The Performance of Measures of Shareholder Influence

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Abstract

This article investigates the performance of various measures of shareholder influence. Performance is evaluated on the basis of the measures' ability to explain the representation of the two largest shareholders in the boards of German stock corporations. This yardstick for the shareholders' power seems to be more closely related to actual shareholder power than the yardsticks used in the small stock of previous studies. The measures of shareholder influence comprise the share in voting rights, the Shapley-Shubik index, and the Banzhaf index, from all of these measures several variants enter the analyses.

In case of the principal shareholder, the plain share in voting rights can fend off all competitors. For the second largest shareholder, the ability of power values to accentuate the strength of the second largest shareholder's position subject to the principal shareholder emerges as an important improvement, but it can be conveniently reproduced by simple modifications of the share in voting rights. The results reveal that the fine tuning of the power values is of little importance, even the choice between Shapley-Shubik index and an identically defined Banzhaf index does not matter much. The most important dividing line separates the power indices with adjusted majority requirement from all remaining measures, including the share in voting rights. Another major insight is the context sensitivity of many results. As a consequence, the perspective to find a single measure of shareholder influence for all corporations is unfavorable. Possibly the most striking outcome is that *all* measures of shareholder influence, including the plain share in voting rights, dramatically lose explanatory power for board representation when corporations with a majority shareholder are excluded from the sample. All measures fail to explain our yardstick of shareholder power for samples which only consist of corporations without majority shareholder. The poor performance of all measures of shareholder influence might hint at another potential cause why the empirical research of the relationship between shareholder structure and corporate performance yields such inconclusive results.

1. Introduction

Ownership structure analysis is a major part of corporate governance research. Transforming a shareholder structure into figures that represent the power structure among the shareholders is a precondition to conducting more advanced studies such as a regression of corporate performance on the ownership structure.

Empirical studies utilize different measures to describe shareholders. Contemporary research mainly applies the shareholder's share in votes (or in capital). However, the share in votes suffers from conceptual drawbacks, e.g., it assumes that a shareholder's power is a linear function of his share in votes. Power indices, originally developed in game theory, possess some theoretically attractive features. They have been utilized in empirical ownership research for quite some time (see Rydqvist (1987) for an early application), but although usage seems to have been growing recently, their adoption is still not overwhelming so far. It seems that the scientific community is undetermined in its verdict on power indices. This article contributes to this discussion by comparing the performance of power indices with that of the share in voting rights. However, the plural in the notion indices already hints at the fact that there are several ways to calculate power values. The Shapley-Shubik index and the Banzhaf index are the dominating approaches, of which several variants exist.

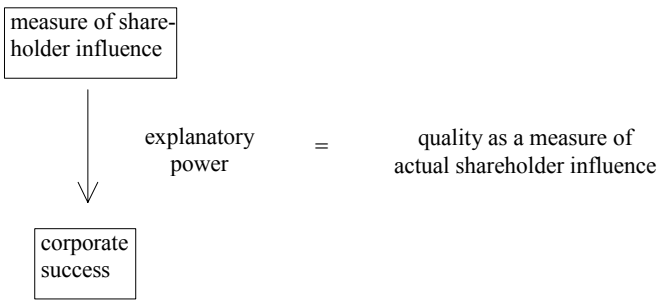
To compare the measures it must be specified which quality of a shareholder they should quantify. A key quality is the size of his power in the corporation.[1] In the context of the stock corporation, Leech & Manjón (2003: 848) define power as "the a priori capacity of a large shareholder to influence a vote in a hypothetical company meeting." Instead of power, the notion of control can be found quite often in the context of shareholder structure analysis. Leech &

[1] Another major quality of a shareholder are the incentives that affect him and determine the ends he is pursuing when using his influence. Important determinants of the incentives are the shareholder type (cf., e.g., Bott (2002: 39-70) and Ruhwedel (2003: 103)) and the relationship between capital share and voting right share (cf., e.g., Bebchuk et al. (2000)). These aspects will be ignored in the following. The article focuses on the ability of different measures to quantify the influence of a shareholder.

Leahy (1991: 1418) define control as "the power to exercise discretion over major decision making, including specifically the choice of directors."

Conducting a comparison of power measures requires a reference measure of a shareholder's power. The closeness of the relationship between this yardstick and the measure under investigation determines the quality of the latter as a measure of the actual influence of a shareholder. But the inclusion of a reference measure causes the problem of joint hypotheses. This can be demonstrated by considering the study of German corporations conducted by Edwards & Weichenrieder (2004). They use the explanatory power of several measures of shareholder influence for corporate success as reference measure. Edwards & Weichenrieder (2004: 23f.) conclude: "These regression results show that there is a stronger relationship between the market-to-book ratio and largest owners' control and cash-flow rights when control rights are measured using either voting rights and the WLP [weakest link principle, a procedure to determine ultimate owners] or the SSI [Shapley-Shubik index] than when they are measured using the BZI [Banzhaf index]. The BZI is thus an unsatisfactory measure of control rights."

At this stage of the article it is not necessary to explain the technical terms used by Edwards and Weichenrieder in greater detail. Important is their test design. They investigate the ability of shareholder power measures to explain corporate success. The greater that ability the better the shareholder influence measure represents the actual power of that shareholder.



This approach rests on the validity of the hypothesis that shareholder influence affects corporate success. According to the literature, the nature of this relationship is far from being well-understood (cf., e.g., Short (1994), Denis

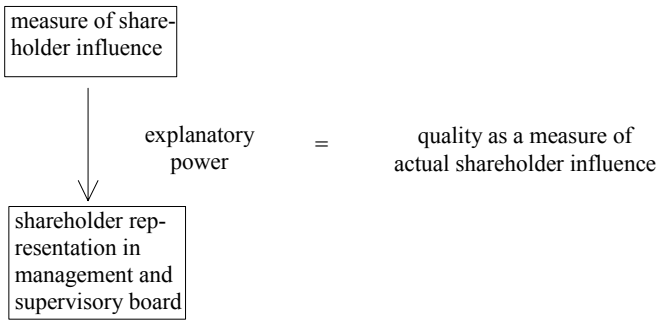
(2001), Gugler (2001), Bott (2002), Becht et al. (2003), Holderness (2003)). With such an uncertain reference measure the whole approach becomes questionable. Crama et al. (2003) and Manjón-Antolín (2004) apply the same approach like Edwards & Weichenrieder (2004), but obtain different results.

The stock of further related empirical literature is small, a variety of yardsticks is utilized, and the results are mixed. Leech (2002b) and Leech & Manjón (2003) derive seven appraisal criteria from the literature and utilize them as yardstick to assess measure of shareholder influence. The reference measure in Gugler & Yurtoglu (2003) is the ability of various measures of the second largest shareholder's influence to explain the dividend pay-out ratio. Renneboog & Trojanowski (2005) use a yardstick related to pay-out policy as well. Guedes & Loureiro (2006) investigate the capacity of measures of shareholder influence to determine a threshold value above which the principal shareholder is entrenched and expropriates the other shareholders. The reference measure of Crespi-Cladera & Renneboog (2003) comes closest to the one applied in this study because it relates to the board. Their yardstick is the qualification of measures of shareholder influence to explain the turnover of executive directors.

This article utilizes a reference measure that is much more closely related to actual shareholder power. The auxiliary hypothesis is more solid. It follows the definition of control by Leech & Leahy (1991: 1418) quoted above. It is based on a shareholder's representation in the decision-making bodies of the company, i.e. in the supervisory board and in the management board of a German stock corporation, AG. The shareholders elect the members of the supervisory board.[2] The supervisory board supervises, advises and, most importantly in this context, appoints the members of the management board. The management board is responsible for managing the enterprise. The strength of a shareholder's influence should be reflected in the share of management and supervisory board members who have a tie with the shareholder under investigation. Kehren (2006) analyzes with the same approach a similar sample like this article. However, this

[2] In AGs with co-determination, the employees elect one third or one half of the supervisory board members.

part of his study is not at the center of his interest and thus not as elaborated as the following analysis.



The sample consists of German stock corporations listed in the official market segment and covers the years 1997-2000. This time span allows to profit from an increase in legal obligations to disclose information about board members. Thus, the connection between shareholders and board members can be detected much more dependable than before. The representation of the two largest shareholders in the boards is the reference measure for their power in the corporation. The empirical part studies the explanatory power of several measures of shareholder influence for board representation. These measures of shareholder influence comprise the share in voting rights, the Shapley-Shubik index, and the Banzhaf index, from all of these measures several variants are considered in the analyses.

In case of the principal shareholder, the plain share in voting rights can fend off all competitors. For the second largest shareholder, the ability of power values to accentuate the strength of the second largest shareholder's position subject to the principal shareholder's power emerges as an important improvement, but it can be conveniently reproduced by simple modifications of the share in voting rights. The results reveal that, contrary to theoretical considerations, the fine tuning of the power values is of little importance, even the choice between Shapley-Shubik index and an identically defined Banzhaf index does not matter much. The most important dividing line separates the power indices with adjusted majority requirement from all remaining measures, including the share in voting rights. Another major insight is the context

sensitivity of many results. As a consequence, the perspective to find a single measure of shareholder influence for all corporations is unfavorable. Finally, the possibly most striking outcome is that *all* measures of shareholder influence, including the plain share in voting rights, dramatically lose explanatory power for board representation when corporations with a majority shareholder are excluded from the sample. All measures fail to explain our yardstick of shareholder power for samples which only consist of corporations without majority shareholder. The poor performance of all measures of shareholder influence might hint at another potential cause why the empirical research of the relationship between shareholder structure and corporate performance yields such inconclusive results.

The article is organized as follows: Section 2 describes the most important measures of shareholder influence, and section 3 provides a survey of related empirical research. After that, issues concerning the sample and the variables are discussed in section 4. Section 5 comprises the empirical analyses, and section 6 concludes the article.

2. Measures of Shareholder Power[3]

We begin with some definitions. The *principal shareholder* of a corporation is the shareholder who controls the largest voting rights bloc. A shareholder who owns more than 50% of the votes is called the *majority shareholder*, otherwise he is a *minority shareholder*. A *dominating principal shareholder* is able to control the corporation alone. Since 50% of the votes is the most important majority requirement in the general meeting, the majority shareholder is always a dominating shareholder as well. However, a minority principal shareholder could also hold a dominating position. This issue is discussed below.

2.1. Early Dichotomous Measures

Looking at the historical development of academic ownership structure analysis, Short (1994: 207) states: “Most of the earlier empirical studies

[3] This section draws heavily on Prigge & Kehren (2006).

differentiate between owner-controlled firms and management-controlled firms, based on a percentage ownership criteria." This kind of classification goes back to the influential study of Berle and Means from 1932. They concluded that 20% of the voting rights are sufficient to supply a shareholder with the dominating position.[4] The cutoff points in the literature vary from 10% to 50%. According to this method, at least implicitly, all but the principal shareholder who is exceeding the cutoff point are assumed to have little or no influence in the company.

This dichotomy is simple, even trivial, if the principal shareholder owns more than 50% of the votes. This procedure becomes problematic if the principal owner disposes of 50% or less of the voting rights. Assume, for instance, the principal owner holds 30% of the votes and the second largest shareholder 25%. In this case, the principal owner cannot take the continuity of his control for granted, because the second largest shareholder may form a coalition with other bloc holders or he may purchase additional voting rights at the stock exchange to take over the dominating position in the corporation. The situation is rather different, if there is only one bloc holder in the corporation disposing of 30% of the votes and the remaining shares are being widely held. In this case, the principal owner will take up a position of power that is similar to, though still somewhat weaker than, that of a majority owner. The small shareholders would behave rationally passive, but the principal shareholder's position could be contested by a competitor who is concentrating the dispersed shares. This suggests that the power of the principal shareholder is not only a question of the pure size of his voting bloc but also of the contestability of his leading position (see the model by Bloch & Hege (2001) on this issue). The contestability is determined by the voting shares of the bloc holders, the free float, and the majority rule. Methods of ownership structure metrics should consider all of these factors as much as possible.

[4] Berle & Means (1939). Actually, Berle & Means (1939: 70) differentiated between five control categories, but it became a custom in empirical research to distinguish only two categories of stock corporations: owner-controlled versus managerially controlled. Surveys in table form of these studies can be found in Cubbin & Leech (1983: 352) and Short (1994: 208-15).

Thus it seems particularly critical that the measure discussed above completely ignores the remaining shareholder structure. One option to improve this kind of measure is to take into account the remaining shareholder structure in the classification rules. For instance, Köke (2002: 53f.) considers a corporation to be dominated by the principal shareholder if he owns more than 50% of the votes, or if he controls at least 25% of the voting rights and the aggregated share in voting rights of all other bloc holders is smaller 25%. The second rule is one way to determine whether a minority principal shareholder is dominating. Of course, assigning a certain constant cutoff point is to a certain degree arbitrary. Choosing a high threshold close to 50% raises the possibility that the principal shareholder actually does have a dominating position, but a high threshold makes it also less probable to identify dominating minority principal shareholders correctly.

2.2. Contemporary Continuous Measures

Contemporary studies rarely use the dichotomy of owner- and managerially controlled corporations. Instead they employ the share of votes of the principal shareholder (and of all other shareholders) as a measure of power.[5] The main weakness of the simple discrete classification scheme, that it ignores the consequences of the remaining shareholder structure for the position of the principal shareholder, is not solved by the continuous variable, either. Moreover, this measure assumes a linear relationship between the share of a shareholder's votes and his influence. This is not convincing. There are good reasons to doubt that the increase of the principal owner's share of votes from, say, 48% to 52% exerts the same effect on his influence in the corporation as an increase from 80% to 84% (or from 80% to 86.66%, if a comparison of two increases by 8.33% is preferred to two increases by 4 percentage points). In this respect even a step backward compared with the categories has to be stated. Categories allow for the

[5] The share in equity capital, i.e., cash-flow rights, is also widely used. The distinction between cash-flow rights and voting rights seems appropriate when both may differ. This could be particularly the case if non-voting shares or pyramidal shareholdings are common. The latter also suggests to analyze the ultimate shareholders instead of the direct shareholders. For example, in the European Union empirical research profited much from an increase in shareholding transparency in the nineties due to a change in regulation. Research shifted from the analysis of direct cash-flow rights to the investigation of voting rights at the ultimate level.

possibility to assign a particular importance to certain bloc sizes by using them as thresholds for the categories. Contrary to that, the plain size of a voting bloc neglects the majority rule and the remaining shareholder structure.

2.3. Power Indices

Generally, a power index measures the relative power of each participant in a decision-making process. It is based on the extent a certain participant contributes to the success of a coalition, that is, his ability to change a winning coalition into a losing coalition by leaving it and turn a losing coalition into a winning coalition by joining it. Each participant's a priori voting strength is measured in view of a given distribution of the votes and a given majority rule. Several power indices have been developed for this purpose. The most familiar ones are the Shapley-Shubik index (Shapley (1953); Shapley & Shubik (1954)) and the Banzhaf index (Banzhaf (1965)). Both account for the complete shareholder structure and the majority rule, and they supply a continuous variable which is connected to the share in votes in a non-linear manner.

2.3.1. The Shapley-Shubik Index

Point of departure for an explanation of the Shapley-Shubik index is the following situation: Coalitions (C) and the values of coalitions (v(C)) are being examined. Coalitions consist of several players.[6] Each player receives the increase in the coalition value caused by his entry. For example, if player i leaves coalition C and causes a drop in coalition value from v(C) to v(C – {i}), this yields a value of player i of [v(C) – v(C – {i})]. This value is incorporated into the Shapley value of player i.

To simplify the calculation of the Shapley value, a simple game may be assumed. In a simple game, a value of one is ascribed to the winning coalition and a value of zero to the losing coalition. If player i is the so-called pivotal player whose entry turns a loosing coalition into a winning coalition et vice versa, then the coalition value of [v(C) – v(C – {i})] = 1 is ascribed to him. If

[6] The term *player* and *game* reflect the origins of power indices in game theory. In the context of ownership structure metrics, the shareholders are the players and the ballot in the general meeting is the game.

player i is not the pivotal player for the coalition under investigation, then his coalition value is zero.

