ respectively. It can be easily seen that the expected value of the second firm is greater after the first firm in the industry has undertaken an IPO.

It becomes obvious that both investors and the entrepreneur of a high-quality firm can extract the same relative amount of information from the secondary market price, namely $1/(\alpha + (1-\alpha)\gamma^n)$, but that the entrepreneur can exploit this information to a larger extent in absolute terms. This shows that the asymmetric information between investors and the entrepreneur actually increases after the first IPO, since the entrepreneur can better decode the information conveyed by the secondary market price of the first firm's IPO. Thus, asymmetric information increases after an infor-

mation release. If bunching still occurs, then it must be triggered by other forces than a decrease of asymmetric information as put forward by Korajczyk, Lucas, and McDonald (1991).

4.3.1 Investor behaviour and information costs

Again, for the second IPO, investor behaviour depends on the information production costs and the price setting strategy of the entrepreneur. Table II describes investor behaviour in the second IPO depending on the level of information production costs. Because of information production in the first period, costs for information acquisition must be smaller than $c_1^\star$. In the second period, $c_2^\star$ and c_2 are the respective cut-off values for informed vs. induced uninformed and induced uninformed vs. uninformed bidding respectively. It can easily be seen that $c < c_1$ does not necessarily imply $c < c_2$.

Lemma 3 *The upper cost bound for informed bidding in the second IPO is smaller than the upper cost bound for informed bidding in the first IPO, i.e.* $c_2 < c_1$, *iff*

$$\alpha\varepsilon > \frac{\alpha + (1-\alpha)\gamma^n}{\alpha + (1-\alpha)\gamma^n + 1}.$$

The inequality in Lemma 3 holds the higher the precision of the signal, $1-\gamma$, and the higher the probability of the firm being good. If ε is high, then the second firm is likely to be of high value. The marginal benefit of further information collection is low and uninformed bidding more likely. Equally, the higher the precision of the signal, the more reliable the information conveyed in the first IPO and the higher the incentive to free-ride on this information.

Since similarly there is no predetermined ordering of $c_1^\star$ and $c_2^\star$, *informed bidding* in the second IPO only comes about if the costs of information production are smaller than $\min\{c_1^\star, c_2^\star\}$. This should be the case for firms and industries where the complexity of the product is minor and the competitive structure clear-cut, such as retailing, eating and drinking places and possibly manufacturing.

There are two ranges for possible values of c for which *induced uninformed bidding* arises after informed bidding in the first IPO. For induced uninformed bidding to arise in the second IPO, c has to be higher than $c_2^\star$, but smaller than c_2. One constellation of c values which provokes induced uninformed bidding in a second IPO after informed bidding in a first IPO is $c_2^\star < c < c_2 < c_1^\star$. In this situation the cost bound for induced uninformed bidding in the second IPO is more restrictive than the cost restriction

for informed bidding in the first IPO. This is the case if the information conveyed in the first IPO is so reliable (γ low) that only low information production costs could provoke further information collection about the value of the second firm. Information production costs are, however, still high enough so that it is more profitable for the entrepreneur to induce uninformed bidding instead of compensating investors for their information production costs. This structure of information costs mostly applies to firms which operate in a complex technological environment (e.g. biotechnology), but where there are enough independent research laboratories able to assess the state of product development in the industry. On the one hand, information acquisition is not trivial, but the information obtained through independent sources is very reliable.

A second constellation of c values for induced uninformed bidding in the second IPO arises for $c_2^\star < c < c_1^\star < c_2$. In this case both $c_2^\star < c_1^\star$ and $c_1^\star < c_2$ impose restrictions on the parameter values. The latter restriction implies that for induced uninformed bidding in the second IPO information production costs are allowed to be higher than for informed bidding in the first. This situation can arise if investors expect the firm to be good (ε close to 1), industry prospects to be poor ($\alpha \leqslant 1/2$), and a good signal to be almost completely misleading (γ close to 1). Since the positive news conveyed after the first IPO are very unreliable the entrepreneur can obtain higher IPO proceeds in the absence of information production. This is true because in case investors obtain a positive signal they mistrust the signal and abstain from the IPO so that even a high-value firm will obtain minuscule IPO proceeds. In order for the second condition $c_2^\star < c_1^\star$ to hold, again the marginal benefit of further information collection has to be negligible. This can either be the case when information about industry prospects is very precise (γ close to 0) or, on the very contrary, if information is so bad (γ close to 1) that even further information collection during the second IPO does not add significantly to investors' knowledge. The latter is predominant in industries with a high pace of technological advancement, where it is costly to obtain information on the prospects of success for an individual company or the industry as a whole. An example might be electronic equipment as well as the telecommunications and software industries.

If $c_2^\star < c_2 < c < c_1^\star$, then investors will abstain from information production and engage in *uninformed bidding*. With information production costs higher than c_2, investors voluntarily abstain from further information collection and prefer to bet blindly the firm's expected value $P(V_2 = 1 \mid \Theta_{21})$. Here, information acquisition costs are substantially higher, but again the validity of information spares investors renewed information collection. Firms in industries like electrical engineering, fabricated metal

and transportation equipment are likely to fall into this category.

4.3.2 Equilibrium conditions for hot issue markets

In the following, we will analyse how the going-public decision of the second entrepreneur is affected by the positive news about industry prospects conveyed by the first IPO. Again, the conditions are only derived for $F_2 = 1$, since there are no costs of mimicing a high-quality firm and no benefits from separation.

Definition 1 *Hot issue markets arise if the first IPO in the industry makes it more likely for a second firm to go public, i.e. if the expected utility derived from an IPO rises to a larger extent than the expected utility from remaining private after a first IPO occurred, i.e.*

$$E(U_2^{IPO} \mid F_2 = 1, \Theta_{21}) - E(U_1^{IPO} \mid F_2 = 1) > E(U_2^P \mid F1 = 1, \Theta_{21}) - E(U_1^P \mid F_1 = 1). \tag{4.14}$$

This equation can be broken down into two components.

Definition 2 *The change in the difference between the expected firm value to the entrepreneur and expected IPO proceeds R_i^{IPO} from the first to the second IPO*

$$\Delta E = E(V_1 \mid F_1 = 1) - E(R_1^{IPO} \mid F_1 = 1) - [E(V_2 \mid F_2 = 1, \Theta_{21}) - E(R_2^{IPO} \mid F_2 = 1, \Theta_{21})]$$

is termed 'expected value effect'.

The effect is positive if $\Delta E > 0$ and negative for $\Delta E < 0$. If the 'expected value effect' is positive, expected IPO proceeds rise to a larger extent than the expected firm value to the entrepreneur. A positive 'expected value effect' does not imply that expected IPO proceeds surmount the expected firm value to the entrepreneur [10], but that a second entrepreneur might be more inclined to undertake an IPO after a first firm in the industry has prepared the ground. The economic interpretation of the 'expected value effect' is the *free-riding* of investors on information about the industry factor conveyed in the first IPO. The market valuation of the firm can increase to larger extent than the entrepreneur's private valuation because investors abstain from renewed information acquisition.

Definition 3 *The change in variance of the entrepreneur's private valuation*

$$\Delta Var = \rho[Var(V_2 \mid F_2 = 1, \Theta_{21}) - Var(V_1 \mid F_1 = 1)]$$

is termed 'variance effect'.

[10] This will never be the case since investors have an informational disadvantage about the quality of the firm and have to be compensated for information collection.

The effect is positive if $\Delta Var > 0$ and negative for $\Delta Var < 0$. If the 'variance effect' is positive, the variance of the entrepreneur's private valuation increases from the first to the second IPO by revealing news about the prospects of the industry. In economic terms, the risk associated with remaining private increases and provokes *risk-induced selling pressure.* Inequality [4.14] can be restated in the following way

$$\Delta E + \rho \Delta Var > 0. \tag{4.15}$$

Hot issue markets arise as long as the joint impact of the two effects is positive.

Hot issue markets due to risk-induced selling pressure

With *informed bidding* in the second IPO, i.e. $c < \min\{c_1^*, c_2^*\}$, the expected private firm value rises to a larger extent than expected IPO proceeds so that the 'expected value effect' is negative or at most neutral. Hot issue markets can therefore only be triggered by an increase in the firm's variance:

Proposition 2 ***Case 1:*** *Hot issue markets with informed bidding* $[c < min\{c_1^*, c_2^*\}]$*: The second firm is more likely to undertake an IPO after the first firm in the industry is floated if the firm is likely to be of high quality (ε is close to 1), and* $\frac{\alpha^2}{(1-\alpha)^2} < \gamma^n$.

The conditions ensure that a positive 'variance effect' dominates the negative 'expected value effect'. A high probability that the firm is of high quality reduces the negative impact of the 'expected value effect'. The latter condition yields a positive 'variance effect' by imposing parameter conditions which increase the entrepreneur's risk of remaining private.

Although both the price and the expected percentage of investors participating in the IPO rise, the growth in IPO proceeds is weaker than the gain in the entrepreneur's private valuation. If ε is close to 1, the information asymmetry between the entrepreneur and investors is negligible and the 'expected value effect' is almost neutral. If ε equals one and there are no information production costs, expected private firm value and IPO proceeds coincide. While there is no informational advantage for the entrepreneur, investors are able to obtain superior information about the firm value by way of their private signal. But this is exactly offset by the fact that only investors with positive signal realizations purchase a share in the IPO. The more the parameters deviate from these values the greater the wedge between expected IPO proceeds and private firm value. Similarly the valuation differential widens from the first to the second IPO with increasing c and decreasing ε.