The assumption about the distribution of the coalition value stems from the idea that the players join a coalition one after another and that each sequence of joining has the same probability. The crucial question then is how often is player i at the pivotal position in the sequence. The Shapley value of player i is the number of sequences he is the pivotal player divided by all possible sequences. It falls into a range between zero and one. The higher the value the larger the a priori decision-making power of the shareholder. The following example in Table 1 demonstrates the calculation of the Shapley value (see for a more formal treatment Holler & Illing (2003: 304-16)).

Table 1 about here

2.3.2. The Banzhaf Index

Contrary to the Shapley-Shubik index, the Banzhaf index ignores the order players join a coalition. Instead, it rests upon the size of a player's contribution to the success of a coalition. Thus, there can be several critical members in a winning coalition whose exit would turn the coalition into a losing coalition, that is, whose withdrawal would cause a swing. The frequency of the pivotal position, which was crucial for the Shapley value, is replaced by the frequency of the swing. As a measure of power in a weighted voting game, the normalized Banzhaf index relates the number of potential swings ascribed to player i to the total amount of swings of all players.

The normalized Banzhaf value falls into the range between zero and one as well. Again, a higher value indicates a larger a priori decision-making power of a shareholder. The Banzhaf values for the numerical example in the previous subsection are calculated in Table 2 (for a more formal approach, cf. Holler & Illing (2003: 317-23)).

Table 2 about here

Obviously, Banzhaf and Shapley values may differ strongly from shares in votes (Table 3). But the values of both power indices can differ as well, which is often the case.

Table 3 about here

2.3.3. The Treatment of Unknown Voting Rights

A serious problem when analyzing the power structure of a stock corporation is incomplete data. For example, in Germany, voting rights in a listed corporation must be notified when they amount to 5% or more. About the remaining shareholders usually nothing is known except that their share does not exceed the notification threshold. But since power in a stock corporation is determined by the complete shareholder structure, concepts for the voting rights blocs below the notification threshold have to be developed. Two general procedures can be found in the literature: One procedure assumes that the unknown votes are powerless, whereas the other procedure supposes that they might be influential.

Under the assumption of powerless unknown shareholdings, the Banzhaf value is calculated with a modified majority rule (Dubey & Shapley (1979)). The same procedure can be applied to the calculation of the Shapley value (cf., for example, Crespi-Cladera & Renneboog (2003: 14)). The majority rule has to be modified as follows:

required majority – (1 – cumulated share in voting rights of all bloc holders) / 2

An example may be useful to explain the modification of the majority rule. We look at a stock corporation with four known bloc holders. The shares in voting rights have the sizes of 10%, 20%, 25%, and 30%, respectively. A simple majority is required, that is 50%. The cumulated share in voting rights of the four bloc holders adds up to 85%. Then the modified required majority is 42.5% (0.5 – (1 – 0.85)/2). This procedure stands in line with the usual assumption in corporate governance research that small shareholders remain rationally passive and only bloc holders would actively use their voting rights.

However, there are also good reasons not to rule out any influence of the small shareholdings from the outset. Via the market for corporate control the unknown shareholdings might possess power and that should be considered when evaluating the decision-making power of the bloc holders. According to Manne (1965) the small shareholders initially leave corporate control completely to the bloc holders. But if the bloc holders decide in favor of value-decreasing investments or pocket private benefits to a greater extent, this should be reflected in a low market value on an efficient stock market. The low share price is then an incentive for a potential bidder to buy the shares from the dispersed shareholders until his stake is large enough to rule the corporation, to restructure it, and to benefit from the accompanying rise in the share price. The takeover threat has an effect on the decision-making power of the incumbent bloc holders and has therefore to be considered when the ownership structure is transformed into numbers (for this interpretation, see, for example, Rydqvist (1987: 61)). There are two options how to incorporate the potential influence of dispersed shareholders.

Under the assumption of concentrated unknown ownership, it is presumed that the unknown shareholders own voting rights blocs of a size that ranges from almost zero to just below the notification threshold. For example, Leech (2002b: 13) assumes that unidentified shareholders hold .25% of votes each, and adds unidentified shareholders to the shareholder list until the joint votes held by all shareholders add up to 100%. This procedure is applicable to the calculation of both Banzhaf and Shapley value.

Only the Shapley value allows for the additional option to ascribe a power value above zero to the entirety of the unknown shareholders. The unknown voting rights are interpreted as an oceanic game. Rydqvist (1987: 32) defines an oceanic game as follows: “This is a model of the corporate meeting with a few major shareholders holding large blocks of shares and an ocean of infinite number of minor shareholders with infinitesimally small shareholdings.” A potential effect of the entirety of the unknown shareholders on the bloc holders’ power is considered (for the calculation of the Shapley-Shubik index for this kind

of oceanic game, see Leech (2002a: 43-44)). So far, it is not possible to attach a Banzhaf value exceeding zero to the collectivity of unknown shareholders. Figure 1 summarizes the alternative procedures to deal with unknown voting rights.

Figure 1 about here

The following two cases, exemplarily applied to the Banzhaf index, will highlight how important the assumptions for the unknown voting rights might be: We start with a corporation for which only a single voting rights bloc of 5% has been notified. Presuming for the Banzhaf value that the unknown voting rights are powerless, the modified majority rule will be applied. The modified required majority is equal to 2.5%. This leads to a Banzhaf value of one, which implies a dominating position of a principal shareholder only controlling 5% of the votes. This assessment is unsatisfactory because the dominating position of the principal shareholder can be easily terminated by means of share purchases at the stock market. If we assume instead that the unknown shareholders own a 1% bloc of voting rights each, we calculate a Banzhaf value of only 0.054. Obviously, this figure is a much more convincing indicator for the power structure among the shareholders.

Another pitfall emerges in cases with two voting rights blocs that are of almost equal size. Let the principal shareholder A control 17% of the votes and bloc holder B 15%. The modified majority requirement is at 16%. This yields a Banzhaf value of one for shareholder A. But if we assume again that the unknown shareholders own 1% voting rights blocs each, the Banzhaf value of the principal shareholder is equal to 0.142 and that of bloc holder B amounts to 0.097. Again, this seems to be a much more appropriate indicator of the control situation.

2.4. A First Assessment of Measures of Shareholder Power

Using the Banzhaf index and the Shapley-Shubik index to measure the power structure in stock corporations may be criticized for some reasons. Nevertheless, it seems that, in theory, these power indices have the potential to

yield more adequate representations of the power structure than shares in voting rights or the classification of shareholder structures. They incorporate the complete shareholder structure and the majority requirement in their power values. Moreover, they do not assume a linear relationship between the share in voting rights and power.

Shapley-Shubik index and Banzhaf index may yield different results. Moreover, variants of both indices may enlarge the variety of results even further. This raises the question which index and variant should be preferred. In science in general this issue is still highly controversial. For instance, Felsenthal et al. (1998: 84) state: "While papers have been written on the relative merits of these indices … it seems fair to say that no index has achieved general recognition as the one correct way to measure voting power." A similar situation can be stated for corporate governance research: So far, neither of the power indices is dominating, but the Shapley-Shubik index may have a small lead over the Banzhaf index. The Shapley-Shubik index is utilized, for example, by Rydqvist (1987), Wong (1989), Zingales (1994), Chung & Kim (1999), Crespi-Cladera & Renneboog (2003), Gugler & Yurtoglu (2003), Nicodano & Sembenelli (2004), and Guedes & Loureiro (2006). The Banzhaf-Index is used by Khatri et al. (2001), Crama et al. (2003), and Renneboog & Trojanowski (2005). Both indices are applied by Leech (2002b), Leech & Manjón (2003), Edwards & Weichenrieder (2004), Manjón-Antolín (2004), and Kehren (2006).[7] These studies deal in greater detail with a comparison of both indices. They are at the center of the following literature review.

3. A Review of Related Empirical Research

Empirical research about the performance of measures of shareholder influence is underdeveloped (Leech & Manjón (2003: 849)). This can be traced back to the difficulties in implementing the ideal research design, which is described by Leech (2002b: 2, 5) as follows: "Ideally what would be required would be some independent evidence on the distribution of power in the

[7] In addition, the degree of control, which has been developed by Cubbin & Leech (1983), can be found in some studies, for example, Pohjola (1988), Leech & Leahy (1991), Köke (2001, 2002), Leech & Manjón (2003), and Manjón-Antolín (2004).

particular voting body with which to compare the results for the indices. … The difficulty with this approach is that independent evidence of the type required is hard to gather because it is difficult to observe power empirically." This measure is called yardstick or reference measure in this article.

The survey begins with work that evaluates measures of shareholder influence more on a verbal, but not an econometric basis. Leech (2002b) uses the study of Berle & Means (1939) and the Listing Rules of the London Stock Exchange to set up a catalogue of seven criteria to evaluate how appropriately a power index represents the power structure in a stock corporation. Leech then analyzes verbally the relationship between the measures of shareholder influence and his yardstick for a sample of 444 large British corporations without a majority shareholder in 1985 or 1986, but he does not run econometric tests. The seven criteria read as follows (Leech (2002b: 9)):

1. The power value for the principal shareholder should vary as voting weights vary. 2. The power value for the principal shareholder should vary as the voting rights bloc sizes of the principal shareholder and the second largest bloc holder vary between companies. 3. The power value of the principal shareholder should increase with his voting rights bloc and decrease with an increase in the voting rights bloc of the second largest shareholder. 4. The power value of the principal shareholder should almost always be close to one whenever his voting rights bloc exceeds 30%. 5. The power value of the principal shareholder should often be close to one whenever his voting rights bloc is between 20% and 30%. 6. The power value of the principal shareholder should sometimes be close to one whenever his voting rights bloc is between 15% and 20%. 7. The power value of the principal shareholder should virtually never be close to one whenever his voting rights bloc is less than 15%.

Notwithstanding the general quality of the appraisal criteria, they and the evaluation of the various measures in light of these criteria will always be particularly susceptible to the objection of being subjective. Some details of the criteria could also be questioned. For example, Leech's threshold values comply with concepts of power prevalent in corporate governance research, but still it

can be doubted that a principal shareholder controlling 20% of the votes should often have the same power value as a principal shareholder owning a simple majority. The regency of the latter cannot be contested, but this contrast in the strength of their positions cannot be seen from their power values.

Leech investigates four power value variants, two variants each of the Shapley-Shubik index and of the Banzhaf index. Leech (2002b: 19) concludes that the Shapley-Shubik index fails most of the appraisal criteria, its main weakness being the ascription of too low a power value to the principal shareholder in many instances. On the other hand, the Banzhaf index satisfies the appraisal criteria. Thus Leech recommends to reject the Shapley-Shubik index but not the Banzhaf index as empirical measure. In Leech & Manjón (2003), a sample of Spanish corporations with data from 1989 to 1995 is being analyzed in a similar manner as in Leech (2002b). The focus is on the subsample of corporations without majority shareholder. The conclusion of Leech and Manjón resembles that for the British sample, i.e., the Banzhaf indices "correspond much more to widely accepted ideas" than the Shapley-Shubik indices and are recommended.

The survey is now turning to studies which econometrically test the relationship between measures of shareholder influence and a reference measure for shareholder power. The article of Edwards & Weichenrieder (2004) has already been outlined in the introduction so that the following notes can be rather brief. Edwards and Weichenrieder use a sample of German corporations. They analyze the share in votes, the oceanic game variant of the Shapley-Shubik index, and the Banzhaf index with adjusted majority requirement. Their yardstick is the ability of several measures of shareholder influence to explain corporate success, measured with the market-to-book ratio of equity. This approach is rather vulnerable because it rests on the hypothesis that shareholder influence affects corporate success. But the relationship between both is yet far from being well-understood in the literature and is thus a problematic yardstick. To complicate matters further: Which measure of corporate success is appropriate here, in particular against the background that a shareholder might use more influence to

pocket more private benefits what might have an uneven effect on different measures of corporate success? The authors conclude that the share in voting rights and the Shapley-Shubik index (oceanic game) are equally appropriate as measures of shareholder influence, whereas the Banzhaf index (adjusted majority rule) is less qualified.

Crama et al. (2003) and Manjón-Antolín (2004) apply the same approach like Edwards & Weichenrieder (2004) to a sample of British corporations and Spanish corporations, resp. from 1988 to 1993. Crama et al. (2003) find that the principal shareholder's Banzhaf value (presumably with adjusted majority rule) is superior in explaining total shareholder return compared to the squared share in voting rights, i.e., the Herfindahl index of the principal shareholder. Manjón-Antolín (2004) cannot find a noteworthy difference between the share in votes, the Shapley value, and the Banzhaf value in their ability to explain corporate success. For both power indices Manjón-Antolín assumes that the unknown votes are held in .5% blocs.

Guedes & Loureiro (2006) investigate the ability of measures of shareholder influence to determine a threshold value above which the principal shareholder is entrenched and expropriates the other shareholders. For a sample of European corporations, they find that above a Shapley value (oceanic game) of .34 or above a share in votes of 71%, the principal shareholder becomes entrenched and begins to expropriate the remaining shareholders as indicated by the market-to-book ratio of equity. Guedes and Loureiro conclude that the Shapley value is superior to the share in votes in capturing the effective power of the principal shareholder over the managerial policy of the firm (Guedes & Loureiro (2006: 441)). In general, the quality of this approach also rests on assumptions on the relationship between ownership and corporate success. More specifically, for example, the assumption of a threshold above which the principal shareholder becomes entrenched is plausible, however, there could be more than one threshold. For instance, it is also plausible that at very high shares in cash flow rights of the principal shareholder his interests again align with those of the remaining shareholders.

Gugler & Yurtoglu (2003) analyze for a sample of German companies whether the dividend pay-out ratio is related to the size of the second largest shareholder's stake. The intuition of this approach is that a more powerful second largest shareholder reduces the amount of private benefits of the principal shareholder and instead raises the amount of corporate wealth distributed to the entirety of shareholders. Gugler and Yurtoglu indeed find a significant positive relationship between the holdings of the second largest shareholder, measured as both shares in capital and in voting rights, and the pay-out ratio. The comparison of different measures of shareholder influence is not at the center of their interest. But Gugler & Yurtoglu (2003: 752) repeat as a robustness check their analysis with the Shapley value (adjusted majority rule) as measure of shareholder influence. The results do not change. One possible interpretation is that all three measures of shareholder influence perform equally. But of course, this approach also suffers from the problem of joint hypotheses. It rests on the hypothesis that the second largest shareholder supervises the activities of the principal shareholder. But, for example, it can also be hypothesized that the two largest shareholders collude to the detriment of the remaining shareholders (for models of the second largest shareholder, cf. Pagano & Röell (1998), Bennedsen & Wolfenzon (2000), Bloch & Hege (2001), Gomes & Novaes (2001), for a survey, cf. Kehren (2006)).

Renneboog & Trojanowski (2005) use the qualification of measures of shareholder influence to explain the pay-out policy as reference measure. For a sample of British corporations they contrast the share in votes and the Banzhaf value with adjusted majority requirement as regressors of pay-out variables Object of the analyses are shareholder types and the two largest shareholders. In most cases, the p-value of the Banzhaf index exceeds the p-value of the share in voting rights. Renneboog & Trojanowski (2005: 31) conclude that they "… advocate the use of Banzhaf indices as a relevant measure of voting power …". However, they refrain from an explicit comparison with the share in voting rights. As with the yardsticks described above, it is indeed plausible that the pay-out policy and shareholder structure are related with each other, but we

have no assured knowledge about its actual nature. For instance, it could be argued that executive directors might use their voting power to keep funds in the corporation under their control but it could be just as well suggested that they prefer a higher pay-out to use these funds to improve diversification of their wealth (Renneboog & Trojanowski (2005: 25)). Such contradictory arguments weaken this yardstick.

Crespi-Cladera & Renneboog (2003) study a sample of British corporations. Their yardstick is the qualification of the share in voting rights and the Shapley value with adjusted majority requirement to explain the turnover of executive directors. Contrasting the explanatory power of both measures applied to each of the five largest shareholders, to the largest shareholder of several shareholder types, and to the entirety of all shareholders of a certain type, suggests a slight superiority, indicated by the t-values, of the Shapley-Shubik index. This approach is closer to the one applied in this article than those described before as it relates to the board. Nevertheless, there are still some problems as to the theoretical foundation of the yardstick since it is by no means obvious for every rank in the shareholder order by size or for every shareholder type, how they are supposed to be connected to executive director turnover. For instance, it is plausible to assume that shareholding executive directors usually would reject turnover of executive directors, but what about shareholdings of other companies? Would they, possibly as part of an implicit solidarity, reject turnover, or would they support it, particularly in case of an inferior performance of the company under investigation, to safeguard their own position? Crespi-Cladera & Renneboog (2003: 35) even find related specifications in which the significant coefficient for the largest shareholder being an investment or pension fund is positive for voting rights, but negative for the Shapley value.

Kehren's (2006) approach follows Leech & Leahy (1991: 1418) who define control as "the power to exercise discretion over major decision making, including specifically the choice of directors." The auxiliary hypothesis is based on a shareholder's representation in the decision-making bodies of the company, i.e., the supervisory board and the management board in a German stock

corporation. The shareholders elect the members of the supervisory board[8], and the supervisory board, among other things, appoints the members of the management board. The strength of a shareholder's influence should be reflected in the share of management and supervisory board members who have a tie with the shareholder under investigation. As a consequence, the reference measure is much more closely related to actual shareholder power. Kehren conducts his analysis with a similar sample of German corporations and with the same approach like this article. However, this part of his study is not at the center of his interest and thus not as elaborated as the following analysis.

Kehren investigates the share in voting rights, the Shapley-Shubik index (oceanic game), and two Banzhaf indices (adjusted majority rule, unknown voting rights held in 1% blocs) for both the principal shareholder and the second largest shareholder. His ranking of the four measures of shareholder influence for the principal shareholder differs from that for the second largest shareholder: For the principal shareholder, the share in voting rights is in the leading position, followed by the Shapley-Shubik index (oceanic game) on a level with the Banzhaf index (unknown voting rights held in 1% blocs), and the Banzhaf index (adjusted majority rule) is located at the bottom of the ranking. The order is totally different for the second largest shareholder: The Shapley-Shubik index (oceanic game) stands at the top, and the share in voting rights is at the fourth position. All in all Kehren considers the Shapley-Shubik index to be more appropriate than the Banzhaf index.

To summarize, the stock of empirical studies is rather small, and the few results are inconclusive.[9] The field suffers from the difficulty to find convincing reference measures for shareholder power that can also be applied in econometric tests. Moreover, the studies are in two respects quite general: Firstly, they only

[8] In AGs with co-determination, the employees elect one third or one half of the supervisory board members.

[9] Early evidence provided by Zingales (1994) has not been described. The comparison of measures of shareholder influence is only a subordinated issue of his work. Moreover, in his analysis of the determinants of the voting right premium in Italian dual-class stock corporations, Zingales indeed investigates three different variables to capture shareholder power, among them a measure based on the Shapley-Shubik index (Zingales (1994: 137-40). But due to their definition they are difficult to interpret for the purposes of this article. The same approach was applied by Chung & Kim (1999).

analyze a smaller subset of power index variants. Secondly, they pass up chances to partition their samples in subsamples and to investigate whether the relative performance of various measures of shareholder influence is context sensitive. The following empirical analysis tries to advance research by using a convincing reference measure for shareholder power and by analyzing a greater variety of power measures and subsamples.

Table 4 about here

4. Sample

4.1. Sample Selection

Point of departure for the sample selection are those German stock corporations whose shares were traded at the official market segment on at least one final trading day of the years 1997 to 2000. For stock corporations in the official segment, the transparency rules of the Securities Trading Act (Wertpapierhandelsgesetz) apply. Blocs of voting rights of 5% or more have to be disclosed.[10]

From this pool of 1,811 observations, a number of exclusions were made due to the requirements of another study for which the data were originally collected. Excluded were corporations from certain industries (bank, insurance, real estate, utilities, transportation, holding companies, and corporations whose major business consists of services for other companies),[11] and corporations who are not a "pure" stock corporation (Kommanditgesellschaft auf Aktien, KGaA), furthermore observations of corporations for which no consolidated annual financial statement according to German accounting standards was available, of corporations for which no industry classification was available, of corporations in liquidation, of corporations who were not listed during the complete business year, and of corporations with a shortened fiscal year.

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[10] Cf. Bott & Schleef (1998), Bott (2002: 201-29), and Becht & Böhmer (2003: 15-26) on the reliability of the act in creating a complete picture of a corporation's voting rights structure.

[11] Classification and classification scheme of the Deutsche Bundesbank (for the current version, see Special Statistical Publication 2 "Bankenstatistik - Kundensystematik: Firmenverzeichnisse", German only, available at www.bundesbank.de/statistik/statistik_veroeffentlichungen_sonder.en.php?print=no&, visited 15.8.2006) were used. Excluded were industries with the numbers 40, 41, 60, 65, 66, 67, 70A, 70B, 74A, 74B.

Another cause for exclusion was an inconsistent situation with the voting rights data. Primary source for the voting rights data is the data base "Major Holdings of Voting Rights in Officially Listed Companies" which was then kept by the Federal Securities Supervisory Office (BAWe).[12] The data base contains the public statements about voting rights according to sections 21ff. Securities Trading Act. Supplementary information, particularly about voting rights blocs smaller than 5%, were taken from various editions of the Hoppenstedt Aktienführer (Stock Corporation Guide) and of the Commerzbank's publication "Wer gehört zu wem?"(Who owns Whom?). The voting rights data are considered inconsistent if there are no voting rights blocs according to the BAWe data base, whereas the two other sources report the existence of voting rights blocs, but contradict each other. Finally, the very few cases where there was no bloc holder at all, i.e., ownership is totally dispersed, are excluded. After these exclusions, 469 observations remain in the sample.

The full sample has the structure of an unbalanced panel. The usual procedure would be to apply a statistical approach that accounts for both the cross-section dimension and for time effects. However, in the case of this dataset the time dimension is almost irrelevant. The shareholder structure of those corporations for which observations for more than one year are available prove to be extremely stable. Only to a slightly lesser degree, this statement also holds for the presence of shareholders in the boards. Thus a time effect is not to be expected. Rather, several observations for a single company would wrongly give the impression of a richer dataset. Consequently, only one observation of each corporation enters the final sample. Since disclosure requirements concerning board members became markedly severer at the end of the time period to be analyzed (see below under 4.3. for details), the latest observation of each company is included in the final sample. This procedure yields the final sample of 161 observations.

Table 5 about here

[12] The BAWe became part of the encompassing Federal Financial Supervisory Authority (BaFin) in May 2002. The current version of the database can be found at www.bafin.de/datenbanken/stimmrechte_erl_e.htm, visited 15.8.2006.

4.2. Determination of Ultimate Owners

The *ultimate owner* is assumed to actually decide how the influence is used that is attached to the voting rights at the first level of shareholdings. The determination of the ultimate owner requires a procedure to decide whether a principal shareholder is dominating. To determine whether a principal shareholder is dominating, a concept close to that of Köke (2002: 53f.) is followed: A principal shareholder is deemed dominating (1) if he either disposes of a majority of the voting rights, or (2) if he controls at least 25% of the voting rights and the aggregated share in voting rights of all other bloc holders is smaller than the share of the principal shareholder. The second rule has its roots in empirical work which finds that voting rights blocs in German stock corporations cluster strikingly around 25% (see, e.g., Köke (2001: 270) and Bott (2002: 257)). This may be caused by regulation in the Stock Corporation Act. A shareholder exceeding the 25% threshold disposes of a number of veto rights. In discouraging potential raiders this bloc size stabilizes the leading position of the principal shareholder.

The analysis of a vertical shareholder chain is conducted as follows: Starting at a directly held voting rights bloc, the investigation works down along the vertical chain that begins there. If there is a dominating shareholder at a certain level of the chain, the analysis continues with the investigation of him and so forth. The analysis is terminated and the ultimate shareholder has been identified, when the analysis of a vertical chain reaches a dominating individual person or a dominating public authority, because it is not possible to hold a share in a natural person or a public authority. The vertical analysis is also finished when at a certain stage in the chain either the voting rights are totally dispersed, or no ownership information are available, or none of the identified owners is dominating (see Prigge & Kehren (2006: 215-21) for more details). Of course, other procedures to determine ultimate shareholders are possible, e.g., the use of power indices. Since it is the ultimate goal of this article to contrast different power indices and their variants, one could also think of, firstly, employing a variety of measures of shareholder influence, including power index-based

procedures, to determine the level of ultimate shareholders, and then, secondly, analyze the level of ultimate shareholders with a variety of measures of shareholder influence. This article confines itself to the latter task because otherwise the approach would become too complex. Therefore, there is only a single procedure in use to determine ultimate shareholders.[13]

An ultimate owner is assigned to each directly held voting rights bloc. As a result, there can be more than one ultimate shareholder in a corporation.[14] The complete direct voting rights bloc that the ultimate shareholder controls is ascribed to him.[15] An example of the procedure and additional information can be found in the appendix.

4.3. Connection between Shareholders and Corporate Boards

The detection of connections between the members of the boards of a corporation and its shareholders has been markedly facilitated by a change in section 285 (10) Commercial Code. It obliged the corporations from 1999 on to disclose membership of their management and supervisory board members in supervisory boards and similar organs in other corporations. This legislatory change also improves data quality before 1999 because board memberships are quite stable during the course of time. Besides the information disclosed by the companies various editions of the reference books "Aktienführer" (Stock Corporation Guide) and "Leitende Männer und Frauen der Wirtschaft" (Leading Men and Women of the Economy), both of the Hoppenstedt publishing house, and "Wem gehört die Republik?" (Who Owns Germany?) by Rüdiger Liedtke are used.

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[13] A comparison of different methods is left for further research. Gugler & Yurtoglu (2003) and especially Edwards & Weichenrieder (2004) explore this issue to some extent. See also the discussion of Prigge & Kehren (2006: 221) on the eligibility of power indices in the analysis of vertical chains of shareholders.

[14] Some authors use a procedure that identifies no more than a single ultimate shareholder in a corporation, who is then, consequently, also the dominating ultimate shareholder; see, for instance, Gugler & Yurtoglu (2003: 754-56).

[15] Some authors, for example Claessens et al. (2000), Gorton & Schmid (2000), Claessens et al. (2002), and Faccio & Lang (2002), use the „weakest link principle" to determine the share in voting rights of the ultimate shareholders which amounts to "… the weakest link in the chain of voting rights."; Claessens et al. (2000: 91). It is not fully convincing that it is not the complete bloc of voting rights at the direct level that is ascribed to a shareholder who is identified to be dominating a vertical chain of shareholders. For discussions of the weakest link principle, see, e.g., Edwards & Weichenrieder (2004) and Prigge & Kehren (2006: 217f.).

The most obvious case of a connection between shareholders and board members exists when a board member holds a voting rights bloc personally. Another constellation that is easy to handle persists when a board member is clearly connected to a shareholder which is a legal person, e.g., the management board member of the corporation under investigation is or has been supervisory board member of the shareholding company. The most difficult case arises with foreign shareholders that are not natural persons. Due to data availability problems a connection between a foreign board member of the corporation under investigation and a foreign shareholder of that company is already assumed when both come from the same country. Note that the complete vertical chain between direct and ultimate shareholder is considered in the search of connections between shareholders and board members.

4.4. Variable Definitions

The analysis investigates the two largest shareholders of a corporation. The most basic measure of shareholder influence is the simple share in voting rights of the principal shareholder (v1) and of the second largest shareholder (v2) in per cent. This measure assumes a linear relationship with shareholder influence. To add a non-linear feature, two modifications are part of the analysis: v1mod1 is based on v1, but is set to 100%, when the principal shareholder controls at least 50% of the voting rights.[16] v1mod2 equals v1, but turns to 100%, when v1 is above 25% and v2 below 25%, indicating a powerful principal shareholder. Whereas the modifications of v1 ascribe, under some circumstances, an influence to the principal shareholder that exceeds his share in voting rights, the modifications of v2 could quantify a smaller, but never a larger, influence of the second largest shareholder than v2: v2mod1 is equal to v2, but turns zero, if v1mod1 equals 100%. v2mod2 equals v2, but becomes zero, when v1mod2 has the value of 100%.

Banzhaf values are calculated without and with consideration of unknown voting rights. In the case without consideration of unknown voting rights the

[16] Here it is assumed that already 50% of the voting rights and not 50% and one vote grant a shareholder the simple majority because if need be the shareholder should be able to buy a single voting right at the stock exchange.

majority requirement is adjusted according to this formula already described above:

required majority – (1 – cumulated share in voting rights of all bloc holders) / 2

The variable is labeled b1amr and b2amr for the largest and the second largest shareholder, respectively; "amr" is the abbreviation of adjusted majority requirement. Different variants are used when the unknown voting rights receive attention: It is assumed that the unknown voting rights are either held in blocs of .5%, 1%, 3%, or 5%. These variables are labeled b1c0.5, b1c1, b1c3, and b1c5, respectively, for the principal shareholder. The "c" indicates the assumption of concentrated unknown voting rights and the "1" the principal owner. Accordingly the variables for the second largest shareholder are termed with a "2". Actually, 5% minus one voting right should be the highest assumed concentration of the unknown voting rights because a bloc of 5% has to be notified according to the Securities Trading Act. The assumption of 5% is more convenient for calculation purposes and has no meaningful influence on the results.

The power values are calculated with algorithms which Dr. Dennis Leech, University of Warwick, provides on the internet at http://www.warwick.ac.uk/~ecaae/ (visited 16.8.2006). The Banzhaf value with the adjusted majority requirement is calculated with the algorithm "ipgenf", the Banzhaf values with concentrated unknown voting rights with the algorithm "ipmmle".[17]

The procedure is conducted accordingly for the Shapley-Shubik indices, which are labeled "ss" instead of "b". There is one addition: As a further way to consider unknown voting rights, the Shapley-Shubik index with oceanic game ("ss1o", "ss2o") is computed with the algorithm "ssocean".

Board membership of principal and second largest shareholder is measured separately for supervisory board membership and management board

[17] Throughout this article the normalized version of the Banzhaf value is used. The normalized Banzhaf values of all players add up to 1 or 100%, like the voting rights. The aggregated absolute Banzhaf values are usually larger. Tests not shown here reveal a very close correlation between absolute and normalized Banzhaf values so that only one of them has to be considered.

membership. supb1 denotes the supervisory board members related with the principal shareholder as percentage of all supervisory board members elected by the shareholders. The share of management board members related with the principal shareholder is labeled manb1. The corresponding variables for the second largest shareholders are defined accordingly and labeled supb2 and manb2, resp.

Table 6 about here

4.5. Descriptive Statistics

The descriptive statistics reveal that the sample contains very small as well as very large corporations, e.g., Siemens and Volkswagen. The shareholder data demonstrate the well-known feature of highly concentrated shareholdings in Germany. In most corporations only one voting rights bloc exists. Thus the high concentration is overwhelmingly due to the largest shareholder. A second bloc holder can only be found in about every third corporation, and a third bloc holder is a clear exception. As was to be expected, representation in both boards is stronger for the principal shareholder. This is a first, albeit tentative, support for the reference measure used in this article. Shareholders are more often represented in the supervisory board than in the management board.

Table 7 about here

5. Analysis

5.1. Approach and Methodology

Analysis starts with some introductory cases and global observations. After that, the econometric analysis unfolds in three steps. Firstly, as a kind of pretest, homogeneity of the power value variants is investigated by means of a correlation analysis. The idea is to find out whether power values can be considered a homogeneous group of measures or whether there are several challengers of the share in voting rights in this group. In the second step, correlation between the share in voting rights and the power value variants is calculated to estimate the number of alternatives to the share in voting rights to measure shareholder influence. In the final step, it is analyzed how measures of

shareholder influence correlate with shareholder board representation to evaluate the relative and absolute performance of these measures. As explained in section 4.1. above, the correlation analyses in the following chapters investigate the final sample and ignore the time dimension.