With an only moderately negative 'expected value effect' hot issue markets can be triggered by risk-induced selling pressure. The risk of remaining private increases for two parameter constellations: First, if α is close to zero, there is an almost unequivocal understanding of gloomy industry prospects. Any signal realization after the first IPO which reverses the picture by conveying a prosperous industry outlook, will increase the uncertainty about the industry factor. Second, if α is smaller but close to 1/2, there is still potential for an increase in the variance of the private firm value. With an equal probability of a good and bad industry uncertainty about the future state of the industry reaches its climax. In order for the firm's variance to increase an imprecise signal quality ($\gamma \nearrow 1$) has to ensure that the expectation about the industry factor does not rise above 1/2.

Even if the informational asymmetry between investors and entrepreneur is resolved (ε close to 1) the likelihood of a second IPO can diminish if the firm's variance decreases after the first IPO. This points to the fact that a decrease in asymmetric information per se is not sufficient to generate bunching of IPOs. Since the variance of the industry factor $\alpha(1-\alpha)$ reaches its maximum at $\alpha = 1/2$, a sufficient condition for the variance to decrease after positive industry news is $\alpha \geq 1/2$. Thus, when the *a priori* probability of bright industry prospects is greater than 50%, further positive news will reduce the risk of remaining private.

Hot issue markets due to informational free-riding

A common feature of hot issue market equilibrium conditions in the presence of induced or "voluntary" uninformed bidding is that investors "free-ride" on the industry news conveyed by the first IPO. While it was profitable for investors to engage in information production in the first period, the level of information production costs no longer justifies information acquisition given the incremental knowledge about the industry factor after the first IPO. The entrepreneur does not have to compensate investors for their information production activity, and the unrestricted participation in the IPO increases proceeds from a second IPO. Contrary to the case of informed bidding in the second IPO, the 'expected value effect' can become positive in the presence of (induced) uninformed bidding. Hot issue markets can thus arise due to the dual trigger of informational free-riding ('expected value effect') and risk-induced selling pressure ('variance effect').

Proposition 3 *Hot issue markets with induced uninformed bidding: The second firm is more likely to undertake an IPO after the first firm in the industry is floated if*

Case 2a: $c_2^* < c < c_2 < c_1^*$*: the firm is likely to be of high value (ϵ close to 1), the signal is sufficiently precise (γ close to 0) and industry prospects are very bad (α close to 0);*

Case 2b: $c_2^* < c < c_1^* < c_2$*: the firm is likely to be of high value (ϵ close to 1), the signal is sufficiently imprecise (γ close to 1), industry prospects are very uncertain (α smaller but close to 1/2) and information production costs are sufficiently large (c smaller but close to c_1^*).*

Compared to the previous case of informed bidding IPO volume is always greater under (induced) uninformed bidding. The maximum price the entrepreneur can charge, however, is lower if investors are induced to abstain from information production. Note that for $c < c_2$, the maximum price under informed bidding is $\bar{p}_2 > \underline{p}_2$. Since in the presence of informed bidding the 'expected value effect' is at most neutral, the parameter constellations which trigger a positive 'expected value effect' with induced uninformed bidding will have to make the 'volume effect' more than outweigh the disadvantageous price differential.

In case 2a, with ϵ approaching 1 and γ close to zero, $\bar{p}_2$ and $\underline{p}_2$ move closer together[11], reducing the price differential between informed and induced uninformed bidding. The precise signal and high expected firm quality makes additional information acquisition after the first IPO less attractive and the difference between informed and uninformed bidding shrink. Also, the comparison between the first period IPO price $\bar{p}_1$ and $\underline{p}_2$ shows that the higher value of c depresses $\bar{p}_1$, but has a countercurrent effect on $\underline{p}_2$. In case 2a, a positive 'expected value effect' additionally requires α or γ to be close to 0. If α approaches zero, the entrepreneur expects low proceeds with informed bidding since only investors with wrong signals participate in the IPO. Furthermore, given that the signal is very precise (low γ), there would be very few misguided investors. The percentile participation in the first period IPO, $\alpha+\gamma(1-\alpha) < 1$, is thus decreasing for small α and γ. With induced uninformed bidding, however, the entrepreneur lures all n investors into the IPO and thus more than compensates for the lower IPO price. Hot issue markets are further fostered by a positive 'variance effect' which is released by a combination of an a priori miserable industry outlook (α close to 0) and a subsequent startlingly positive outcome of the first IPO. This contradictory informational evidence increases uncertainty about industry prospects and the risk associated with remaining private.

[11] Both $\bar{p}_2$ and $\underline{p}_2$ increase with rising ϵ, but the first derivative of $\underline{p}_2$ with respect to ϵ at $\gamma = 0$ is greater than the first derivative of $\underline{p}_2$ with respect to ϵ for $\epsilon > 1/2$.

In case 2b, hot issue markets arise if information asymmetry between investors and entrepreneur is trifling (ε close to 1), the precision of the signal is inferior, the prospects of the industry almost at the peak of uncertainty (α only insignificantly smaller than 1/2) and c close to its upper limit c_1^*. It is clear that the higher information production cost, the smaller the price the first entrepreneur could charge in the presence of information production and therefore the larger the price increase from $\bar{p}_1$ to $\underline{p}_2$. A similar effect is obtained by a low signal precision which increases $\underline{p}_2$ and lowers $\bar{p}_1$. An unreliable signal ($\gamma \nearrow 1$) also makes $\underline{p}_2$ rise to a larger extent than $\bar{p}_2$ if ε increases. [12] A poor signal does not drastically increase the benefit of information acquisition over uninformed participation, so that an increase in expected firm quality has a more pronounced effect on $\underline{p}_2$. Since the price difference between $\underline{p}_2$ and $\bar{p}_2$ is minor and there is still a slight increase in IPO volume, higher IPO proceeds are obtained by charging $\underline{p}_2$ and leaving investors in a state of 'ignorant benevolence' after the first IPO. The positive 'variance effect' disengages because of increasing uncertainty about industry prospects, this time induced by general uncertain investor sentiment (α close to, but still smaller than 1/2) and poor signal quality (γ close to 1). The poor signal precision makes the industry outlook only slightly less opaque after the positive outcome of the first IPO. Industry prospects are revised upwards, but the increase is marginal (α still $\leqslant 1/2$).

Proposition 4 *Case 3: Hot issue markets with uninformed bidding* $[c_2^* < c_2 < c < c_1^*]$*: The second firm is more likely to undertake an IPO after the first firm in the industry is floated if the firm is likely to be of high value (ε close to 1), the signal is sufficiently precise (γ close to 0) and industry prospects are very bad (α close to 0).*

In case 3 the highest possible price the entrepreneur can charge is $E(V_i \mid \Theta_{21}, F_2 = 1)$ which for $c > c_2$ exceeds $\bar{p}_2$. Here it is clear that both IPO price and volume are higher compared to informed bidding. Since information production costs are substantial, investors rely on the current reliable industry information (γ close to 0) and abstain from further information collection. In order for the 'expected value effect' to be positive, it suffices if the information asymmetry between investors and entrepreneur is low, i.e. ε close to 1. In this case proceeds in the second IPO and expected firm value to the entrepreneur are almost the same; in the first IPO expected proceeds were, however, significantly lower than expected firm value to the entrepreneur (which was close to α) so that the rise in expected IPO revenue exceeds

[12] Both $\bar{p}_2$ and $\underline{p}_2$ increase with rising ε, but $\bar{p}_2$ is concave in ε, whereas $\underline{p}_2$ in convex. The first derivative of $\underline{p}_2$ with respect to ε for $\gamma \nearrow 1$ is greater than the first derivative of $\underline{p}_2$ at $\varepsilon = 0$.

the increase in expected firm value from remaining private. The parameter restrictions imposed by the sequence of cost bounds again trigger a positive variance effect as in case 2.

4.4 Underpricing and hot issue markets

Again, the level of information production costs decides about the type of potential underpricing. In case $c < \min\{c_1^*, c_2^*\}$ investors collect information about the value of the second firm. Again, it can be shown that the issue price is smaller than the secondary market price if all investors obtain positive signals during the second IPO ('observed underpricing'). The amount of observed underpricing can even increase from the first to the second IPO:

Proposition 5 *The amount of underpricing increases after the first IPO, i.e.* $(\Pi_2 - \overline{p}_2) > (\Pi_1 - \overline{p}_1)$, *if the firm is likely to be of high value* (ε *close to 1), the costs of information production* c *are close to zero and*

$$\gamma^{2n+1} > \frac{\alpha^2}{(1-\alpha)^2}. \tag{4.16}$$

It can be shown that the lower the costs of information production, the stronger the increase in underpricing from the first to the second IPO. The higher c, the higher the resulting underpricing in both IPOs. High information production costs, however, have a higher impact on underpricing in the first IPO than in the second. Therefore, an increase in underpricing is more likely the smaller the influence of information production costs.

The conditions which ensure an increase in underpricing coincide with the ones yielding hot issue markets. The parameter combination ε close to 1 and c close to zero simultaneously ensure that the 'expected value effect' becomes close to neutral. The 'variance effect' comes about if investors are surprised by the positive outcome of the first IPO. Observed underpricing results from the same effect, namely unexpectedly positive information about the overall firm value. Both underpricing and hot issue markets are therefore phenomena which arise from realizations which increase the firm's a priori expected value. Although this does not explain why issues are *on average* underpriced, it highlights why underpricing is *higher than average* when issues are clustered. Condition [4.16] is almost identical to the condition for a positive 'variance effect', $\gamma^n > \alpha^2/(1-\alpha)^2$. The higher power of γ in [4.16], however, imposes a more exacting condition on the signal precision and the industry factor. This is due to the fact that secondary market prices incorporate the signal realizations of both

rounds of information production. Therefore both an increase in underpricing and hot issue markets arise if uncertainty reaches its peak either due to a very unpromising prior industry outlook and stunningly good news in the first IPO (small α), or by way of general uncertainty about industry prospects and very poor signal quality (α smaller but close to 1/2 and $\gamma \nearrow 1$).

For information production costs of $c_2^* < c < c_2$ the entrepreneur optimally charges $\underline{p}_2 < E(V_2 \mid \Theta_{21})$ which provokes induced uninformed bidding The issue is thus, on average, priced below its expected value. The measure for underpricing in this case is no longer the difference between the issue price and the secondary market price (which in the case of induced uninformed bidding is zero, i.e. no observed underpricing, as no private information is transmitted into the secondary market price), but the difference between the average issue price and the firm's expected value. In case of expected or average underpricing there is no requisite coincidence with hot IPO markets. Given the specific cost bounds for information acquisition, issues will always be priced below their expected value. Since no new information gets into prices, induced uninformed bidding will cut off the path to further hot issue markets. Thus hot issue markets die away either because uncertainty can no longer rise, or because investors abstain from information production. Table III provides an overview of how a positive 'expected value' and 'variance effect' concur with underpricing.

4.5 Extensions

4.5.1 Endogenous timing of IPO decision

An interesting path of further investigation is to analyse whether the equilibrium conditions for hot issue markets still hold if the ordering of the IPO decision is endogenous. In a case where industry prospects are rather moderate, an IPO of one firm in the industry can raise IPO proceeds of competitor firms (relative to private firm value) by disclosing unexpectedly positive industry prospects. Waiting for another firm to pave the way to the stock market with favourable industry news may therefore be profitable. In particular, entrepreneurs with low-quality firms might be tempted to wait for a second period in which investors abstain from information production. On the other hand, the waiting strategy involves the risk for both high- and low-quality firms that another high-quality firm precedes with an IPO and reveals poor industry prospects. In this case the expected utility for entrepreneurs of both high- and low-quality firms shrinks to zero. The respective risk aversion coefficients of the two entrepreneurs should therefore be a determinant for the timing of the IPO.

We therefore assume that entrepreneurs exhibit different coefficients of risk-aversion, ρ_1 and ρ_2 respectively. Sufficiently risk-averse entrepreneurs will independently of firm type always choose to go public in the first period so as to avoid the risk of a total loss. In fact it can be shown that

Proposition 6 *There exists a pooling equilibrium, in which independent of firm type an entrepreneur with risk aversion coefficient ρ_1 goes public in the first period, and a second entrepreneur with a risk aversion coefficient of ρ_2 is more likely to follow with an IPO after the flotation of the first firm, iff*

$$\rho_1 > \rho^*, \quad \rho_2 < \min\{\rho^*, \rho^{**}\} \text{ and } \rho_2 > \rho^{***}.$$

For the parameter values of the hot issue market equilibria in cases 2b and 3 (see propositions [3] and [4]) there exists a solution to the system of inequalities. If we further assume that $c^2 = k\alpha$ where $k < 1$, then this also holds for the parameter constellations of hot issue markets under informed bidding, i.e. $\varepsilon \nearrow 1$ and $\alpha \searrow 0$ (proposition [2]).

A necessary condition for a pooling equilibrium of hot issue markets is therefore $\rho_1 > \rho_2$. This condition ensures that the first entrepreneur undertakes an IPO because of the risk-reduction benefit, but the less risk-averse second entrepreneur waits for a second round with higher expected proceeds. The risk-tolerance of the second entrepreneur is, however, limited by $\rho_2 < \min\{\rho^*, \rho^{**}\}$ in order to still leave an incentive for an IPO in the second period.

4.5.2 Variance of IPO proceeds

In section [4.2.4] we assumed that the entrepreneur could sell his firm to a risk-neutral underwriter who could diversify the risk of varying IPO proceeds over time. This assumption is obviously only necessary if investors engage in information production. Only then is it possible that fewer than n investors participate because they can possibly obtain a negative signal. If the entrepreneur is exposed to the risk of insufficient demand for the IPO issue, the variance of IPO proceeds has to be taken into account in order to determine the benefits of an IPO. Even if the variance term is included in the entrepreneur's expected utility from an IPO, hot issue markets can arise:

Proposition 7 *Hot issue markets with informed bidding $c < \min\{c_1^{**}, c_2^{**}\}$: The second firm is more likely to undertake an IPO after the first firm in the industry is floated if there is a sufficient number of investors $n > n^*$, the firm is likely to be of high value ($\varepsilon \nearrow 1$), the signal is sufficiently imprecise ($\gamma \nearrow 1$) and industry prospects are very bad ($\alpha \searrow 0$);*

First, a relatively large number of investors is required in order for the variance of private firm value to outweigh the variance of IPO proceeds in the first period IPO. Poor industry prospects (small α) in combination with a positive signal realization after the first IPO ensure that the variance of private firm value increases after the first IPO. The variance of IPO proceeds depends crucially on the degree of signal precision. If the signal is very unreliable ($\gamma \nearrow 1$), almost all investors will participate in the IPO so that the variance of expected IPO proceeds is negligible and rises to a smaller extent than the variance of private firm value.

One could also easily include the variance of IPO proceeds for the case of (induced) uninformed bidding in the second period. Under the equilibrium conditions for hot issue markets the variance of the private firm value increases after the first IPO. The volume-related risk factor associated with an IPO, however, would disappear and the likelihood of a second IPO would rise to an even larger extent.

4.5.3 Robustness of 'variance effect'

Since the 'variance effect' is crucial for the emergence of hot issue markets, it is worthwhile investigating whether the effect is robust to the introduction of other distributions than the binomial distribution $B(1,p)$ used in this chapter. The trigger for a hot issue market is a simultaneous increase in both the firm's expected value and its variance due to positive news about one of the valuation factors. If we use other distributional assumptions to characterise the firm value, this feature of the first and second moments has to be fulfilled. In fact, it can be easily shown that

Proposition 8 *The variance of an underlying asset can increase in line with its expected value if the distribution of the asset is subject to a $B(n,p)$ binomial or a normal distribution.*

This result holds since the expected value and variance of the $B(n,p)$ binomial distribution only change for a constant factor in comparison with $B(1,p)$. For large n, the normal distribution approximates the binomial distribution and can therefore also exhibit the required characteristic.

4.6 Conclusion

This chapter has argued that there are two effects at place which can trigger hot issue markets in a setting where both entrepreneurs and investors do not have complete information about industry prospects. First, it depends upon whether the expected

IPO proceeds rise to a larger extent than the expected private firm value after one firm in the industry has gone public. This in turn depends on whether investors free-ride on the industry information revealed in the first IPO. If the marginal benefit of further information production does not outweigh its costs, investors' 'uninformed valuation' of the firm can increase to a larger extent than the expected private firm value. This is because more investors participate in the IPO (not only the ones with positive signal realizations) and investors do not have to be compensated for information acquisition through a smaller issue price. Second, the rise of hot issue markets depends on the change in the riskiness of the firm in response to news conveyed about the state of the industry ('variance effect'). If the uncertainty about the state of the industry rises after the first IPO, the risk-reduction benefits of an IPO render a flotation relatively more attractive.

The model also offers an explanation for why hot issue markets often coincide with more pronounced underpricing than cold issue markets. Both underpricing and hot issue markets arise from the same underlying phenomenon, namely that the value of the IPO firm is higher than initially expected. The model could be generalized to a setting in which there are n privately owned firms in the industry, each with a decreasing degree of risk-aversion. Less risk-averse owners can only be induced to go public if the riskiness of their firm has significantly increased in the wake of an IPO. Waves of IPO activity thus fade away if the risk-diversification benefit no longer warrants a stock market flotation for the remaining private entrepreneurs with a lower degree of risk-aversion.

The model suggests hypotheses for empirical examination with respect to hot issue markets. First, the model establishes that underpricing (as a signal for positive industry news) increases the likelihood of subsequent IPOs. On the other hand, a failure of an IPO will reduce further incentives to go public in the same industry An unsuccessful issue is associated with worse than expected industry news and hence overpricing of the issue. Therefore, one would expect higher underpricing to be associated with an increase of IPOs in the same industry and vice versa. In contrast to the current empirical evidence by Helwege and Liang [1996] this model suggests a causal relationship rather than simultaneity between clustering and underpricing.

The model also offers some insight into the inter-industry clustering effects of IPOs. Besides the risk-induced selling pressure the model implies that the clustering of IPOs is the result of informational free-riding by investors on the industry news conveyed by the first IPO. This effect only arises in the presence of (induced) uninformed

bidding, where information production costs are relatively high. Therefore one would expect the clustering phenomenon to be more pronounced in industries with high product complexity and market uncertainty, such as telecommunications, electronics and software.