It has to be justified why the analysis is confined to correlation analysis and why it is only univariate. Spearman's correlation coefficient stands at the center of interest because the distributional properties of the regression residuals are rather problematic, even after various transformations of the variables. This is particularly the case for the most important analysis when board representation is the dependent variable. A paralleling computation of correlation coefficients according to Pearson reveals that the results according to Spearman and according to Pearson resemble each other in most cases very much.

Confinement on a univariate procedure is not as serious a limitation as it might seem to be at first sight. For the most important approach, the regression of board representation on a measure of shareholder influence, there are no coercive control variables. Even the common control variable company size would mainly be needed to supplement the share in voting rights as a regressor. In contrast, company size is at least partially already integrated in power values.[18]

5.2. Introductory Cases and Global Observations

To get a first impression how the different measures transform an ownership structure into numbers, some prototype cases will be considered. Kiekert AG is a corporation with a majority shareholder. In this case, all power values of the principal shareholder amount to 100% whether there are additional bloc holders or not. Other bloc holders will always have a power value of 0%. The modified voting rights variables are defined in a way to replicate this feature of power values.

Table 8 about here

[18] This argument is based on the following reasoning: If we assume a close connection between the share in equity capital and the share in voting rights, holding a bloc of a given size is more costly in larger corporations. Thus, the influence connected to a bloc of a given size should c.p. increase with company size. Power values incorporate this effect at least partially, because they consider the complete shareholder structure which reflects the effect of the company size on the costs of holding blocs.

Linde AG, Degussa AG, and Rhön-Klinikum AG all have in common that their principal shareholder owns a minority bloc of about one third of the votes. They differ with respect to the second largest shareholder. There is no second bloc holder in Linde AG. The range of the power values in Linde AG, particularly the Banzhaf values, is striking. The Banzhaf values have a range of 35 percentage points, whereas the Shapley values with consideration of the unknown voting rights display a remarkably stable value of about 50%. But there is a great difference to the Shapley value with adjusted majority requirement. Thus, it matters whether and how the unknown voting rights are considered.

Roughly the same tendencies can be seen at Degussa AG with a small second bloc holder. Some different patterns appear at Rhön-Klinikum AG where the second largest shareholder is only slightly smaller than the principal shareholder. There, the Banzhaf value for the largest shareholder is, in contrast to the cases discussed before, unaffected by the assumed bloc size of the unknown voting rights, but the second largest shareholder's Banzhaf value is not. Note also the effect that is caused by the existence of a bigger second largest shareholder on most of the power values of the principal shareholder: The bloc sizes of the principal owners in Linde AG, Degussa AG, and Rhön-Klinikum AG are roughly similar, but most of the principal shareholder's power values in Rhön-Klinikum AG differ markedly from the corresponding measures in Linde AG and Degussa AG because the second largest shareholder disposes of a large bloc. This feature underlines a major quality of power indices, i.e., the power value of a given shareholder also reflects the remaining shareholder structure.

BASF AG represents the case with a single smaller bloc holder. As before, it matters for both Banzhaf and Shapley-Shubik index whether the unknown voting rights are considered. And again, the Banzhaf values are quite sensitive to the assumption how the unknown voting rights are concentrated. The power values resemble much more the share in voting rights than in Linde AG where the single bloc holder disposes of a larger, though not majority, bloc which leads to a larger "markup" in the power values.

The central tendencies of the single case analysis are confirmed by the mean values of the final sample: The power values accentuate the power structure among the shareholders compared to the plain share in voting rights. The power values of the principal shareholder are on average higher than his share in voting rights, the opposite is true for the second largest shareholder. The modified voting rights variables resemble power values. The power values which ignore the unknown voting rights differ markedly from those power values that consider the unknown voting rights potentially powerful. The assumption about the concentration of the unknown voting rights exerts a visible influence on the Banzhaf values of the principal shareholder. With increasing concentration of the unknown voting rights the Banzhaf value decreases and approaches the level of the Shapley values, which is not affected by different concentration rates of the unknown voting rights, including the Shapley value with oceanic game. On relative terms, the various power values of the second largest shareholder might even be more volatile, but in absolute numbers it seems not overly important whether and how the unknown voting rights are considered.

Table 9 about here

A first conclusion may state that power values may considerably differ from shares in voting rights, but power values could also markedly differ from each other. The question is not simply whether “the” power index is a superior measure of shareholder influence compared to the traditional simple voting rights measure. The different variants of power values should not be treated all alike. A more profound analysis is necessary. In addition, the cases hint at the possibility that the relevant correlations may differ for different shareholder structures. This is to be considered in the following analysis. All these properties increase the probability that power value variants differ from the share in voting rights. This is a precondition for power values being a superior measure of shareholder influence compared to the share in voting rights.

5.3. The Relationship among Power Value Variants

The analysis of the correlation among power value variants supports the general findings of the previous section. To preserve space, only the most general

trends displayed in the tables can be mentioned here. In those cases in which the principal shareholder disposes of more than 50% of the votes, all of his power values amount to 100% and the power values of all remaining shareholders account for 0%. A correlation analysis of these cases does not make much sense. Far more interesting are those 51 cases without a majority shareholder, on which the following analyses concentrate.

Table 10 to Table 12 about here

The Shapley-Shubik index variants (Table 10 Panel A) which consider unknown voting rights yield extremely uniform results. A discussion which concentration assumption should be chosen or whether the oceanic game is to be preferred to the assumption of concentrated unknown voting rights would be no more than l'art pour l'art. The Banzhaf index variants (Table 10 Panel B) which consider unknown voting rights are not as uniform as the Shapley-Shubik indices. In this case, the assumed bloc size for the unknown votes does matter. The smaller the supposed size, the larger the difference to the Shapley-Shubik indices with consideration of the unknown voting rights. Shapley-Shubik and Banzhaf values with adjusted majority rule are very closely related with each other and are a group of measures distinct from the other variants (Table 11 and Table 12). Having these points stated, it is coercive that Shapley-Shubik and Banzhaf index are most closely related with each other, when the majority rule is modified and when it is assumed that the unknown votes are held in blocs of 1% or more. The results are rather stable. The general tendencies hold for the principal and for the second largest shareholder, and their context sensitivity is mostly moderate.[19] All results described above would not change substantially if the Pearson correlation would be used instead of the Spearman correlation.

To summarize, there is more than just one distinct measure of shareholder influence. The Shapley-Shubik indices with consideration of unknown votes and both indices with adjusted majority requirement constitute two different groups of measures. The Banzhaf index variants which assume smaller bloc sizes for the

[19] Context sensitivity of the results displayed in Table 10 has been analyzed along the lines that can be seen in Table 11 and Table 12, but to preserve space the results are not tabulated.

unknown voting rights might add a third distinct measure group. Thus, the measures under investigation will supply at least one real alternative measure of shareholder influence to the simple share in voting rights.

5.4. The Relationship between Power Value Variants and the Share in Voting Rights

In the second step, the correlation between power value variants and the share in voting rights is investigated to find out whether there are measures with a rather low correlation. This is a necessary precondition for a measure to beat the share in voting rights in its ability to reflect shareholder power. Again, discussion has to be confined to the basic trends, which are in line with the findings in the previous sections.

Table 13 to Table 15 about here

As to the principal shareholder (Table 13), the power index with adjusted majority requirement is the only clear competitor to the simple share in voting rights as an alternative measure of shareholder influence. It does not matter whether the Shapley-Shubik index or the Banzhaf index is chosen, both are closely related with each other and show only little correlation with the share in voting rights. In contrast, all Shapley-Shubik variants with consideration of the unknown voting rights are so tightly connected to the share in voting rights that it is hardly imaginable that they might constitute a serious alternative. The same statement, though slightly weaker, could be made for the corresponding Banzhaf index variants. Only the variant which assumes rather dispersed unknown voting rights might be another promising candidate. These estimations are not context sensitive (Table 14). The second modification of the share in voting rights (v1mod2) differs under some circumstances from the simple share in voting rights, particularly when the second largest shareholder disposes of a bigger bloc.

The situation for the second largest shareholder is vague (Table 13). Despite a lower overall level of correlation coefficients, the general analyses do not identify a promising candidate to substitute the share in voting rights with the exception of modification 2 (v2mod2). Further analyses reveal a considerable

context sensitivity of the results (Table 15). Thus, on the one hand, it seems more probable to find encouraging alternatives to the share in voting rights for the second largest shareholder than for the principal shareholder in general, but on the other hand, the eligibility of the alternatives may strongly depend on the circumstances. Moreover, it should be added that the results for the second largest shareholder differ to some degree between Spearman and Pearson correlation. This is not the case for the principal shareholder.

5.5. The Relationship between Various Measures of Shareholder Influence and the Board Representation of Shareholders

5.5.1. Principal Shareholder

After all the preliminaries we can now turn to the most interesting questions: In a relative perspective, is there a measure that indicates shareholder influence — approximated by board representation — more accurately than the plain share in voting rights? And generally, how good is the quality of all these measures of shareholder influence at all?

Table 16 displays for the complete final sample a close correlation between supervisory board and management board representation, resp., and almost all measures of shareholder influence. After the analyses above it comes as no surprise that the results for both power value variants with adjusted majority rule differ from the remaining findings. However, none of the competitors displays higher correlation coefficients than the share in voting rights. The accentuation of power, that characterizes all these measures, does not mean an improvement.

Table 16 about here

The results for the subsample that only consists of corporations without a majority shareholder are completely different. All results for supervisory board membership and all results but one for the management board are insignificant at the 5% level. Obviously, the explanatory power that we found for the complete final sample mainly stems from the cases with a majority principal shareholder. All measures have difficulties in picturing the power of a minority principal

shareholder. But again, none of the challengers exhibits a better p-value than the share in voting rights. The corresponding results for the management board are puzzling: Correlation is comparatively strong, though only in one case significant, but all correlation coefficients are negative. This evidence is difficult to explain. Obviously, smaller principal shareholders tend to sit in the management board. They might be inclined to this behavior because their voting rights base is too small to exert influence without a direct say in the corporation's operations. On the other hand, their comparatively small shareholding still seems sufficient to achieve a position in the management board.

This train of thought is supported by the two power indices with adjusted majority requirement in three of the four comparisons of two subgroups. Their correlation coefficients are negative and significant, or at least rather strong, when there is more than one bloc holder, the second largest bloc is large and the difference in size between the two largest blocs is small. These are circumstances under which the position of the principal shareholder is seriously contested by the second largest shareholder. In this context, with a decreasing voting rights base, principal shareholders tend to supplement their influence via voting rights by a representation in the management board. Similar evidence can be found for all measures of shareholder influence with the exception of those with adjusted majority rule when the share of unknown votes is rather large. In this case, the principal shareholder's position is particularly threatened not by an incumbent bloc holder, but by a potential buyer of a rivaling bloc. However, these two arguments cannot be merged consistently. E.g., all measures except those with adjusted majority requirement indicate a stronger negative correlation when there is only one bloc, what contradicts the impression supplied by the power indices with adjusted majority rule. It seems that one group of measures, the power indices with adjusted majority rule, is associated with the threat of the principal shareholder's position by the incumbent second largest bloc holder, whereas the other group is related with the threat of the emergence of a new bloc holder.

Among the four confrontations, there is only one row with significant correlation coefficients for the supervisory board. Almost all measures, with the

most notably exception of the power indices with adjusted majority requirement, indicate a positive correlation when the difference in size between the two largest blocs is small. When the advantage in voting rights over the second largest bloc holder is small, the principal shareholder seems anxious to supplement his position with supervisory board representation. A somewhat weaker effort for management board representation is also reflected in these measures, hinting at another contradiction to the picture shown by the power value variants with adjusted majority requirement.

A striking point of the four comparisons of two subgroups is the context sensitivity of the correlation results. The results for the two corresponding legs of a confrontation differ almost in all of the available six cases (four comparisons for the supervisory board, two for the management board). This is inconvenient evidence for those looking for generally applicable measures.

All significant correlations for the supervisory board are positive. Evidence for the management board is mixed: All significant coefficients are positive for the complete final sample, but significant coefficients for smaller subsamples are all negative.

Confining analysis on significant cases, the plain share in voting rights is never defeated by its rivals in the case of the supervisory board, a minor exception might be seen for the management board in some subsamples where v1mod2 and the power indices with adjusted majority rule are strong. This supports further the impression that most alternative measures of shareholder influence resemble the explanatory power of the plain share in voting rights very much and are only close variations of the plain share in voting rights. Only both power values with adjusted majority requirement take on a special position in almost all separations into categories and are really distinct from the plain share in voting rights.

5.5.2. Second Largest Shareholder

The most interesting results in Table 17 can be found on the left-hand side. For the complete final sample of 161 corporations, most measures of

shareholder influence display a significant positive correlation with both supervisory board and management board membership. For the former, the figures are considerably higher than for the principal shareholder. The correlation coefficient of the plain share in voting rights is not the maximum coefficient for supervisory board membership, but it is quite competitive with its challengers. Correlation decreases when the sample focuses on corporations with a second bloc holder and deteriorates for the supervisory board even further when the sample focus is sharpened once more, on corporations which have a minority principal shareholder *and* a second bloc holder. This development reveals that the explanatory power of the measures of influence mainly stems from cases in which a measure value of zero is ascribed to the second largest bloc holder, either because there is no second bloc holder at all or because the principal shareholder disposes of a majority bloc. The latter can be nicely observed for the subsample comprising all corporations with a second bloc holder (v2>0%) for supervisory board membership when contrasted with the subsamples of corporations with a minority principal shareholder *and* a second bloc holder (v2>0% AND v1<50%). The correlation coefficient of the share in voting rights is clearly insignificant whereas almost all other measures are significantly correlated with supervisory board membership. Especially the significant coefficients for the two modified variables of the share in voting rights (v2mod1 and v2mod2) prove that this feature is caused by the accentuating characteristic of the superior measures. It is the only part of the analyses of the correlation between measures of shareholder influence and board representation for both principal and second largest shareholder that the plain share in voting rights is unequivocally inferior to most of its competitors. But even this case does not mean a massive victory for the power indices because that feature that causes the superior results — the accentuation of powerless second largest shareholders by ascribing a measure value of zero to them — can be conveniently achieved with slight modifications of the share in voting rights.

Table 17 about here

But the advantage of the accentuating measures is only a partial one. It disappears when the sample only consists of corporations with a minority principal shareholder. Thus, *all* measurement concepts fail to indicate the power of the second largest shareholder to be represented on the boards in this case. Indeed, there is only one positive significant correlation coefficient in the analysis of the subsample (v2>0% AND v1<50%) or subsamples thereof, i.e., v2mod2 when the two largest blocs differ not much in size. As for the principal shareholder, there are many negative correlation coefficients, few of them even significant, which is difficult to explain. Two features, which were also found for the principal shareholder, should be singled out: The results are again quite context sensitive. And the two power value variants with modified majority requirement take on a special role once again, although it is somewhat weaker than in the case of the principal shareholder.

5.5.3. Summary and Discussion

Leaving all details aside, the general conclusion for the principal shareholder is that power values and the modifications of the share in voting rights are not superior, often even inferior, to the plain share in voting rights in their ability to explain principal shareholder representation in the main bodies of the corporation, particularly in the supervisory board. The general picture for the management board is inconclusive.

The main result for the second largest shareholder is that the explanatory power of the simple share in voting rights for supervisory board membership could be markedly improved by ascribing a value of zero to the second largest shareholder in case of a dominating principal shareholder. This could be achieved either by using a power index with consideration of unknown voting rights other than the Banzhaf index variants with a low assumed concentration of the unknown voting rights, or, more conveniently, by modified versions of the share in voting rights. The latter misses only those cases with a dominating minority principal shareholder. As for the principal shareholder, the analyses never make a substitution of a share in voting rights measure by a power index necessary, but in the case mentioned above, the *plain* share in voting rights is

clearly inferior. Significant correlations for management board membership can only be found for the complete final sample.