4.7 Tables

FIGURE I

TIMING

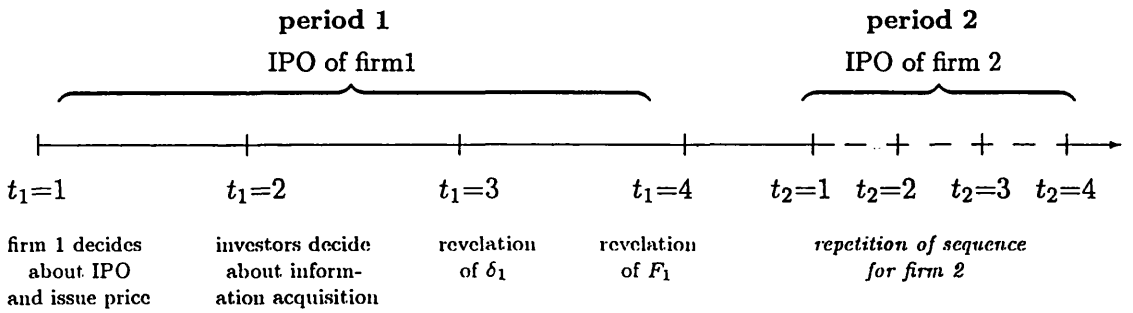


TABLE I

REVISED EXPECTATIONS OF SECOND FIRM VALUE AFTER FIRST IPO

Signal realization	Revealed type of first firm $F_1 = 1$		$F_1 = 0$	
	Investors	Entrepreneur $F_2 = 1$	Investors	Entrepreneur $F_2 = 1$
$n = \delta_1$	$\frac{\alpha\varepsilon}{\alpha+(1-\alpha)\gamma^n}$	$\frac{\alpha}{\alpha+(1-\alpha)\gamma^n}$	$\alpha\varepsilon$	α
$n > \delta_1$	0	0	$\alpha\dot{\varepsilon}$	α

TABLE II

INFORMATION ACQUISITION COSTS AND INVESTOR BEHAVIOUR

Case	Information costs	Parameter restrictions	Investor behaviour in second IPO
1	$c < \min\{c_1^*, c_2^*\}$	–	informed
2a	$c_2^* < c < c_2 < c_1^*$	$\varepsilon \nearrow 1 \wedge \gamma \searrow 0$	induced uninformed
2b	$c_2^* < c < c_1^* < c_2$	$\varepsilon \nearrow 1 \wedge \gamma \nearrow 1 \wedge \alpha \nearrow 1/2$	induced uninformed
3	$c_2^* < c_2 < c < c_1^*$	$\varepsilon \nearrow 1 \wedge \gamma \searrow 0$	uninformed

TABLE III

HOT ISSUE MARKETS AND UNDERPRICING

Case	Hot issue markets due to				Underpricing	
	ΔE	Parameter values	ΔVar	Parameter values	Type	Parameter values
1	-	$\varepsilon \nearrow 1$	+	$\gamma \nearrow 1 \wedge \alpha \nearrow 1/2$	observed	$\varepsilon \nearrow 1 \wedge \gamma \nearrow 1 \wedge$ $\alpha \nearrow 1/2 \wedge c \searrow 0$
2a	+	$\varepsilon \nearrow 1 \wedge \gamma \searrow 0$	+	$\alpha \searrow 0$	average	no restriction
2b	+	$\varepsilon \nearrow 1 \wedge c \nearrow c_1^*$	+	$\gamma \nearrow 1 \wedge \alpha \nearrow 1/2$	average	no restriction
3	+	$\varepsilon \nearrow 1 \wedge \gamma \searrow 0$	+	$\alpha \searrow 0$	no	-

TABLE A.I

NUMBER OF IPOS IN TWO-DIGIT SIC CATEGORIES IN THE US DURING 1975-1984

The table lists the IPOs in each two-digit SIC category in which at least 10 IPOs took place during 1975-84. In order to test for the clustering of IPOs across time a decile-based variant of the sign-test is used. Under the null hypothesis of $H_0^{ij} := P(X_{ij}) = 0.1$ where X_{ij} denotes the number of IPOs in a specific industry $i = 1, ..., 26$ in a specific year $j = 1975, ..., 1984$ the random variable $\widetilde{X}_{ij}$ is distributed binomially $B(n_i, 0.1)$. The null hypothesis is rejected if $X_{ij} \leqslant k_{\alpha/2}$ or $X_{ij} \geq k_{1-\alpha/2}$ where $k_{\alpha/2}$ and $k_{1-\alpha/2}$ are the greatest respectively the smallest integers which satisfy

$$\Sigma_{m=0}^{k_{\alpha/2}} \binom{n_i}{m} 0.1^{n_i} \leqslant \alpha/2 \quad \text{and} \quad \Sigma_{m=k_{1-\alpha/2}}^{k_{\alpha/2}} \binom{n_i}{m} 0.1^{n_i} \leqslant \alpha/2$$

respectively. Numbers market with * indicate years in which the null hypothesis can be rejected at the 5% significance level.

SIC	Industry	75	76	77	78	79	80	81	82	83	84	n_i
89	Services, NEC	0	0	1	0	0	0	2	0	4*	3*	10
49	Electric/Gas/Sanitary	1	0	0	0	0	3	2	1	3	2	12
20	Food/Kindred Prod.	2	1	0	1	0	1	2	0	1	5*	13
39	Misc. Manufacturing	0	1	0	0	0	3	5*	0	4*	1	14
62	Security/Comm. Brokers	0	0	0	0	0	1	0	0	13*	0	14
63	Insurance Carriers	0	0	2	1	0	1	2	1	7*	1	15
27	Printing and Publishing	0	0	0	0	0	1	3	0	10*	2	16
56	Apparel/Accessory Stores	1	0	0	0	0	0	3	0	11*	2	17
34	Fabricated Metal Prod.	0	1	0	1	1	3	4	2	5*	1	18
37	Transportation Equip.	0	1	1	0	1	2	3	0	7*	4	19
51	Wholesale: Non-durables	0	0	0	0	0	2	3	1	11*	7*	24
59	Miscellaneous Retail	0	1	0	0	1	1	3	1	11*	6*	24
45	Transportation by Air	0	0	0	1	0	5	8*	2	7*	2	28
48	Communications	0	0	0	0	0	5	5	4	10*	6	30
60	Depository Institutions	0	0	0	0	0	0	0	0	17*	18*	35
50	Wholesale: Durables	0*	1	0*	0*	0*	4	8*	2	15*	9*	39
67	Holding/Investment Co.	1	0*	0*	0*	1	5	1	2	13*	16*	39
58	Eating/Drinking Places	0*	0*	1*	1*	1*	1*	9	9	23*	9	54
80	Health Services	0*	1*	1*	0*	3	1*	8	1*	29*	14*	58
28	Chemical/Allied Prod.	2	0*	0*	2	1*	5	14*	3	32*	4	63
61	Non-Depository Instit.	0*	0*	0*	0*	0*	0*	0*	1*	49*	16*	66
13	Oil and Gas Extraction	0*	1*	1*	2*	15	30*	63*	1*	2*	0*	115
38	Instruments/Related Prod.	0*	0*	3*	4*	8	5*	29*	10	49*	13	121
36	Electronic Equipment	0*	3*	1*	4*	6*	15	43*	11	53*	31*	167
73	Business Services	1*	3*	1*	3*	3*	4*	33*	20	70*	29*	167
35	Industrial Machinery	2*	8*	3*	6*	8*	17	27*	12	63*	22	168
	n_t	10	22	15	26	49	115	280	84	519	226	1346

TABLE A.II

PERCENTAGE NUMBER OF IPOS IN TWO-DIGIT SIC CATEGORIES IN THE US DURING 1975-1984

The table presents the percentage of IPOs in two-digit SIC categories in the US during 1975-1984. The last two columns show the time series averages and standard deviations for each industry, whereas the last two rows denote the cross- sectional averages and standard deviations for each year. Numbers marked with $^*_*$ and * are two respectively one standard deviations away from the cross-sectional average, numbers marked with ^{2} and ^{1} are two respectively one standard deviations away from the time series average.

SIC	75	76	77	78	79	80	81	82	83	84	$\overline{X_i}$	SD_i
89	0.0	0.0	10.0^*_*	0.0	0.0	0.0^*	20.0	0.0^*	40.0^2	30.0^1	10	14.9
49	8.3^*	0.0	0.0	0.0	0.0	25.0^{*1}_*	16.7	8.3	25.0	16.7	10	10.2
20	15.4^*_*	7.7^*_*	0.0	7.7^*_*	0.0	7.7	15.4	0.0^*	7.7^*	38.5^2	10	11.5
39	0.0	0.0	0.0	0.0	0.0	7.1	0.0^*	0.0^*	92.9^{*2}_*	0.0^*	10	29.2
62	0.0	7.1^*_*	0.0	0.0	0.0	21.4	35.7^1	0.0	28.6^1	7.1	10	13.6
63	0.0	0.0	13.3^*_*	6.7^*_*	0.0	6.7	13.3	6.7	46.7^2	6.7	10	13.8
27	0.0	0.0	0.0	0.0	0.0	6.3	18.8	0.0	62.5^2	12.5	10	19.6
56	5.9^*	0.0	0.0	0.0	0.0	0.0^*	17.7	0.0^*	64.7^{*2}	11.8	10	20.2
34	0.0^1	5.6^*	0.0^1	5.6^*	5.6^*	16.7^*	22.2^1	11.1^*	27.8^1	5.6^*	10	9.4
37	0.0	5.3^*	5.3^*	0.0	5.3	10.5	15.8	0.0^*	36.8^{*2}	21.1	10	11.8
51	0.0	4.2^*	0.0	0.0	4.2	4.2	12.5	4.2	45.8^2	25.0^1	10	14.7
59	0.0	0.0	0.0	0.0	0.0	8.3	12.5	4.2	45.8^2	29.2^1	10	15.6
45	0.0	0.0	0.0	3.6	0.0	17.9^*	28.6^1	7.1	25.0^1	17.9	10	11.3
48	0.0	0.0	0.0	0.0	0.0	16.7^*	16.7	13.3^*	33.3^1	20.0	10	11.8
60	0.0	0.0	0.0	0.0	0.0	0.0^*	0.0^*	0.0^*	48.6^1	51.4^*_*	10	21.1
50	2.6	0.0	0.0	0.0	2.6	12.8	2.6^*	5.1	33.3^1	41.0^{*2}	10	14.9
67	0.0	2.6	0.0	0.0	0.0	10.3	20.5	5.1	38.5^2	23.1	10	13.2
58	0.0	0.0	1.9	1.9	1.9	1.9	16.7	16.7^*_*	42.6^2	16.7	10	13.6
80	0.0	1.7	1.7	0.0	5.2	1.7	13.8	1.7	50.0^2	24.1	10	16.0
28	3.2	0.0	0.0	3.2	1.6	7.9	22.2	4.7	50.8^2	6.4^*	10	15.7
61	0.0	0.0	0.0	0.0	0.0	0.0^*	0.0^*	1.5	74.2^2	24.2	10	23.8
13	0.0	0.9	0.9	1.7	13.0^*_*	26.1^*_*	54.8^*_*	0.9	1.7^*	0.0^*	10	17.8
38	0.0	0.0	2.5	3.3	6.6^*	4.1	24.0^1	8.3	40.5^2	10.7	10	12.8
36	0.6	1.8	0.6	1.8	1.8	2.4	19.8	12.0^*	41.9^2	17.4	10	13.4
73	0.0	1.8	0.6	2.4	3.6	9.0	25.8^1	6.6	31.7^1	18.6	10	11.4
35	1.2	4.8	1.8	3.6	4.8	10.1	16.1	7.1	37.5^2	13.1	10	10.8
$\overline{X_t}$	1.4	1.7	1.5	1.6	2.2	9.0	17.8	4.8	41.3	18.8		
SD_t	3.5	2.5	3.3	2.3	3.2	7.6	11.4	4.8	18.8	12.4		

4.8 Appendix

4.8.1 Proofs to Lemmas and Propositions

Proof to Proposition 1:

For $c < c_1^*$ the entrepreneur will set the maximum price for his firm that he can obtain in the presence of informed bidding $\bar{p}_1$. If the entrepreneur decides to keep his firm in private hands, he obtains $\alpha[1-\rho(1-\alpha)]$ if he owns a good firm and 0 if he owns a bad firm. If he decides to go public, the entrepreneur of a good firm obtains $\bar{p}_1[\alpha+\gamma(1-\alpha)]$ and the entrepreneur of a bad firm obtains $\gamma\bar{p}_1$. Since $\gamma\bar{p}_1 > 0$ the bad firm always has an incentive to go public. The good firm, however, only goes public if the proceeds from the IPO outweigh the utility from owning the firm which is the case if condition (4.13) holds.

In the cases where it is more profitable for a good firm to stay private it will be impossible for an entrepreneur of a bad firm to increase his utility by way of an IPO since investors foresee that it will only be profitable for a bad firm to undertake an IPO. Investors will not pay more than $p_1 = 0$ for the shares of the firm so that also a bad firm will remain private when an IPO incurs infinitesimally small transaction costs. ■

Proof to Lemma 2:

The difference between the secondary market price and the issue price

$$\Pi_1 - \bar{p}_1 = \frac{\alpha\varepsilon}{\alpha\varepsilon+(1-\alpha\varepsilon)\gamma^n} - \frac{\alpha\varepsilon - c}{\alpha\varepsilon+(1-\alpha\varepsilon)\gamma}$$

can be simplified to

$$\frac{\alpha\varepsilon(1-\alpha\varepsilon)\gamma(1-\gamma^{n-1})+c(\alpha\varepsilon+\gamma^n(1-\alpha\varepsilon)}{[\alpha\varepsilon+(1-\alpha\varepsilon)\gamma^n][\varepsilon\alpha+\gamma(1-\alpha\varepsilon)]}.$$

Since numerator and denominator are both greater than zero the secondary market price is greater than the issue price if $c > 0$ or $\gamma < 1$. ■

Proof to Lemma 3:

- Substituting for $P(V_i = 1 \mid \Theta_i)$ and $P(V_i = 0 \mid \Theta_i)$ in [4.5] for $i = 1,2$ yields $c_1 = (1-\gamma)\varepsilon\alpha(1-\varepsilon\alpha)$ and

$$c_2 = \frac{\varepsilon\alpha(1-\gamma)[(1-\alpha)\gamma^n+\alpha(1-\varepsilon)]}{[\alpha+(1-\alpha)\gamma^n]^2}.$$

- $c_1 > c_2$ implies $(k - \alpha\varepsilon)/k^2 < 1 - \alpha\varepsilon$, where $k \equiv \alpha + (1-\alpha)\gamma^n$. Solving $k^2 - k/(1-\alpha\varepsilon) + \alpha\varepsilon/1 - \alpha \equiv f(k) > 0$ as a quadratic equality yields

$$k_{1,2} = \frac{1}{2-2\alpha\varepsilon} \pm \sqrt{\frac{1-(4-4\alpha\varepsilon)\alpha\varepsilon}{(2-2\alpha\varepsilon)^2}}$$

which gives $k_1 = \frac{\alpha\varepsilon}{1-\alpha\varepsilon}$ and $k_2 = 1$. The roots have the following characteristics:

  - For $\alpha\varepsilon = 1/2$ the roots coincide.
  - For $\alpha\varepsilon > 1/2$, $k_1 > 1$ so that $f(k) > 0$ for all k, since $0 < k < 1$.
  - For $\alpha\varepsilon < 1/2$, k_1 lies in the interval $[0, 1[$ so that $f(k) > 0$ for $k < k_1$.

- Summarizing the conditions for which $c_2 < c_1$ yields

$$\alpha\varepsilon > \frac{\alpha + (1-\alpha)\gamma^n}{\alpha + (1-\alpha)\gamma^n + 1}. \blacksquare$$

Proof to Proposition 2:

Since $c < \min\{c_1^*, c_2^*\}$ does not impose any restriction on the parameter values, we only need to consider the sign of the "expected value" and "variance effect":

- "Expected value effect":
  Substituting for $P(V_i = 1 \mid \Theta_i)$ and $P(V_i = 0 \mid \Theta_i)$ in [4.9] for $i = 1, 2$ we obtain the issue prices for the first and second IPO:

$$E(U_1^{IPO} \mid F_i = 1) = \frac{\varepsilon\alpha - c}{\varepsilon\alpha + \gamma(1-\varepsilon\alpha)}[\alpha + \gamma(1-\alpha)]$$

$$E(U_2^{IPO} \mid F_2 = 1, \Theta_{21}) = \frac{\varepsilon\alpha - c[\alpha + (1-\alpha)\gamma^n]}{\varepsilon\alpha + \gamma[(1-\alpha)\gamma^n + \alpha(1-\varepsilon)]}\left(\frac{\alpha + \gamma(1-\alpha)\gamma^n}{\alpha + (1-\alpha)\gamma^n}\right).$$

  The difference between the expected private firm value $E(V_1 \mid F_1 = 1)$ and expected IPO proceeds of a high-quality firm $E(U_1^{IPO} \mid F_1 = 1)$ in the first period is

$$D_1 = \frac{\alpha\gamma(1-\varepsilon) + c[\alpha + \gamma(1-\alpha)]}{\varepsilon\alpha + \gamma(1-\varepsilon\alpha)}.$$

  The difference between the expected value of a high-quality firm $E(V_2 \mid F_2 = 1, \Theta_{21})$ and IPO proceeds $E(U_2^{IPO} \mid F_2 = 1, \Theta_{21})$ in the second period is

$$D_2 = \frac{\alpha\gamma(1-\varepsilon) + c[\alpha + \gamma^{n+1}(1-\alpha)]}{\varepsilon\alpha + \gamma[\gamma^n(1-\alpha) + \alpha(1-\varepsilon)]}.$$

The difference is increasing for the second IPO, since $D_2 - D_1$:

$$\frac{\alpha(1-\alpha)\gamma(1-\varepsilon)(1-\gamma^n)[\gamma+c(1-\gamma)]}{[\varepsilon\alpha+\gamma(1-\varepsilon\alpha)][\varepsilon\alpha+\gamma[\gamma^n(1-\alpha)+\alpha(1-\varepsilon)]]} > 0. \blacksquare$$

so that $\Delta E < 0$. Since the "expected value effect" is negative or at the maximum neutral (e.g. for $\alpha, \varepsilon \nearrow 1$), hot issue markets can only be triggered through a positive "variance effect".