For the principal as for the second largest shareholder, the correlation with representation in the boards is context sensitive for most measures under investigation. Thus, the optimal measure might depend on the context and, as a consequence, be not the same for all cases in a sample. The two power value variants with adjusted majority rule differ particularly pronounced from the share in voting rights and also from the other power index variants and thus seem to form a group of measures of their own; under some circumstances they are even superior to the share in voting rights. However, the examples in section 2.3.3. showed that this power index variant seems to be particularly prone to yield an implausible picture of the power structure. The results for the correlation according to Pearson are similar to the Spearman correlations shown above for the principal shareholder; however, there are some differences for the second largest shareholder.[20]

So far, the examination concentrated on the comparative evaluation of measures of shareholder influence to investigate if there is a superior measure to the plain share in voting rights. However, another tendency of the results is at least as remarkable: In absolute terms, the generally low explanatory power of *all* measures of shareholder influence for representation in the boards for *corporations without a majority principal shareholder* is striking. Obviously, none of the measures is able to deliver variables that are closely connected to board representation of the principal shareholder and the second largest shareholder, resp., when there is no majority shareholder in the corporation. The quality of all tested measures in this respect has to be called disappointing.

What are possible causes for this evidence? Data problems could be a reason. But data quality is considered to be good. Board data are hand-collected and profit from the markedly increased transparency obligations, beginning in the

[20] There are fewer significances than on the left-hand side of Table 17. Moreover, in the last column of the supervisory board on the right, the correlation coefficients of all Shapley-Shubik indices which consider unknown voting rights are significant, whereas among the Banzhaf indices only the coefficient of the variant which assumes 5% blocs for the unknown voting rights is significant.

business year 1999, which clearly improve, even for the years prior to 1999, the ability to detect connections between board members and shareholders. Ownership data come from the data base kept by the Federal Securities Supervisory Office, which contains the public statements about voting rights according to sections 21ff. Securities Trading Act. The lowest notification threshold amounts to 5% of the voting rights. It should deliver a quite encompassing picture of the complete shareholder structure, i.e., beyond direct shareholders. Consequently, the board membership data do also consider connections to indirect shareholders. Nevertheless, it is still quite probable that available data are insufficient to discover all existing links between shareholders and board members. But this difficulty should not be confined to corporations without a majority shareholder.

Another potential cause could be that shareholder influence does not manifest itself in board representation, i.e., the basic hypothesis of this article's approach — the yardstick for shareholder power — would be flawed. Of course, there could be informal channels through which a large shareholder is able to influence a corporation independent of its legal bodies. Managing a corporation means interaction of people, and the structure of this interaction will become only partially apparent by means of an analysis that is confined to publicly available information about the corporation, its shareholder structure, and the members of its boards. Nevertheless, the existence of the boards and their competences are determined by the laws. Thus, it seems plausible that at least some of the shareholders' influence should be reflected in connections between members of the boards and those shareholders. Moreover, the reference measure proposed in this article seems to be superior to its existing competitors anyhow. It should not be dismissed prematurely.

For the sake of discussing another possible reason, let us assume that data quality be unproblematic, and the reference measure be able to display shareholder power satisfactorily. Then the results lead to the conclusion that neither the share in voting rights nor power indices are able to adequately translate the power of a shareholder into figures in corporations without majority

shareholder. To be sure, criticizing the dominating measure for shareholder influence — the simple share in voting rights — so strongly needs far more substance than can be delivered by this study. Nevertheless has this thought some attractive features: Corporate governance research is plagued by the difficulty to find unambiguous relationships between corporate governance forces and corporate performance. This is also true for the shareholder structure as a determinant of performance. Internationally, research hardly finds any results that can be generalized (cf., for example, the surveys by Short (1994), Gugler (2001), Bott (2002: 148-53), or Becht et al. (2003: 50-67)). Various causes for this unsatisfactory state are discussed in the literature, for example, the hypothesis of the optimality of ownership structures (cf. Demsetz (1983), Demsetz & Lehn (1985)), the econometric difficulties in treating adequately interactions among various corporate governance forces or reverse causality between these forces and performance, provided these phenomena actually exist (see, e.g., Agrawal & Knoeber (1996) or Bøhren & Ødegaard (2006)), or the problems in detecting non-linear relationships (see the classic studies of Morck et al. (1988) and McConnell & Servaes (1990)). The manner in which shareholder structure is measured in current corporate governance research plays at best a minor role, if any at all, when the reasons for the mixed results are discussed. Possibly, shareholder power does actually exert an influence on corporate performance, but it cannot be detected due to deficient measures of shareholder power. An advance in this field might support progress in the research of the shareholder structure-performance relationship as well.

A final point to be discussed is the comparison with the results of the other studies presented in Table 4. This article's results mostly agree with the outcome obtained by Manjón-Antolín (2004) for a Spanish sample who concludes that the share in votes, the Shapley-Shubik index (oceanic game), and the Banzhaf index (adjusted majority rule) are equally suitable measures of shareholder influence. This article's results are also in line with those found by Edwards & Weichenrieder (2004) for a German sample. According to them, the share in votes and the Shapley-Shubik index (oceanic game) rank even, followed by the

Banzhaf index (adjusted majority rule). In our study both power index variants with adjusted majority requirement are clearly distinct from all remaining measures and, with the exception of some particular circumstances, they are inferior measures. However, there are some differences in comparison with the two other studies using German data: Our results are rather distinct from those obtained by Gugler & Yurtoglu (2003) because they ascribe the same capacity to the share in votes and to the Shapley-Shubik index with adjusted majority rule. As to the study by Kehren (2006), it has to be considered that he in fact analyzes a similar data base, but he does not distinguish between corporations with and without majority shareholder. Contrary to him, this study does not detect a general superiority of the Shapley-Shubik index over the Banzhaf index, but this might be caused by his usage of Banzhaf values which assume that the unknown voting rights are held in 1% blocs. His outcomes are similar to those in this study, in that he finds different results for the principal and the second largest shareholder.[21]

6. Concluding Remarks

It seems useful to distinguish between the relative and the absolute performance of measures of shareholder influence to explain shareholders' representation in boards. In a comparative perspective, the plain share in voting rights can fend off all competitors in case of the principal shareholder. For the second largest shareholder, the accentuating feature of power values proves to be superior, but it can be conveniently reproduced by simple modifications of the share in voting rights. As to the power indices, it is crucial whether the unknown voting rights are considered or not. It is of minor importance whether the Banzhaf index or the corresponding Shapley-Shubik index are chosen and how the unknown voting rights are considered. An inconvenient part of the results is that they are often strongly context sensitive. This feature could turn out to be a major impediment on the way to a one-fits-all measure. Using different

[21] As noted earlier, the voting rights blocs in German stock corporations cluster strikingly around 25%, what may be caused by a number of veto rights a shareholder exceeding the 25% threshold can dispose of. Thus 75% of the votes might be another important threshold. In untabulated tests the measures of shareholder influence were defined with a majority requirement of 75% instead of 50%. The results do not change materially.

procedures to derive the single measure of shareholder influence in an analysis, i.e., for some corporations b1amr and for others s1o enters the analysis, as a result of a kind of calibration process, needs getting used to it.

The most alarming result is the absolute performance of the measures. *All* measures of shareholder influence, i.e., including the simple share in voting rights, fail to explain shareholders' representation in the boards of corporations without majority shareholder. Since ownership structure analysis is a central area of corporate governance research, a further investigation of this potential cause for the inconclusive evidence in studies of the relationship between corporate performance and shareholder structure might be fruitful.

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Figure 1: Consideration of Unknown Voting Rights

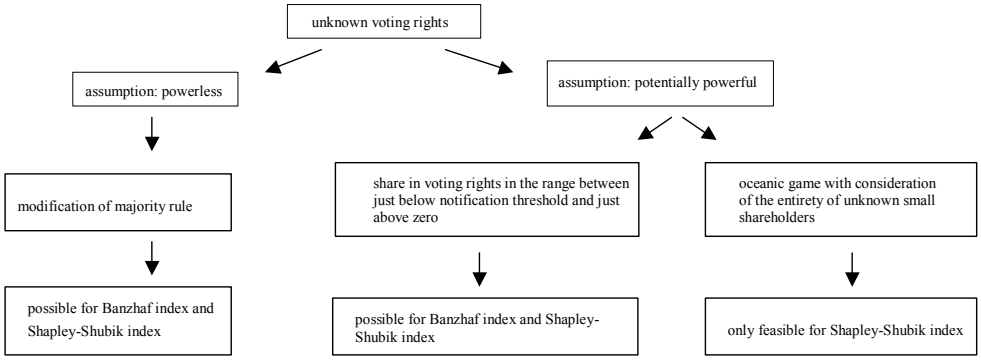


Table 1: Example of the Shapley Value

Example: We assume that the votes of players A, B, and C amount to 50, 49, and 1 resp. A simple majority, i.e., 51 votes, is needed to get a resolution passed. Player B is the pivotal player (denoted P) in the permutation ABC, player C in the permutation ACB, and player A in the remaining permutations. Accordingly, the Shapley values are equal to 4/6 for A, 1/6 for B, and 1/6 for C. Note, that according to the Shapley value, player B is not more powerful than player C even though he can dispose of 49 times more votes than C.	**Permutation**	**Player**		
		A	**B**	**C**
	(A, B, C)	-	P	-
	(A, C, B)	-	-	P
	(B, A, C)	P	-	-
	(B, C, A)	P	-	-
	(C, A, B)	P	-	-
	(C, B, A)	P	-	-
	Number of pivots	4	1	1
	Shapley value	0.67	0.17	0.17
	Share in votes	0.50	0.49	0.01

Notes: Modified example adopted from Holler & Illing (2003: 308). P denotes the pivotal player.

Table 2: Example of the Banzhaf Value

Example: As in the previous example we assume that the votes of players A, B, and C amount to 50, 49, and 1 resp. and that there is still a simple majority rule. In this case, C_4, C_5, and C_N are winning coalitions. There are five swings overall. Three of them can be ascribed to player A, one to B, and one to C. The resulting Banzhaf values are 3/5 for A, 1/5 for B, and 1/5 for C.	**Players**	**Coalitions**							
		-	C_1	C_2	C_3	C_4	C_5	C_6	C_N
	A	0	1	0	0	***1***	***1***	0	***1***
	B	0	0	1	0	***1***	0	1	1
	C	0	0	0	1	0	***1***	1	1
		L	L	L	L	W	W	L	W
	Winning coalition: W Losing coalition: L Member of coalition: 1 Swing: ***1***								

Table 3: Comparison of the Share in Votes, the Shapley Value, and the Banzhaf Value in the Example with three Players

Measures	**Players**		
	A	B	C
Share in votes	0.50	0.49	0.01
Shapley value	0.67	0.17	0.17
Banzhaf value	0.60	0.20	0.20

Table 4: Survey of Related Empirical Research

Study	Sample	Measures of Shareholder Influence	Reference Measure, Approach	Result
Leech (2002b)	444 large British corporations without majority shareholder, 1985 or 1986	Focus of analysis on principal shareholder Share in votes Shapley-Shubik index (oceanic game; unknown votes held in .25% blocs) Banzhaf index (modified majority rule; unknown votes held in .25% blocs)	Compliance with catalogue of seven criteria derived from the study of Berle & Means (1939) and the Listing Rules of the London Stock Exchange. Analysis is verbal, not econometrical.	Reject Shapley-Shubik index, but not Banzhaf index.
Crama et al. (2003)	250 listed U.K. companies, 1988-1993	Focus of analysis on principal shareholder Herfindahl index of share in votes Banzhaf index (presumably with adjusted majority rule)	Ability of measures of shareholder influence to explain total shareholder return.	Banzhaf index superior to Herfindahl index of share in voting rights.
Crespi-Cladera & Renneboog (2003)	about 200 listed U.K. companies, 1988-1993	Focus of analysis on shareholder types Share in votes Shapley-Shubik index (adjusted majority rule)	Ability of measures of shareholder influence to explain turnover of executive directors.	Shapley-Shubik index superior to share in voting rights.
Gugler & Yurtoglu (2003)	266 large German companies, 1992-1998	Focus of analysis on principal and second largest shareholder Share in votes Shapley-Shubik index (adjusted majority rule)	Ability of measures of shareholder influence to explain pay-out ratio.	Share in voting rights and Shapley-Shubik index even.
Leech & Manjón (2003)	Spanish corporations, 1989-1995; focus on subsample of corporations without majority shareholder	Focus of analysis on principal shareholder and aggregated holdings of largest shareholders Share in votes Shapley-Shubik index (oceanic game; unknown votes held in .5% blocs) Banzhaf index (modified majority rule; unknown votes held in .5% blocs) [further measure: degree of control]	Compliance with "widely accepted ideas", based on catalogue of Leech (2002b). Analysis is verbal, not econometrical.	Banzhaf index superior to Shapley-Shubik index.
Edwards & Weichenrieder (2004)	97 large German corporations, 1991	Focus of analysis on principal and second largest shareholder Share in votes Shapley-Shubik index (oceanic game) Banzhaf index (adjusted majority rule)	Ability of measures of shareholder influence to explain corporate success (market-to-book ratio of equity).	Share in voting rights and Shapley-Shubik index even, Banzhaf index ranks behind.
Manjón-Antolín (2004)	Spanish corporations	Focus of analysis on principal shareholder	Ability of measures of shareholder influence to explain corporate	Similar explanatory power of all measures of shareholder influence

(2004)	corporations, 1991-1995r	Share in votes Shapley-Shubik index (unknown votes held in .5% blocs) Banzhaf index (unknown votes held in .5% blocs) [further measure: degree of control]	influence to explain corporate success (difference between ROA and opportunity cost of debt and equity).	of shareholder influence.
Renneboog & Trojanowski (2005)	985 listed British corporations, 1992-1998	Focus of analysis on shareholder types and on principal and second largest shareholder Share in votes Banzhaf index (adjusted majority rule)	Ability of measures of shareholder influence to explain measures of pay-out policy.	Good evaluation of the Banzhaf index, but no explicit comparative statement as to share in voting rights.
Guedes & Loureiro (2006)	217 large listed European corporations, 1999	Focus of analysis on principal shareholder Share in votes Shapley-Shubik index (oceanic game)	Ability of measures of shareholder influence to determine a threshold value above which the principal shareholder is entrenched and expropriates the other shareholders as indicated by the market-to-book ratio of equity.	Shapley-Shubik index more appropriate than the share in voting rights.
Kehren (2006)	German corporations, 1996-2000, yearly sample size between 139 and 180	Focus of analysis on principal and second largest shareholder Share in votes Shapley-Shubik index (oceanic game) Banzhaf index (adjusted majority rule; unknown votes held in 1% blocs)	Ability of measures of shareholder influence to explain membership in management and supervisory board.	Shapley-Shubik index more appropriate than the Banzhaf index. Results for principal and second largest shareholder differ. Share in votes best measure for principal shareholder and worst for second largest shareholder.