- "Variance effect":
  The difference in the variance of the firm value, $Var(V_i \mid F_i = 1, \Theta_i)$, from the second to the first IPO

$$\Delta Var = \frac{\rho\alpha(1-\alpha)\gamma^n}{[\alpha+(1-\alpha)\gamma^n]^2} - \rho\alpha(1-\alpha)$$

  can be rearranged to

$$\Delta Var = \frac{\rho\alpha(1-\alpha)(1-\gamma^n)[(1-\alpha)^2\gamma^n]-\alpha^2]}{[\alpha+(1-\alpha)\gamma^n]^2}$$

  so that an increase in the variance ($\Delta Var > 0$) comes about if $\gamma^n > \frac{\alpha^2}{(1-\alpha)^2}$ which is the case either for $\alpha \searrow 0$ or $[\alpha \nearrow 1/2 \wedge \gamma \nearrow 1]$.

- Combining the two effects in one inequality yields

$$\underbrace{\frac{\rho[\gamma^n(1-\alpha)^2-\alpha^2]}{[\alpha+(1-\alpha)\gamma^n]^2}}_{\text{"variance effect"}} > \underbrace{\frac{(1-\varepsilon)\gamma[\gamma+(1-\gamma)c]}{[\varepsilon\alpha+\gamma(1-\varepsilon\alpha)][\varepsilon\alpha+\gamma[\gamma^n(1-\alpha)+\alpha(1-\varepsilon)]]}}_{\text{"expected value effect"}}$$

  If ε and γ are both close to 1, $\alpha < 1/2$ and for n not too big, this inequality is satisfied. Since the difference between the expected firm value to the entrepreneur and the IPO proceeds is increasing from the first to the second IPO, hot issue markets can only be triggered if the increase in firm variance outweighs this effect. Since all terms are continuous at the chosen parameter values, the inequalities also hold in an environment of these values. Summarizing the above conditions for the parameter values we find that a combination of $\varepsilon \nearrow 1$, and $\alpha \searrow 0 \vee [\alpha \nearrow 1/2 \wedge \gamma \nearrow 1]$ yields hot issue markets. Cold issue markets arise if the variance of a second firm in the industry is decreasing in the wake of the first IPO. Since expected IPO proceeds are growing less than the expected value, it is obvious that if the variance decreases after the first IPO, the entrepreneur will derive greater utility from remaining private. ■

Proof to Proposition 3:

The proof proceeds in the following steps. First, it will be shown for which parameter values information production costs are such that induced uninformed bidding arises in the second IPO. The two cases for which this situation arises are (2a) $c_2^\star < c < c_2 < c_1^\star$ and (2b) $c_2^\star < c < c_1^\star < c_2$ which will be considered separately. After identifying the parameter values for which these specific constellations of c values arise, we will investigate for which parameter values the going-public decision of the second entrepreneur will become more likely after the first IPO. Finally, the combinations of parameter values are compared to find existence of a solution.

1. Derivation of $c_i^\star$: Using [4.12] for $i = 1, 2$ we find

$$\begin{aligned} c_2^\star &= \frac{\alpha\varepsilon(1-\gamma)[k-\alpha\varepsilon)][\alpha+\gamma(1-\alpha)\gamma^n]}{k\{k[\varepsilon\alpha+\gamma(k-\alpha\varepsilon)]+[\alpha+\gamma(1-\alpha)\gamma^n](1-\gamma)(k-\alpha\varepsilon)\}} \\ c_1^\star &= \frac{\varepsilon\alpha(1-\gamma)(1-\varepsilon\alpha)[\alpha+(1-\alpha)\gamma]}{\varepsilon\alpha+(1-\varepsilon\alpha)\{\gamma+(1-\gamma)[\alpha+(1-\alpha)\gamma]\}} \end{aligned}$$

   where $k \equiv \alpha + (1-\alpha)\gamma^n$.

2. Case 2a: $c_2^\star < c < c_2 < c_1^\star$

   (a) Since $c_2^\star < c_2$, it remains to be found for which values of ε, α and γ, the inequality $c_2 < c_1^\star$ holds. With $\varepsilon \nearrow 1$, the inequality simplifies to

$$\frac{\gamma^n}{[\gamma^n(1-\alpha)+\alpha]^2} < \frac{\alpha+\gamma(1-\alpha)}{\alpha+(1-\alpha)[\gamma+(1-\gamma)(\alpha+\gamma(1-\alpha))]}.$$

   Cross-multiplying and collecting terms we obtain

$$\begin{aligned} g(\gamma) \equiv \alpha^3 + \gamma\alpha^2(1-\alpha) + 3\alpha^2\gamma^n - 2\alpha(1+\alpha^2)\gamma^n - 2\gamma^{n+1}(1-\alpha)^3 + \\ \gamma^{n+2}(1-\alpha)^2 + \alpha\gamma^{2n}(1-\alpha)^2 + \gamma^{2n+1}(1-\alpha)^3 > 0 \end{aligned}$$

   This inequality holds if $\gamma \searrow 0$.

   (b) In a next step we have to ensure that for the given parameter values above, $\Delta E + \rho\Delta Var > 0$, so that a second IPO becomes more likely. For means of clearer exposition we separate the change in the variance of the firm's value and the change in the difference between the expected firm value and expected IPO proceeds.

   - "Expected value effect":

– For $c_2^* < c < c_2$, the entrepreneur will set $\underline{p}_2$ in order to induce all investors to engage in uninformed bidding so that IPO proceeds in the second round equal:

$$E(U_2^{IPO} \mid F_2 = 1, \Theta_{21}) = \underline{p}_2 = \frac{c[\alpha + (1-\alpha)\gamma^n]}{(1-\gamma)[(1-\alpha)\gamma^n + \alpha(1-\varepsilon)]}$$

– The change in the difference between the expected firm value and expected IPO proceeds from the first to the second IPO equals

$$\Delta E = \frac{\alpha\gamma(1-\varepsilon) + c[\alpha + \gamma(1-\alpha)]}{\varepsilon\alpha + \gamma(1-\varepsilon\alpha)} + \frac{ck}{(1-\gamma)(k-\alpha\varepsilon)] - \frac{\alpha}{k}} \tag{4.17}$$

where again $k \equiv \alpha + (1-\alpha)\gamma^n$. Setting $\varepsilon \nearrow 1$ we find that $\Delta E > 0$ iff

$$\frac{c[\alpha + (2-\gamma)\gamma^n(1-\alpha)]}{(1-\gamma)\gamma^n(1-\alpha)} > \frac{\alpha}{\alpha + (1-\alpha)\gamma^n}$$

This inequality holds for $\gamma \searrow 0$.

- "Variance effect"
  See Proof to Proposition 2.

Since all terms are continuous at the chosen parameter values, the inequalities also hold in an environment of these values. Summarizing the above conditions for the parameter values we find that for any arbitrarily small α there exists an $\varepsilon \nearrow 1$ and $\gamma \searrow 0$ to satisfy the inequalities, i.e. a combination of $\varepsilon \nearrow 1$, $\gamma \searrow 0$, and $\alpha \searrow 0$ triggers hot issues markets with induced uninformed bidding.

3. Case 2b: $c_2^* < c < c_1^* < c_2$

(a) • First we need to find parameter values for which $c_1^* < c_2$. With $\varepsilon \nearrow 1$ we obtain $g(\gamma) < 0$. Further we let $\gamma \nearrow 1$. Since $g(1) = 0$ we need to differentiate $g(\gamma)$ with respect to γ and evaluate the derivative at $\gamma = 1$ which yields

$$\left.\frac{\partial g(\gamma)}{\partial \gamma}\right|_{\gamma=1} = n + 1 + \alpha(-2n-1)$$

In order for $g(\gamma) < 0$ for $\gamma \nearrow 1$ the function must be monotonically increasing at $\gamma = 1$. $\left.\frac{\partial g(\gamma)}{\partial \gamma}\right|_{\gamma=1} > 0$ for $\alpha < \frac{n+1}{2n+1}$ which is true for $\alpha \leqslant 1/2$.

- Furthermore the relationship $c_2^\star < c_1^\star$ has to hold. For $\varepsilon \nearrow 1$ and $\alpha = 1/2$ this inequality translates into

$$i(\gamma) \equiv \gamma^{2n+1} - 2\gamma^{2n} - \gamma^{n+1} + 3\gamma^n - 1 < O \qquad (4.18)$$

Since $i(1) = 0$ and $\frac{\partial j(\gamma)}{\partial \gamma}\Big|_{\gamma=1} = 0$ we have to calculate the second derivative and evaluate at $\gamma = 1$ which yields

$$\frac{\partial^2 i(\gamma)}{\partial^2 \gamma}\Big|_{\gamma=1} = 2n(1-n)$$

Since $\frac{\partial^2 i(\gamma)}{\partial^2 \gamma}\Big|_{\gamma=1} < 0$ for $n > 1$, $i(\gamma)$ reaches its maximum at $(1;0)$. Because $i(\gamma)$ is monotonically increasing for $\gamma \nearrow 1$, inequality [4.18] is satisfied.

(b) In a next step we have to ensure that for the given parameter values above, $\Delta E + \rho \Delta Var > 0$, so that a second IPO becomes more likely. For means of clearer exposition we separate the change in the variance of the firm's value and the change in the difference between the expected firm value and expected IPO proceeds.

- "Expected value effect"
  We proceed the same way as under 2 (b) above, and then set $\varepsilon \nearrow 1$, $c = c_1^\star$ and $\alpha = 1/2$ in [4.17]. We find that $\Delta E > 0$ iff $i(\gamma) < 0$ so that the same results as under 3a apply.
- "Variance effect":
  See Proof to Proposition 2.

Since all terms are continuous at the chosen parameter values, the inequalities also hold in an environment of these values. Summarizing the above conditions for the parameter values we find that or any arbitrarily large $\gamma \nearrow 1$ there exists an $\varepsilon \nearrow 1$, $\alpha \nearrow 1/2$ and $c \nearrow c_1^\star$ to satisfy the inequalities, i.e. a second combination of $\varepsilon \nearrow 1$, $\alpha \nearrow 1/2$, $c \nearrow c_1^\star$ and $\gamma \nearrow 1$ triggers hot issues markets with induced uninformed bidding. ■

Proof to Proposition 4:

- For procedure and parameter values for $c_2^\star < c_2 < c < c_1^\star$:
  See Proof of Proposition 3 (Case 2a).

- "Expected value effect":
  The expected utility from an IPO in this case will be $E[U_2^{IPO} \mid c > c_2, \Theta_{21}] =$

$\frac{\varepsilon\alpha}{\alpha+(1-\alpha)\gamma^n}$. Consequently,

$$\Delta E = \frac{\alpha\gamma(1-\varepsilon)+c[\alpha+\gamma(1-\alpha)]}{\varepsilon\alpha+\gamma(1-\varepsilon\alpha)} - \frac{\alpha(1-\varepsilon)}{\alpha+(1-\alpha)\gamma^n}$$

For $\varepsilon \nearrow 1$, the expected value effect is positive, since $\Delta E > 0$ for all $c > 0$.

- "Variance effect":
  See Proof to Proposition 2.

Since all terms are continuous at the chosen parameter values, the inequalities also hold in an environment of these values. Summarizing the above conditions for the parameter values we find that for any arbitrarily small α there exists an $\varepsilon \nearrow 1$ and $\gamma \searrow 0$ to satisfy the inequalities, i.e. a combination of $\varepsilon \nearrow 1$, $\gamma \searrow 0$, and $\alpha \searrow 0$ triggers hot issues markets with induced uninformed bidding. ■

Proof to Proposition 5:

In a pooling equilibrium, where investors only participate in the IPO if they find $S = G$, and all investors receive good signals δ_2, the secondary market price of the second firm will be

$$\Pi_2 = E(V_2 \mid n = \delta_2, \Theta_{21}) = \frac{\alpha\varepsilon}{\alpha[\varepsilon+(1-\varepsilon)\gamma^n]+(1-\alpha)\gamma^{2n}}$$

The second IPO in the industry is thus associated with underpricing of the following amount:

$$\Pi_2 - \bar{p}_2 = \frac{\alpha\varepsilon\gamma(1-\gamma^{n-1})[\gamma^n(1-\alpha)+\alpha(1-\varepsilon)]+c\{\alpha[\varepsilon+\gamma^n(1-\varepsilon)]+(1-\alpha)\gamma^{2n}\}[\alpha(1-\alpha)\gamma^n]}{\{\varepsilon\alpha+\gamma[\gamma^n(1-\alpha)+\alpha(1-\varepsilon)]\}\{\alpha[\varepsilon+(1-\varepsilon)\gamma^n]+(1-\alpha)\gamma^{2n}\}}$$

Comparing the amount of underpricing in the first IPO (see Lemma 1) with underpricing in the second, and setting $\varepsilon \nearrow 1$ and $c = 0$ we find that

$$\Pi_2 - \bar{p}_2 > \Pi_1 - \bar{p}_1$$

$$\iff \frac{\gamma^n}{[\alpha+(1-\alpha)\gamma^{2n}][\alpha+(1-\alpha)\gamma^{n+1}]} > \frac{1}{[\alpha+(1-\alpha)\gamma^n][\alpha+(1-\alpha)\gamma]}$$

Cross-multiplying and rearranging terms we find that this inequality holds for

$$\gamma^{2n+1} > \frac{\alpha^2}{(1-\alpha)^2}.$$

A special solution to this inequality is $\alpha \searrow 0$ or $[\alpha \nearrow 1/2 \wedge \gamma \nearrow 1]$. ■

Proof to Proposition 6:

In order for the equilibrium conditions derived in propositions [2]-[4] to hold true also in a setting with an endogenous ordering of the IPO decision, we have to find restrictions on ρ_i which will trigger an IPO in the first and second period independent of firm type. Therefore for all four possible combinations of firm types, the first entrepreneur with ρ_1 will always have to be the first one to go public, while the second one with ρ_2 should follow in the second period. The discount rate between the first and second period is normalized to 1. We assume that entrepreneurs maximize their period 2 expected utility. The subscripts of ρ and F stand for the two entrepreneurs with different coefficients of risk-aversion, while the subscripts in relation to U denote the first and second period utility. An equilibrium is defined as a set of strategies where the strategy of F_1 is optimal given the strategy of F_2 and vice versa.

- Conjecture: Investors believe that an entrepreneur's going public decision is not influenced by his private signal about firm quality, but only by his coefficient of risk-aversion, ρ_i.

- The following generic conditions for all categories of investor behaviour lead to a pooling equilibrium in pure strategies, where F_1 goes public in the first period and F_2 follows in the second period.

$$F_1 = 1: \quad E(U_1^{IPO} \mid F_1 = 1) > E(U_1^{P} \mid F_1 = 1) \tag{4.19}$$

$$F_2 = 1: \quad (U_2^{\max\{IPO,P\}} \mid F_1 = 1, F_2 = 1) > E(U_1^{IPO} \mid F_2 = 1) \tag{4.20}$$

$$F_1 = 0: \quad \text{identical expected utility for all strategies}$$

$$F_2 = 0: \quad \text{identical expected utility for all strategies}$$

$$F_1 = 0: \quad \text{identical expected utility for all strategies}$$

$$F_2 = 1: \quad E(U_1^{IPO} \mid F_2 = 1) < E(U_1^{P} \mid F_2 = 1) \tag{4.21}$$

$$F_1 = 1: \quad \text{same as condition [4.19]}$$

$$F_2 = 0: \quad E(U_2^{\max\{IPO,P\}} \mid F_1 = 1, F_2 = 0) > E(U_1^{IPO} \mid F_2 = 0) \tag{4.22}$$

The conditions translate into the following specific restrictions on ρ_1 and ρ_2 for the different categories of bidding behaviour in the second period:

1. $c < \min\{c_1^\star, c_2^\star\}$: informed bidding

(a) For entrepreneur of F_1 :

$$\alpha - \rho_1\alpha(1-\alpha) < \overline{p}_1[\alpha + \gamma(1-\alpha)]$$

(b) For entrepreneur of F_2 :

$$\alpha - \rho_2\alpha(1-\alpha) > \overline{p}_1[\alpha + \gamma(1-\alpha)] \tag{4.23}$$

$$\text{If } \overline{p}_2\frac{\alpha+\gamma(1-\alpha)\gamma^n}{\alpha+(1-\alpha)\gamma^n} > \frac{\alpha}{\alpha+(1-\alpha)\gamma^n} - \rho_2\frac{\alpha(1-\alpha)\gamma^n}{[\alpha+(1-\alpha)\gamma^n]^2} \quad \text{then} \tag{4.24}$$

entrepreneur 2 will choose to undertake an IPO in the second period. However, waiting until the second period involves the risk of negative industry news in the first IPO. The risky second period IPO proceeds therefore have to outweigh the safe proceeds of an IPO in the first period:

$$\overline{p}_2[\alpha + \gamma(1-\alpha)\gamma^n] - \rho_2\overline{p}_2^2\frac{[\alpha+\gamma(1-\alpha)\gamma^n]^2}{\alpha+(1-\alpha)\gamma^n}(1-\alpha)(1-\gamma^n) > \overline{p}_1[\alpha + \gamma(1-\alpha)] \tag{4.25}$$

$$\gamma\overline{p}_2[\alpha + (1-\alpha)\gamma^n] - \rho_2\gamma^2\overline{p}_2^2[\alpha + (1-\alpha)\gamma^n](1-\alpha)(1-\gamma^n) > \gamma\overline{p}_1 \tag{4.26}$$

Solving inequalities [4.23]-[4.26] for ρ_2, we obtain $\rho_2 < \rho^{1*}$, $\rho_2 > \rho^{2*}$, $\rho_2 < \rho^{3*}$, and $\rho_2 < \rho^{4*}$. In order for a solution to exist for the system of inequalities, $\rho^{2*} < \rho^{1*}, \rho^{2*} < \rho^{3*}$ and $\rho^{2*} < \rho^{4*}$, which is equivalent to postulating that $\rho^{2*}/\rho^{1*} < 1$, $\rho^{2*}/\rho^{3*} < 1$, and $\rho^{2*}/\rho^{4*} < 1$. Using the parameter values which trigger hot issue markets in Proposition (2), $\alpha \searrow 0$ and $\varepsilon \nearrow 1$ we find

$$\begin{aligned} \rho^{2*}/\rho^{1*} &= \gamma^n < 1 \\ \lim_{\alpha\to\infty}\rho^{2*}/\rho^{3*} &= \lim_{\alpha\to\infty}\rho^{2*}/\rho^{4*} = \lim_{\alpha\to\infty}\frac{c^2\gamma^{2n}}{\alpha} < 1 \text{ if } c^2 = k\alpha \text{ where } k < 1 \end{aligned}$$

Thus, if $\rho_1 > \rho^{1*}$, $\rho_2 < \min\{\rho^{1*}, \rho^{3*}, \rho^{4*}\}$, and $c^2 = k\alpha$ where $k < 1$, Proposition (2) still holds if we allow for an endogenous timing of the IPO decision.