Table 5: Distribution of Years of Observation in the Final Sample

Year of Observation	Number of Corporations
1997	17
1998	20
1999	34
2000	90
Total	**161**

Table 6: Variable Definitions

Short Cut	Variable	Definition
Voting Rights		
v1	voting rights of the principal shareholder	voting rights of the principal shareholder in %
v1mod1	voting rights of the principal shareholder modification 1	=v1 if v1<50%, else =100%
v1mod2	voting rights of the principal shareholder modification 2	=100% if v1>25% AND v2<25%, else =v1
v2	voting rights of the second largest shareholder	voting rights of the second largest shareholder in %
v2mod1	voting rights of the second largest shareholder modification 1	=0% if v1mod1=100%, else =v2
v2mod2	voting rights of the second largest shareholder modification 2	=0% if v1mod2=100%, else =v2
Banzhaf Index		
b1amr, b2amr	Banzhaf value (normalized) of the principal (second largest) shareholder with adjusted majority requirement; basic majority requirement 50%	Banzhaf value (normalized) of the principal (second largest) shareholder with adjusted majority requirement: required majority [50%] – (1 – cumulated share in voting rights of all bloc holders) / 2
b1c0.5, b2c0.5	Banzhaf value (normalized) of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are held in blocs of .5%; majority requirement 50%	
b1c1, b2c1	Banzhaf value (normalized) of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are held in blocs of 1%; majority requirement 50%	
b1c3, b2c3	Banzhaf value (normalized) of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are held in blocs of 3%; majority requirement 50%	
b1c5, b2c5	Banzhaf value (normalized) of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are held in blocs of 5%; majority requirement 50%	
Shapley-Shubik Index		
ss1amr, ss2amr	Shapley value of the principal (second largest) shareholder with adjusted majority requirement; basic majority requirement 50%	Shapley value of the principal (second largest) shareholder with adjusted majority requirement: required majority [50%] – (1 – cumulated share in voting rights of all bloc holders) / 2
ss1c0.5, ss2c0.5	Shapley value of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are held in blocs of .5%; majority requirement 50%	
ss1c1, ss2c1	Shapley value of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are held in blocs of 1%; majority requirement 50%	
ss1c3, ss2c3	Shapley value of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are held in blocs of 3%; majority requirement 50%	
ss1c5, ss2c5	Shapley value of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are held in blocs of 5%; majority requirement 50%	
ss1o, ss2o	Shapley value of the principal (second largest) shareholder calculated under the assumption that the unknown voting rights are potentially powerful (oceanic game); majority requirement 50%	
Board Membership		
supb1, supb2	Supervisory board representation of the principal (second largest) shareholder	Share of supervisory board members related with the principal (second largest) shareholder in all supervisory board members elected by the shareholders in %
manb1, manb2	Management board representation of the principal (second largest) shareholder	Share of management board members related with the principal (second largest) shareholder in all management board members in %

Table 7: Descriptive Statistics of the Final Sample

Variable	n	Existing Cases	Mean	Standard Deviation	Minimum	Percentiles 25%	50%	75%	Maximum
	Company Size								
Sales in Millions of DM	161	n.a.	6.365,5	20.005,5	0,0	348,3	1.042,4	3.803,7	167.331,0
	Shareholder Concentration								
Number of Voting Rights Blocs	161	n.a.	1,53	0,99	1	1	1	2	7
Aggregated Voting Rights of Bloc Holders	161	n.a.	69,17%	25,27%	4,00%	54,69%	75,50%	89,94%	100,00%
	Largest Shareholders: Voting Rights and Board Representation								
	Principal Shareholder								
s1	161	n.a.	62,15%	27,42%	4,00%	37,50%	65,14%	82,71%	100,00%
supb1	161	n.a.	36,97%	26,89%	0,00%	15,48%	36,36%	54,55%	100,00%
manb1	161	n.a.	16,04%	25,15%	0,00%	0,00%	0,00%	30,95%	100,00%
	Second Largest Shareholder								
s2	161	n.a.	5,21%	8,91%	0,00%	0,00%	0,00%	10,00%	39,98%
s2*	161	52	16,13%	8,33%	3,90%	10,00%	12,96%	23,56%	39,98%
supb2	161	n.a.	3,86%	9,92%	0,00%	0,00%	0,00%	0,00%	63,64%
supb2*	161	52	11,96%	14,48%	0,00%	0,00%	10,10%	24,31%	63,64%
manb2	161	n.a.	0,66%	4,68%	0,00%	0,00%	0,00%	0,00%	50,00%
manb2*	161	52	2,05%	8,12%	0,00%	0,00%	0,00%	0,00%	50,00%
	Third Largest Shareholder								
s3	161	n.a.	1,36%	3,80%	0,00%	0,00%	0,00%	0,00%	22,00%
s3*	161	21	10,39%	4,13%	5,04%	7,45%	10,01%	11,93%	22,00%

Notes: The lines in which a * is added to the variable short cut specify the size of the variables for those companies in which there is a second and third largest bloc holder, resp. For instance, the numbers for the third largest shareholder s3* declare that there exists a third largest bloc holder in 21 of the 161 observations and that the average bloc size in these cases amounts to 10.39%. n.a.: not applicable. The short cuts of variables are explained in Table 6.

Table 8: Example Cases

Variables	Results									
	Kiekert AG 1999		Linde AG 2000		Degussa AG 1998		Rhön-Klinikum AG 1999		BASF AG 2000	
	Principal Shareholder (x=1)	2nd Largest Shareholder (x=2)	Principal Shareholder (x=1)	2nd Largest Shareholder (x=2)	Principal Shareholder (x=1)	2nd Largest Shareholder (x=2)	Principal Shareholder (x=1)	2nd Largest Shareholder (x=2)	Principal Shareholder (x=1)	2nd Largest Shareholder (x=2)
Voting Rights										
vx	53,95%	17,98%	33,36%	0,00%	36,41%	5,12%	29,55%	24,10%	12,36%	0,00%
vxmod1	100,00%	0,00%	33,36%	0,00%	36,41%	5,12%	29,55%	24,10%	12,36%	0,00%
vxmod2	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	12,36%	0,00%
Banzhaf Index										
bxamr	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%
bxc0.5	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	28,99%	4,28%	33,85%	0,00%
bxc1	100,00%	0,00%	99,85%	0,00%	99,94%	0,00%	26,62%	7,13%	20,85%	0,00%
bxc3	100,00%	0,00%	82,35%	0,00%	89,84%	0,72%	28,29%	13,35%	14,71%	0,00%
bxc5	100,00%	0,00%	65,53%	0,00%	76,28%	2,01%	29,76%	16,64%	13,93%	0,00%
Shapley-Shubik Index										
ssxamr	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%	100,00%	0,00%
ssxc0.5	100,00%	0,00%	49,80%	0,00%	56,84%	3,35%	31,47%	19,74%	14,05%	0,00%
ssxc1	100,00%	0,00%	49,81%	0,00%	56,47%	3,41%	31,65%	20,04%	14,05%	0,00%
ssxc3	100,00%	0,00%	48,51%	0,00%	55,93%	3,56%	32,43%	21,00%	13,76%	0,00%
ssxc5	100,00%	0,00%	48,05%	0,00%	56,38%	3,66%	31,90%	21,88%	13,80%	0,00%
ssxo	100,00%	0,00%	50,06%	0,00%	56,82%	3,30%	31,22%	19,47%	14,10%	0,00%

Note: The variables are defined in Table 6.

Table 9: Mean Values of Shareholder Influence Measures in the Final Sample and in the Subsample with a Second Bloc Holder

Variables	Mean Values		
	Final Sample (n=161)		Subsample v2>0% (n=52)
	Principal Shareholder (x=1)	2nd Largest Shareholder (x=2)	2nd Largest Shareholder (x=2)
	Voting Rights		
vx	62,15%	5,21%	16,13%
vxmod1	77,32%	2,96%	9,17%
vxmod2	87,94%	1,21%	3,75%
	Banzhaf Index		
bxamr	96,13%	1,75%	5,41%
bxc0.5	88,07%	1,71%	5,29%
bxc1	86,26%	1,40%	4,35%
bxc3	83,69%	1,70%	5,28%
bxc5	82,44%	1,93%	5,99%
	Shapley-Shubik Index		
ssxamr	96,20%	1,86%	5,76%
ssxc0.5	80,97%	2,16%	6,68%
ssxc1	80,93%	2,18%	6,74%
ssxc3	80,81%	2,11%	6,55%
ssxc5	80,80%	2,27%	7,03%
ssxo	81,02%	2,15%	6,66%

Note: The variables are defined in Table 6.

Table 10: Spearman Correlation between Power Index Variants for the Principal Shareholder and for the Second Largest Shareholder

Panel A: Spearman Correlation between Shapley-Shubik Index Variants

Variables/Statistics		Spearman Correlation between Shapley-Shubik Indices of Principal Shareholder												Statistics/Variables	
		final sample and subsample (v1<50%)													
		ss1amr final sample		ss1c0.5 final sample		ss1c1 final sample		ss1c3 final sample		ss1c5 final sample		ss1co final sample			
		complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%		
ss2amr	Corr.coeff.			0,38	0,08	0,38	0,08	0,38	0,07	0,38	0,06	0,38	0,08	Corr.coeff.	
	p-value			0,00	0,59	0,00	0,59	0,00	0,65	0,00	0,66	0,00	0,58	p-value	ss1amr
	n			161	51	161	51	161	51	161	51	161	51	n	
ss2c0.5	Corr.coeff.	0,61	0,60			1,00	1,00	1,00	1,00	1,00	1,00	0,99	1,00	Corr.coeff.	
	p-value	0,00	0,00			0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	p-value	ss1c0.5
	n	52	29			161	51	161	51	161	51	161	51	n	
ss2c1	Corr.coeff.	0,61	0,60	1,00	1,00			1,00	1,00	1,00	1,00	0,99	1,00	Corr.coeff.	
	p-value	0,00	0,00	0,00	0,00			0,00	0,00	0,00	0,00	0,00	0,00	p-value	ss1c1
	n	52	29	52	29			161	51	161	51	161	51	n	
ss2c3	Corr.coeff.	0,63	0,64	0,97	0,86	0,97	0,86			1,00	1,00	0,99	1,00	Corr.coeff.	
	p-value	0,00	0,00	0,00	0,00	0,00	0,00			0,00	0,00	0,00	0,00	p-value	ss1c3
	n	52	29	52	29	52	29			161	51	161	51	n	
ss2c5	Corr.coeff.	0,61	0,59	1,00	0,99	1,00	1,00	0,97	0,85			0,99	1,00	Corr.coeff.	
	p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00			0,00	0,00	p-value	ss1c5
	n	52	29	52	29	52	29	52	29			161	51	n	
ss2co	Corr.coeff.	0,62	0,60	1,00	0,99	0,99	1,00	0,97	0,86	0,99	0,99			Corr.coeff.	
	p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00			p-value	ss1co
	n	52	29	52	29	52	29	52	29	52	29			n	
		complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%		
		subsample (v2>0%) ss2amr		subsample (v2>0%) ss2c0.5		subsample (v2>0%) ss2c1		subsample (v2>0%) ss2c3		subsample (v2>0%) ss2c5		subsample (v2>0%) ss2co			
		subsample (v2>0%)													
		Spearman Correlation between Shapley-Shubik Indices of Second Largest Shareholder													

Panel B: Spearman Correlation between Banzhaf Index Variants

Variables/Statistics		Spearman Correlation between Banzhaf Indices of Principal Shareholder										Statistics/Variables	
		final sample and subsample (v1<50%)											
		b1amr final sample		b1c0.5 final sample		b1c1 final sample		b1c3 final sample		b1c5 final sample			
		complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%		
b2amr	Corr.coeff.			0,48	0,38	0,44	0,30	0,40	0,17	0,39	0,14	Corr.coeff.	
	p-value			0,00	0,01	0,00	0,03	0,00	0,25	0,00	0,32	p-value	b1amr
	n			161	51	161	51	161	51	161	51	n	
b2c0.5	Corr.coeff.	0,69	0,72			0,95	0,97	0,91	0,90	0,91	0,88	Corr.coeff.	
	p-value	0,00	0,00			0,00	0,00	0,00	0,00	0,00	0,00	p-value	b1c0.5
	n	52	29			161	51	161	51	161	51	n	
b2c1	Corr.coeff.	0,70	0,79	0,96	0,93			0,97	0,96	0,96	0,94	Corr.coeff.	
	p-value	0,00	0,00	0,00	0,00			0,00	0,00	0,00	0,00	p-value	b1c1
	n	52	29	52	29			161	51	161	51	n	
b2c3	Corr.coeff.	0,66	0,72	0,94	0,91	0,98	0,95			1,00	0,99	Corr.coeff.	
	p-value	0,00	0,00	0,00	0,00	0,00	0,00			0,00	0,00	p-value	b1c3
	n	52	29	52	29	52	29			161	51	n	
b2c5	Corr.coeff.	0,62	0,63	0,94	0,89	0,97	0,90	1,00	0,98			Corr.coeff.	
	p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00			p-value	b1c5
	n	52	29	52	29	52	29	52	29			n	
		complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%	complete	v1<50%		
		subsample (v2>0%) b2amr		subsample (v2>0%) b2c0.5		subsample (v2>0%) b2c1		subsample (v2>0%) b2c3		subsample (v2>0%) b2c5			
		subsample (v2>0%)											
		Spearman Correlation between Banzhaf Indices of Second Largest Shareholder											

Notes: *: The correlation coefficient cannot be calculated because at least one of the variables is constant. The variables are defined in Table 6. Cells with bold type comprise a correlation coefficient with a p-value below 5%. Shaded cells comprise a negative correlation coefficient.

Table 11: Spearman Correlation between Shapley-Shubik Index and Corresponding Banzhaf Index for the Principal Shareholder

Variables/Statistics		Spearman Correlation between Shapley-Shubik Index and Corresponding Banzhaf Index of Principal Shareholder								
		subsample (v1<50%)					subsample (v1<50% AND v2>0%)			
		complete	unknown voting rights		# blocs		second largest bloc		STD (v1, v2)	
			<=58.45%	>58.45%	1	>1	<=15.03%	>15.03%	<=5.865%	>5.865%
amr	Corr.coeff.	1,00	0,99	1,00	*	0,99	1,00	0,99	0,97	1,00
	p-value	0,00	0,00	.	.	0,00	.	0,00	0,00	.
	n	51	26	25	22	29	15	14	15	14
c0.5	Corr.coeff.	0,84	0,95	0,95	0,98	0,83	0,88	0,88	0,51	0,85
	p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,00
	n	51	26	25	22	29	15	14	15	14
c1	Corr.coeff.	0,91	0,98	0,97	0,99	0,91	0,96	0,98	0,69	0,88
	p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	n	51	26	25	22	29	15	14	15	14
c3	Corr.coeff.	0,97	0,98	0,99	1,00	0,97	0,98	0,98	0,96	0,94
	p-value	0,00	0,00	0,00	.	0,00	0,00	0,00	0,00	0,00
	n	51	26	25	22	29	15	14	15	14
c5	Corr.coeff.	0,99	0,99	1,00	1,00	0,99	1,00	1,00	1,00	0,95
	p-value	0,00	0,00	0,00	.	0,00	.	0,00	.	0,00
	n	51	26	25	22	29	15	14	15	14

Notes: *: The correlation coefficient cannot be calculated because at least one of the variables is constant. The variables are defined in Table 6. Each cell comprises the data of the correlation between a Shapley-Shubik index variant and the corresponding Banzhaf index variant. Cells with bold type comprise a correlation coefficient with a p-value below 5%. Shaded cells comprise a negative correlation coefficient. 58.45% is the sample median of the unknown voting rights, 15.03% is the sample median of the size of the second largest bloc, and 5.865% is the sample median of the standard deviation of the two largest blocs.

Table 12: Spearman Correlation between Shapley-Shubik Index and Corresponding Banzhaf Index for the Second Largest Shareholder

Variables/Statistics		Spearman Correlation between Shapley-Shubik Index and Corresponding Banzhaf Index of 2nd Largest Shareholder							
		subsample (v1<50% AND v2>0%)							
		unknown voting rights		# blocs		second largest bloc		STD (v1, v2)	
		<=43.27%	>43.27%	=2	>2	<=15.03%	>15.03%	<=5.865%	>5.865%
amr	Corr.coeff.	0,98	1,00	*	0,98	1,00	0,99	0,98	1,00
	p-value	0,00	.	.	0,00	.	0,00	0,00	0,00
	n	15	14	13	16	15	14	15	14
c0.5	Corr.coeff.	0,92	0,77	0,84	0,67	0,78	0,81	0,64	0,91
	p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00
	n	15	14	13	16	15	14	15	14
c1	Corr.coeff.	0,96	0,73	0,83	0,75	0,80	0,84	0,68	0,93
	p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00
	n	15	14	13	16	15	14	15	14
c3	Corr.coeff.	0,98	0,62	0,62	0,90	0,91	0,89	0,85	0,96
	p-value	0,00	0,02	0,02	0,00	0,00	0,00	0,00	0,00
	n	15	14	13	16	15	14	15	14
c5	Corr.coeff.	0,99	0,95	0,94	0,96	0,95	0,96	0,97	0,95
	p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	n	15	14	13	16	15	14	15	14

Notes: *: The correlation coefficient cannot be calculated because at least one of the variables is constant. The variables are defined in Table 6. Each cell comprises the data of the correlation between a Shapley-Shubik index variant and the corresponding Banzhaf index variant. Cells with bold type comprise a correlation coefficient with a p-value below 5%. Shaded cells comprise a negative correlation coefficient. 43.27% is the sample median of the unknown voting rights, 15.03% is the sample median of the size of the second largest bloc, and 5.865% is the sample median of the standard deviation of the two largest blocs.

Table 13: Spearman Correlation between Share in Voting Rights and Power Indices for the Principal and the Second Largest Shareholder: General Analysis

Variables/Statistics		Spearman Correlation between Share in Voting Rights and Power Indices									
		Principal Shareholder (x=1)					Second Largest Shareholder (x=2)				
		final sample			subsample (v1<50%)		subsample (v2>0%)			subsample (v1<50% AND v2>0%)	
		v1	v1mod1	v1mod2	v1	v1mod2	v2	v2mod1	v2mod2	v2	v2mod2
vx	Corr.coeff.		**0,83**	**0,60**		**0,82**		**0,39**	0,12		0,21
	p-value		**0,00**	**0,00**		**0,00**		**0,00**	0,40		0,27
	n		**161**	**161**		**51**		**52**	52		29
vxmod1	Corr.coeff.	**0,83**		**0,72**			**0,39**		**0,48**		
	p-value	**0,00**		**0,00**			**0,00**		**0,00**		
	n	**161**		**161**			**52**		**52**		
vxmod2	Corr.coeff.	**0,60**	**0,72**		**0,82**		0,12	**0,48**		0,21	
	p-value	**0,00**	**0,00**		**0,00**		0,40	**0,00**		0,27	
	n	**161**	**161**		**51**		52	**52**		29	
bxamr	Corr.coeff.	**0,30**	**0,37**	**0,17**	0,00	-0,11	**0,29**	**0,54**	0,23	**0,41**	0,06
	p-value	**0,00**	**0,00**	**0,03**	0,99	0,45	**0,04**	**0,00**	0,10	**0,03**	0,74
	n	**161**	**161**	**161**	51	51	**52**	**52**	52	**29**	29
bxc0.5	Corr.coeff.	**0,75**	**0,91**	**0,76**	**0,74**	**0,66**	0,21	**0,79**	**0,50**	**0,41**	0,24
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,14	**0,00**	**0,00**	**0,03**	0,21
	n	**161**	**161**	**161**	**51**	**51**	52	**52**	**52**	**29**	29
bxc1	Corr.coeff.	**0,80**	**0,94**	**0,73**	**0,83**	**0,75**	0,25	**0,86**	**0,54**	**0,42**	0,30
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,07	**0,00**	**0,00**	**0,02**	0,11
	n	**161**	**161**	**161**	**51**	**51**	52	**52**	**52**	**29**	29
bxc3	Corr.coeff.	**0,83**	**0,98**	**0,72**	**0,92**	**0,83**	**0,27**	**0,89**	**0,53**	**0,50**	0,30
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,05**	**0,00**	**0,00**	**0,01**	0,11
	n	**161**	**161**	**161**	**51**	**51**	**52**	**52**	**52**	**29**	29
bxc5	Corr.coeff.	**0,83**	**0,98**	**0,72**	**0,94**	**0,85**	**0,30**	**0,91**	**0,53**	**0,59**	0,30
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,03**	**0,00**	**0,00**	**0,00**	0,12
	n	**161**	**161**	**161**	**51**	**51**	**52**	**52**	**52**	**29**	29
ssxamr	Corr.coeff.	**0,30**	**0,37**	**0,17**	0,00	-0,10	**0,29**	**0,54**	0,22	**0,41**	0,05
	p-value	**0,00**	**0,00**	**0,03**	1,00	0,49	**0,04**	**0,00**	0,11	**0,03**	0,81
	n	**161**	**161**	**161**	51	51	**52**	**52**	52	**29**	29
ssxc0.5	Corr.coeff.	**0,83**	**0,99**	**0,72**	**0,97**	**0,85**	**0,30**	**0,92**	**0,50**	**0,59**	0,21
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,03**	**0,00**	**0,00**	**0,00**	0,26
	n	**161**	**161**	**161**	**51**	**51**	**52**	**52**	**52**	**29**	29
ssxc1	Corr.coeff.	**0,83**	**0,99**	**0,72**	**0,97**	**0,86**	**0,30**	**0,92**	**0,50**	**0,59**	0,21
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,03**	**0,00**	**0,00**	**0,00**	0,27
	n	**161**	**161**	**161**	**51**	**51**	**52**	**52**	**52**	**29**	29
ssxc3	Corr.coeff.	**0,83**	**0,99**	**0,72**	**0,98**	**0,86**	0,27	**0,90**	**0,53**	**0,48**	0,30
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,05	**0,00**	**0,00**	**0,01**	0,12
	n	**161**	**161**	**161**	**51**	**51**	52	**52**	**52**	**29**	29
ssxc5	Corr.coeff.	**0,83**	**0,99**	**0,73**	**0,98**	**0,86**	**0,31**	**0,92**	**0,48**	**0,62**	0,17
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,02**	**0,00**	**0,00**	**0,00**	0,37
	n	**161**	**161**	**161**	**51**	**51**	**52**	**52**	**52**	**29**	29
ssxco	Corr.coeff.	**0,82**	**1,00**	**0,73**	**0,97**	**0,85**	0,27	**0,92**	**0,51**	**0,57**	0,24
	p-value	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,05	**0,00**	**0,00**	**0,00**	0,21
	n	**161**	**161**	**161**	**51**	**51**	52	**52**	**52**	**29**	29

Notes: The variables are defined in Table 6. Cells with bold type comprise a correlation coefficient with a p-value below 5%. Shaded cells comprise a negative correlation coefficient. In the analyses on the right-hand side of both the principal and the second largest shareholder, the columns for v1mod1 and v2mod1, resp., are missing because the definitions of the relevant subsamples lead to the result that v1 equals v1mod1 and v2 is equal to v2mod1, resp.

Table 14: Spearman Correlation between Share in Voting Rights and Power Indices for the Principal Shareholder: Analysis of Specific Shareholder Structures

Variables/Statistics		Spearman Correlation between Share in Voting Rights and Power Indices of Principal Shareholder															
		subsample (v1<50%)								subsample (v1<50% AND v2>0%)							
		unknown voting rights				# blocs				second largest bloc				difference in size between blocs 1, 2 STD (v1, v2)			
		<=58.45%		>58.45%		1		>1		<=15.03%		>15.03%		<=5.865%		>5.865%	
		v1	v1mod2	v1	v1mod2	v1	v1mod2	v1	v1mod2	v1	v1mod2	v1	v1mod2	v1	v1mod2	v1	v1mod2
v1	Corr.coeff.		0,31		**0,99**		**0,95**		**0,64**		**0,92**		0,18		**0,84**		-0,24
	p-value		0,13		**0,00**		**0,00**		**0,00**		**0,00**		0,53		**0,00**		0,41
	n		26		**25**		**22**		**29**		**15**		14		**15**		14
v1mod2	Corr.coeff.	0,31		**0,99**		**0,95**		**0,64**		**0,92**		0,18		**0,84**		-0,24	
	p-value	0,13		**0,00**		**0,00**		**0,00**		**0,00**		0,53		**0,00**		0,41	
	n	26		**25**		**22**		**29**		**15**		14		**15**		14	
b1amr	Corr.coeff.	**0,56**	0,22	0,17	0,17	*	*	0,16	0,00	0,27	0,14	0,35	0,04	-0,38	-0,37	0,37	-0,14
	p-value	**0,00**	0,29	0,42	0,41	.	.	0,42	0,98	0,33	0,62	0,22	0,88	0,16	0,18	0,19	0,62
	n	**26**	26	25	25	22	22	29	29	15	15	14	14	15	15	14	14
b1c0.5	Corr.coeff.	**0,84**	**0,40**	**0,95**	**0,93**	**0,98**	**0,98**	**0,72**	**0,52**	**0,85**	**0,71**	**0,84**	0,18	**0,52**	0,38	**0,54**	-0,24
	p-value	**0,00**	**0,04**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,53	**0,05**	0,16	**0,05**	0,41
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	15	**14**	14
b1c1	Corr.coeff.	**0,86**	**0,45**	**0,97**	**0,96**	**0,99**	**0,96**	**0,80**	**0,63**	**0,94**	**0,84**	**0,94**	0,22	**0,70**	0,51	**0,57**	-0,24
	p-value	**0,00**	**0,02**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,45	**0,00**	0,05	**0,03**	0,41
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	15	**14**	14
b1c3	Corr.coeff.	**0,88**	**0,43**	**0,99**	**0,98**	**1,00**	**0,95**	**0,90**	**0,71**	**0,98**	**0,91**	**0,95**	0,22	**0,96**	**0,81**	**0,72**	-0,31
	p-value	**0,00**	**0,03**	**0,00**	**0,00**	.	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,44	**0,00**	**0,00**	**0,00**	0,28
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	**15**	**14**	14
b1c5	Corr.coeff.	**0,89**	**0,44**	**1,00**	**0,99**	**1,00**	**0,95**	**0,91**	**0,72**	**0,99**	**0,92**	**0,95**	0,26	**0,99**	**0,85**	**0,73**	-0,31
	p-value	**0,00**	**0,02**	**0,00**	**0,00**	.	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,36	**0,00**	**0,00**	**0,00**	0,28
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	**15**	**14**	14
ss1amr	Corr.coeff.	**0,56**	0,25	0,17	0,17	*	*	0,16	0,03	0,27	0,14	0,33	0,09	-0,34	-0,28	0,37	-0,14
	p-value	**0,00**	0,22	0,42	0,41	.	.	0,40	0,88	0,33	0,62	0,25	0,77	0,21	0,31	0,19	0,62
	n	**26**	26	25	25	22	22	29	29	15	15	14	14	15	15	14	14
ss1c0.5	Corr.coeff.	**0,92**	**0,43**	**1,00**	**0,99**	**1,00**	**0,95**	**0,95**	**0,71**	**1,00**	**0,92**	**0,95**	0,26	**1,00**	**0,86**	**0,85**	-0,31
	p-value	**0,00**	**0,03**	**0,00**	**0,00**	.	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,36	**0,00**	**0,00**	**0,00**	0,28
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	**15**	**14**	14
ss1c1	Corr.coeff.	**0,92**	**0,43**	**1,00**	**0,99**	**1,00**	**0,95**	**0,95**	**0,70**	**0,99**	**0,92**	**0,95**	0,26	**0,99**	**0,85**	**0,86**	-0,31
	p-value	**0,00**	**0,03**	**0,00**	**0,00**	.	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,36	**0,00**	**0,00**	**0,00**	0,28
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	**15**	**14**	14
ss1c3	Corr.coeff.	**0,93**	**0,41**	**1,00**	**0,99**	**1,00**	**0,95**	**0,96**	**0,69**	**1,00**	**0,92**	**0,97**	0,23	**1,00**	**0,86**	**0,88**	-0,31
	p-value	**0,00**	**0,04**	**0,00**	**0,00**	.	**0,00**	**0,00**	**0,00**	.	**0,00**	**0,00**	0,42	**0,00**	**0,00**	**0,00**	0,28
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	**15**	**14**	14
ss1c5	Corr.coeff.	**0,93**	**0,43**	**1,00**	**0,99**	**1,00**	**0,95**	**0,95**	**0,70**	**0,99**	**0,92**	**0,96**	0,26	**0,99**	**0,85**	**0,88**	-0,31
	p-value	**0,00**	**0,03**	**0,00**	**0,00**	.	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,36	**0,00**	**0,00**	**0,00**	0,28
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	**15**	**14**	14
ss1co	Corr.coeff.	**0,92**	**0,43**	**1,00**	**0,99**	**1,00**	**0,95**	**0,94**	**0,70**	**0,99**	**0,92**	**0,95**	0,26	**0,99**	**0,85**	**0,82**	-0,31
	p-value	**0,00**	**0,03**	**0,00**	**0,00**	.	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	0,36	**0,00**	**0,00**	**0,00**	0,28
	n	**26**	**26**	**25**	**25**	**22**	**22**	**29**	**29**	**15**	**15**	**14**	14	**15**	**15**	**14**	14

Notes: *: The correlation coefficient cannot be calculated because at least one of the variables is constant. The variables are defined in Table 6. Cells with bold type comprise a correlation coefficient with a p-value below 5%. Shaded cells comprise a negative correlation coefficient. For these subsamples, v1mod1 is equal to v1 and is not reported. 58.45% is the sample median of the unknown voting rights, 15.03% is the sample median of the size of the second largest bloc, and 5.865% is the sample median of the standard deviation of the two largest blocs.

Table 15: Spearman Correlation between Share in Voting Rights and Power Indices for the Second Largest Shareholder: Analysis of Specific Shareholder Structures