2. $c_2^* < c < c_1^* < c_2$: induced uninformed bidding. Since $E(U_2^{\max\{IPO,P\}} \mid F_1 = 1, F_2 = 1) = E(U_2^{\max\{IPO,P\}} \mid F_1 = 1, F_2 = 0)$ and $E(U_1^{IPO} \mid F_2 = 1) > E(U_1^{IPO} \mid F_2 = 0)$, condition [4.20] implies [4.22]. Thus the conditions for F_2 reduce to

$$\alpha - \rho_2\alpha(1-\alpha) > \overline{p}_1[\alpha + \gamma(1-\alpha)]$$

$$\underline{p}_2 > \frac{\alpha}{\alpha+(1-\alpha)\gamma^n} - \rho_2\frac{\alpha(1-\alpha)\gamma^n}{[\alpha+(1-\alpha)\gamma^n]^2}$$

$$\underline{p}_2[\alpha + (1-\alpha)\gamma^n] - \rho_2\underline{p}_2^2[\alpha + (1-\alpha)\gamma^n](1-\alpha)(1-\gamma^n) > \overline{p}_1[\alpha + \gamma(1-\alpha)]$$

Using the parameter values which trigger hot issue markets in Proposition (3), $\varepsilon \nearrow 1$, $\gamma \nearrow 1$ and $\alpha \nearrow 1/2$ we find that $\rho_2 < 4c$, $\rho_2 > -\infty$, $\rho_2 < \frac{1}{nc}$. Thus, if $\rho_1 > 4c$ and $\rho_2 < \min\{4c, \frac{1}{nc}\}$, Proposition (3) still holds if we allow for an endogenous timing of the IPO decision.

3. $c_2^* < c_2 < c < c_1^*$: uninformed bidding. As under 2 ρ_2 only has to satisfy the following three inequalities:

$$\alpha - \rho_2\alpha(1-\alpha) > \bar{p}_1[\alpha + \gamma(1-\alpha)]$$

$$\frac{\varepsilon\alpha}{\alpha+(1-\alpha)\gamma^n} > \frac{\alpha}{\alpha+(1-\alpha)\gamma^n} - \rho_2 \frac{\alpha(1-\alpha)\gamma^n}{[\alpha+(1-\alpha)\gamma^n]^2}$$

$$\frac{\varepsilon\alpha}{\alpha+(1-\alpha)\gamma^n}[\alpha + (1-\alpha)\gamma^n] - \rho_2 \left(\frac{\varepsilon\alpha}{\alpha+(1-\alpha)\gamma^n}\right)^2 [\alpha + (1-\alpha)\gamma^n](1-\alpha)(1-\gamma^n) > \bar{p}_1[\alpha + \gamma(1-\alpha)]$$

Using the parameter values which trigger hot issue markets in Proposition (4), $\varepsilon \nearrow 1$, $\gamma \nearrow 0$ and $\alpha \nearrow 0$ we find that the above conditions are satisfied. Thus, if $\rho_1 > \rho^{1*}$ Proposition (4) also holds if we allow for an endogenous timing of the IPO decision.

- In all three cases the investors' initial beliefs that the going public decision is not influenced by the entrepreneur's private signal, but only by his coefficient of risk-aversion, ρ_i, are consistent with the equilibrium strategies given the above parameter values. ■

Proof to Proposition 7:

The variance associated with IPO proceeds under informed bidding is given by

$$Var(R_i \mid F_i = 1, p = \bar{p}_i, \Theta_i) = E(R_i^2 \mid F_i = 1, p = \bar{p}_i, \Theta_i) - [E(R_i \mid F_i = 1, p = \bar{p}_i, \Theta_i)]^2$$

where

$$E(R_i^2 \mid F_i = 1, p = \bar{p}_i, \Theta_i) =$$
$$\bar{p}_i^2 \left\{P(I = 1 \mid \Theta_i) + P(I = 0 \mid \Theta_i)\tfrac{1}{n^2}\left[1^2\tbinom{n}{1}\gamma(1-\gamma)^{n-1} + \ldots + n^2\tbinom{n}{n}\gamma^n\right]\right\}.$$

The last term in square brackets corresponds to the second moment M_2 of a random variable X (number of investors mistakenly receiving a good signal) which is binomially distributed $B(n, \gamma)$. M_2 can be determined by way of the generating function $G(z) = [\gamma z + (1-\gamma)]^n$ of the binomial distribution $B(n, \gamma)$ where

$$M_2 = G''(1) + G'(1) = n[(n-1)\gamma^2 + \gamma].$$

Thus we obtain

$$Var(R_i \mid F_i = 1, p = \bar{p}_i, \Theta_i) = \bar{p}_i^2\{[P(I = 1 \mid \Theta_i) + P(I = 0 \mid \Theta_i)\tfrac{1}{n}[(n-1)\gamma^2 + \gamma] - [P(I = 1 \mid \Theta_i) + P(I = 0 \mid \Theta_i)\gamma]^2\}$$

In order for an IPO to take place under informed bidding in the first period we have to redefine the cost bounds between informed and induced uninformed bidding. Solving $E(R_1^{IPO} \mid F_1 = 1,\ p_1 = \bar{p}_1) - Var(R_1^{IPO} \mid F_1 = 1, p_1 = \bar{p}_1) > E(R_1^{IPO} \mid F_1 = 1,\ p_1 = \underline{p}_1)$, we find that there exists a c_1^{**} such that for $c < c_1^{**}$ the inequality is satisfied. The above expression corresponds to a quadratic inequality of the form $a_1c^2 + a_2c + a_3 > 0$ with $a_1 < 0$ and $a_3 > 0$. We obtain c_1^{**} as the positive root of the corresponding quadratic equality. Similarly, $c < c_2^{**}$ ensures that an IPO with information acquisition dominates uninduced informed bidding in the second period. Furthermore, we have to ensure that $Var(V_1 \mid F_1 = 1) > Var(R_1^{IPO} \mid F_1 = 1)$ which is the case if $n > \frac{\bar{p}_1^2(1-\gamma)\gamma}{\alpha[1-\bar{p}_1^2(1-\gamma)]} = n^*$. A positive 'variance effect' giving rise to hot issue markets finally requires that

$$\Delta Var = Var(V_1 \mid F_1 = 1) - Var(R_1^{IPO} \mid F_1 = 1) - [Var(V_2 \mid F_2 = 1, \Theta_{21}) - Var(R_2^{IPO} \mid F_2 = 1, \Theta_{21})] < 0.$$

Substituting for the variance terms in the first and second period and simplifying, we obtain

$$\bar{p}_2^2(1-\alpha)(1-\gamma)\tfrac{\gamma^n}{[\alpha+(1-\alpha)\gamma^n]^2}[\gamma^{n+1}(1-\alpha)+\alpha\gamma+n\alpha(1-\gamma)] - \bar{p}_1^2(1-\alpha)(1-\gamma)[\gamma+n\alpha(1-\gamma)] < \tfrac{n\alpha(1-\alpha)\gamma^n}{[\alpha+(1-\alpha)\gamma^n]^2} - n\alpha(1-\alpha)$$

Rearranging this inequality we obtain

$$\alpha c\gamma^{3n+2}[nc(1-\gamma)(1-\gamma^n) - 2(1-\gamma^n)(c+\gamma) - c\gamma^{n+1}] + \alpha^2 P(\alpha) < 0$$

where $P(\alpha)$ is a polynomial in α. The inequality holds for $\alpha \searrow 0 \wedge \gamma \nearrow 1$. Combining this with the condition for an almost neutral 'expected value effect' we obtain that hot issue markets arise for $n > n^*$, $\varepsilon \nearrow 1$, $\gamma \nearrow 1$ and $\alpha \searrow 0$ if $c < \min\{c_1^{**}, c_2^{**}\}$. ■

Proof to Proposition 8:

- *Robustness to $B(n,p)$ binomial distribution:* Assume a random variable for the firm value $X \equiv \frac{1}{n}Y$ with Y being binomially distributed $B(n,p)$. The expected value of the random firm value, $E(X)$, is equal to p which is identical to the expected value of a random variable Z with a binomial distribution $B(1,p)$.

The variance $Var(X) = \frac{1}{n}p(1-p)$ corresponds to the variance of Z, $Var(Z) = p(1-p)$ except for a constant factor. Thus, even if the firm value is binomially distributed $B(n,p)$, the variance of the firm value increases if p increases from 0 to 1/2.

- *Robustness to normal distribution:* Since the binomial distribution $B(n,p)$ can be approximated by a normal distribution for n big enough, i.e. $Y \sim B(n,p) \underset{n\to\infty}{\approx} N(np, np(1-p))$, the distribution of $X = \frac{1}{n}Y$ can equally be approximated by $N(p, \frac{1}{n}p(1-p))$. So, even if the firm value is normally distributed, there can still be a 'variance effect' if the expected value of the firm increases. ■

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