Variables/Statistics		Spearman Correlation between Share in Voting Rights and Power Indices of Second Largest Shareholder															
		subsample (v1<50% AND v2>0%)															
		unknown voting rights				# blocs				second largest bloc				difference in size between blocs 1, 2 STD (v1, v2)			
		<=43.27%		>43.27%		2		>2		<=15.03%		>15.03%		<=5.865%		>5.865%	
		v2	v2mod2	v2	v2mod2	v2	v2mod2	v2	v2mod2	v2	v2mod2	v2	v2mod2	v2	v2mod2	v2	v2mod2
v2	Corr.coeff.		**0,78**		0,33		0,07		0,34		0,04		**0,70**		0,30		0,45
	p-value		**0,00**		0,25		0,83		0,19		0,90		**0,00**		0,28		0,11
	n		**15**		14		13		16		15		**14**		15		14
v2mod2	Corr.coeff.	**0,78**		0,33		0,07		0,34		0,04		**0,70**		0,30		0,45	
	p-value	**0,00**		0,25		0,83		0,19		0,90		**0,00**		0,28		0,11	
	n	**15**		14		13		16		15		**14**		15		14	
b2amr	Corr.coeff.	0,23	0,04	0,30	0,42	*	*	0,31	0,10	0,51	0,17	0,46	0,04	0,51	-0,08	0,10	-0,14
	p-value	0,42	0,89	0,30	0,14	.		0,25	0,70	0,05	0,55	0,10	0,88	0,05	0,78	0,75	0,62
	n	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14
b2c0.5	Corr.coeff.	0,37	0,17	0,52	**0,61**	-0,17	0,33	0,42	0,36	0,20	**0,67**	0,53	0,03	**0,63**	-0,05	0,15	-0,35
	p-value	0,18	0,53	0,06	**0,02**	0,58	0,27	0,10	0,17	0,48	**0,01**	0,05	0,91	**0,01**	0,86	0,61	0,22
	n	15	15	14	**14**	13	13	16	16	15	**15**	14	14	**15**	15	14	14
b2c1	Corr.coeff.	0,43	0,22	0,44	**0,76**	-0,19	0,49	0,46	0,34	0,21	**0,64**	**0,57**	0,22	**0,64**	0,10	0,19	-0,24
	p-value	0,11	0,43	0,12	**0,00**	0,53	0,09	0,07	0,19	0,46	**0,01**	**0,03**	0,44	**0,01**	0,73	0,51	0,41
	n	15	15	14	**14**	13	13	16	16	15	**15**	**14**	14	**15**	15	14	14
b2c3	Corr.coeff.	0,48	0,25	**0,64**	**0,76**	-0,06	0,46	**0,60**	0,36	0,32	**0,62**	0,52	0,20	**0,82**	0,06	0,17	-0,24
	p-value	0,07	0,37	**0,01**	**0,00**	0,86	0,12	**0,01**	0,17	0,25	**0,01**	0,06	0,49	**0,00**	0,82	0,55	0,41
	n	15	15	**14**	**14**	13	13	**16**	16	15	**15**	14	14	**15**	15	14	14
b2c5	Corr.coeff.	**0,53**	0,25	**0,72**	**0,65**	0,06	0,41	**0,74**	0,35	0,35	**0,62**	**0,53**	0,20	**0,91**	0,08	0,31	-0,10
	p-value	**0,04**	0,37	**0,00**	**0,01**	0,84	0,16	**0,00**	0,19	0,19	**0,01**	**0,05**	0,49	**0,00**	0,79	0,28	0,73
	n	**15**	15	**14**	**14**	13	13	**16**	16	15	**15**	**14**	14	**15**	15	14	14
ss2amr	Corr.coeff.	0,22	0,00	0,30	0,42	*	*	0,31	0,06	0,51	0,17	0,40	0,00	0,48	-0,13	0,12	-0,14
	p-value	0,43	1,00	0,30	0,14	.	.	0,24	0,83	0,05	0,55	0,15	1,00	0,07	0,63	0,68	0,62
	n	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14
ss2c0.5	Corr.coeff.	0,51	0,22	**0,82**	**0,63**	0,02	0,28	**0,74**	0,30	0,45	**0,56**	0,44	0,16	**0,86**	0,03	0,18	-0,31
	p-value	0,05	0,43	**0,00**	**0,01**	0,94	0,35	**0,00**	0,25	0,09	**0,03**	0,11	0,58	**0,00**	0,90	0,53	0,28
	n	15	15	**14**	**14**	13	13	**16**	16	15	**15**	14	14	**15**	15	14	14
ss2c1	Corr.coeff.	0,51	0,22	**0,84**	**0,63**	0,05	0,27	**0,74**	0,30	0,46	**0,55**	0,44	0,16	**0,86**	0,03	0,18	-0,31
	p-value	0,05	0,43	**0,00**	**0,02**	0,87	0,37	**0,00**	0,25	0,09	**0,03**	0,11	0,58	**0,00**	0,90	0,53	0,28
	n	15	15	**14**	**14**	13	13	**16**	16	15	**15**	14	14	**15**	15	14	14
ss2c3	Corr.coeff.	**0,55**	0,25	0,44	**0,84**	-0,29	0,46	**0,76**	0,34	0,46	**0,55**	0,42	0,27	**0,73**	0,25	0,18	-0,31
	p-value	**0,04**	0,36	0,12	**0,00**	0,33	0,12	**0,00**	0,20	0,09	**0,03**	0,14	0,35	**0,00**	0,36	0,53	0,28
	n	**15**	15	14	**14**	13	13	**16**	16	15	**15**	14	14	**15**	15	14	14
ss2c5	Corr.coeff.	**0,55**	0,25	**0,86**	**0,55**	0,07	0,19	**0,81**	0,27	0,48	**0,52**	0,47	0,11	**0,87**	-0,03	0,22	-0,31
	p-value	**0,04**	0,36	**0,00**	**0,04**	0,82	0,54	**0,00**	0,31	0,07	**0,05**	0,09	0,71	**0,00**	0,90	0,45	0,28
	n	**15**	15	**14**	**14**	13	13	**16**	16	15	**15**	14	14	**15**	15	14	14
ss2co	Corr.coeff.	0,51	0,22	**0,78**	**0,66**	-0,02	0,32	**0,71**	0,35	0,42	**0,58**	0,44	0,16	**0,86**	0,03	0,17	-0,31
	p-value	0,05	0,43	**0,00**	**0,01**	0,96	0,29	**0,00**	0,19	0,12	**0,02**	0,11	0,58	**0,00**	0,90	0,55	0,28
	n	15	15	**14**	**14**	13	13	**16**	16	15	**15**	14	14	**15**	15	14	14

Notes: *: The correlation coefficient cannot be calculated because at least one of the variables is constant. The variables are defined in Table 6. Cells with bold type comprise a correlation coefficient with a p-value below 5%. Shaded cells comprise a negative correlation coefficient. For these subsamples, v2mod1 is equal to v2 and is not reported. 43.27% is the sample median of the unknown voting rights, 15.03% is the sample median of the size of the second largest bloc, and 5.865% is the sample median of the standard deviation of the two largest blocs.

Table 16: Spearman Correlation between Measures of Shareholder Influence and Board Representation for the Principal Shareholder

Variables/Statistics		Spearman Correlation between Measures of Shareholder Influence and Board Membership of Principal Shareholder																			
		final sample		subsample (v1<50%)								subsample (v1<50% AND v2>0%)									
		complete		complete		unknown voting rights				# blocs				second largest bloc				diff. in size between blocs 1, 2 STD (v1, v2)			
						<=58.45%		>58.45%		1		>1		<=15.03%		>15.03%		<=5.865%		>5.865%	
		supb1	manb1	supb1	manb1	supb1	manb1	supb1	manb1	supb1	manb1	supb1	manb1	supb1	manb1	supb1	manb1	supb1	manb1	supb1	manb1
v1	Corr.coeff.	**0,36**	**0,27**	0,14	-0,23	0,14	0,06	0,12	**-0,53**	-0,06	-0,33	0,33	0,07	0,37	*	0,25	-0,20	**0,60**	0,41	-0,21	*
	p-value	**0,00**	**0,00**	0,31	0,10	0,50	0,78	0,57	**0,01**	0,81	0,13	0,08	0,74	0,17	.	0,39	0,49	**0,02**	0,13	0,48	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
v1mod1	Corr.coeff.	**0,34**	**0,24**																		
	p-value	**0,00**	**0,00**																		
	n	**161**	**161**																		
v1mod2	Corr.coeff.	**0,26**	0,08	0,15	**-0,32**	0,05	-0,03	0,14	**-0,54**	-0,01	-0,41	0,31	0,00	0,48	*	0,02	-0,18	0,47	0,30	0,03	*
	p-value	**0,00**	0,30	0,29	**0,02**	0,79	0,89	0,50	**0,01**	0,96	0,06	0,10	1,00	0,07	.	0,94	0,54	0,08	0,28	0,91	.
	n	**161**	161	51	**51**	26	26	25	**25**	22	22	29	29	15	15	14	14	15	15	14	14
b1amr	Corr.coeff.	0,14	0,09	0,01	-0,02	-0,07	-0,19	0,24	0,11	*	*	-0,01	**-0,43**	0,29	*	-0,16	-0,52	-0,22	-0,46	0,14	*
	p-value	0,07	0,23	0,97	0,89	0,73	0,36	0,24	0,59	.	.	0,97	**0,02**	0,29	.	0,59	0,06	0,43	0,08	0,64	.
	n	161	161	51	51	26	26	25	25	22	22	29	**29**	15	15	14	14	15	15	14	14
b1c0.5	Corr.coeff.	**0,29**	**0,21**	0,09	-0,20	-0,05	0,07	0,19	**-0,41**	-0,03	-0,37	0,25	-0,15	0,42	*	0,01	-0,30	**0,55**	0,14	-0,30	*
	p-value	**0,00**	**0,01**	0,51	0,15	0,82	0,73	0,37	**0,04**	0,89	0,09	0,20	0,45	0,12	.	0,97	0,29	**0,03**	0,63	0,30	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
b1c1	Corr.coeff.	**0,31**	**0,26**	0,08	-0,24	0,00	0,14	0,14	**-0,47**	-0,06	-0,32	0,32	-0,10	0,46	*	0,10	-0,15	**0,75**	0,27	-0,31	*
	p-value	**0,00**	**0,00**	0,55	0,09	0,99	0,49	0,49	**0,02**	0,78	0,15	0,09	0,61	0,09	.	0,75	0,60	**0,00**	0,33	0,28	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
b1c3	Corr.coeff.	**0,33**	**0,25**	0,08	-0,27	0,01	0,09	0,12	**-0,53**	-0,06	-0,33	0,30	-0,08	0,48	*	0,11	-0,25	**0,70**	0,36	-0,37	*
	p-value	**0,00**	**0,00**	0,57	0,06	0,94	0,68	0,57	**0,01**	0,81	0,13	0,11	0,67	0,07	.	0,71	0,38	**0,00**	0,18	0,19	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
b1c5	Corr.coeff.	**0,34**	**0,25**	0,08	-0,26	0,00	0,11	0,12	**-0,53**	-0,06	-0,33	0,25	-0,05	0,40	*	0,11	-0,20	**0,58**	0,41	-0,42	*
	p-value	**0,00**	**0,00**	0,57	0,06	0,99	0,58	0,57	**0,01**	0,81	0,13	0,19	0,80	0,14	.	0,71	0,49	**0,02**	0,13	0,13	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
ss1amr	Corr.coeff.	0,14	0,09	0,00	-0,02	-0,09	-0,20	0,24	0,11	*	*	-0,02	**-0,44**	0,29	*	-0,22	**-0,57**	-0,23	-0,50	0,14	*
	p-value	0,07	0,23	0,99	0,87	0,65	0,32	0,24	0,59	.	.	0,91	**0,02**	0,29	.	0,45	**0,03**	0,40	0,06	0,64	.
	n	161	161	51	51	26	26	25	25	22	22	29	**29**	15	15	14	**14**	15	15	14	14
ss1c0.5	Corr.coeff.	**0,34**	**0,26**	0,10	-0,24	0,02	0,09	0,13	**-0,52**	-0,06	-0,33	0,25	-0,02	0,39	*	0,11	-0,20	**0,57**	0,41	-0,35	*
	p-value	**0,00**	**0,00**	0,50	0,09	0,93	0,68	0,55	**0,01**	0,81	0,13	0,19	0,93	0,15	.	0,71	0,49	**0,03**	0,13	0,22	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
ss1c1	Corr.coeff.	**0,34**	**0,26**	0,10	-0,24	0,01	0,09	0,12	**-0,53**	-0,06	-0,33	0,25	-0,02	0,40	*	0,11	-0,20	**0,58**	0,41	-0,37	*
	p-value	**0,00**	**0,00**	0,50	0,09	0,96	0,68	0,56	**0,01**	0,81	0,13	0,19	0,93	0,14	.	0,71	0,49	**0,02**	0,13	0,19	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
ss1c3	Corr.coeff.	**0,33**	**0,26**	0,09	-0,24	0,03	0,09	0,09	**-0,53**	-0,06	-0,33	0,25	-0,02	0,37	*	0,13	-0,20	**0,57**	0,41	-0,37	*
	p-value	**0,00**	**0,00**	0,53	0,09	0,90	0,68	0,66	**0,01**	0,81	0,13	0,19	0,93	0,17	.	0,67	0,49	**0,03**	0,13	0,19	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
ss1c5	Corr.coeff.	**0,34**	**0,26**	0,09	-0,24	0,01	0,09	0,11	**-0,53**	-0,06	-0,33	0,25	-0,02	0,40	*	0,14	-0,20	**0,58**	0,41	-0,39	*
	p-value	**0,00**	**0,00**	0,51	0,09	0,98	0,68	0,61	**0,01**	0,81	0,13	0,19	0,93	0,14	.	0,63	0,49	**0,02**	0,13	0,17	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14
ss1co	Corr.coeff.	**0,34**	**0,24**	0,09	-0,24	0,02	0,09	0,12	**-0,53**	-0,06	-0,33	0,24	-0,02	0,40	*	0,11	-0,20	**0,58**	0,41	-0,40	*
	p-value	**0,00**	**0,00**	0,53	0,09	0,93	0,68	0,56	**0,01**	0,81	0,13	0,20	0,93	0,14	.	0,71	0,49	**0,02**	0,13	0,16	.
	n	**161**	**161**	51	51	26	26	25	**25**	22	22	29	29	15	15	14	14	**15**	15	14	14

Notes: *: The correlation coefficient cannot be calculated because at least one of the variables is constant. The variables are defined in Table 6. Cells with bold type comprise a correlation coefficient with a p-value below 5%. Shaded cells comprise a negative correlation coefficient. 58.45% is the sample median of the unknown voting rights, 15.03% is the sample median of the size of the second largest bloc, and 5.865% is the sample median of the standard deviation of the two largest blocs. v1mod1 is equal to v1 if v1<50%, thus the results are not shown twice.

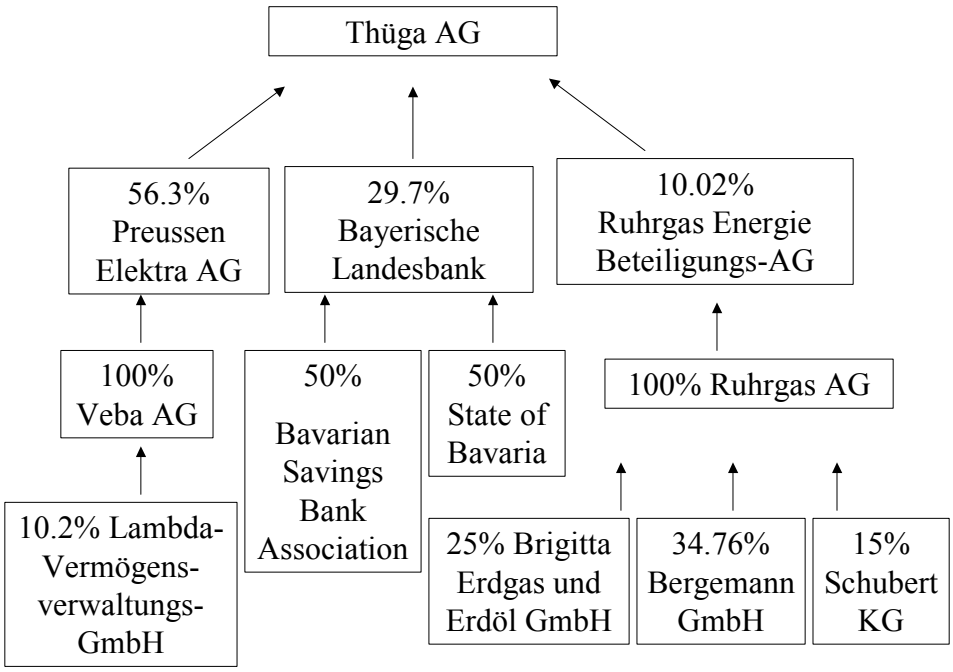
Table 17: Spearman Correlation between Measures of Shareholder Influence and Board Representation for the Second Largest Shareholder

Variables/Statistics		Spearman Correlation between Measures of Shareholder Influence and Board Membership of Second Largest Shareholder																							
		final sample		subsample (v2>0%)		subsample (v2>0% AND v1<50%)																			
		complete		complete		complete		unknown voting rights				# blocs				second largest bloc				diff. in size between blocs 1, 2 STD (v1, v2)					
								<=43.27%		>43.27%		2		>2		<=15.03%		>15.03%		<=5.865%		>5.865%			
		supb2	manb2	supb2	manb2	supb2	manb2	supb2	manb2	supb2	manb2	supb2	manb2	supb2	manb2	supb2	manb2	supb2	manb2	supb2	manb2	supb2	manb2		
v2	Corr.coeff.	**0,64**	**0,25**	0,07	0,12	-0,20	-0,01	-0,24	*	0,02	0,28	0,11	0,26	-0,04	*	0,33	-0,06	0,01	0,03	0,12	0,12	**-0,58**	-0,31		
	p-value	**0,00**	**0,00**	0,64	0,41	0,29	0,96	0,38	.	0,96	0,33	0,73	0,38	0,87	.	0,23	0,83	0,96	0,91	0,66	0,66	**0,03**	0,28		
	n	**161**	**161**	52	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	**14**	14		
v2mod1	Corr.coeff.	**0,65**	0,13	**0,32**	-0,02																				
	p-value	**0,00**	0,09	**0,02**	0,86																				
	n	**161**	161	**52**	52																				
v2mod2	Corr.coeff.	**0,45**	-0,05	**0,28**	-0,16	0,10	-0,22	0,15	*	0,03	-0,42	-0,31	-0,37	0,44	*	-0,43	-0,24	0,41	-0,20	**0,65**	-0,34	-0,32	-0,08		
	p-value	**0,00**	0,57	**0,04**	0,27	0,60	0,26	0,60	.	0,93	0,13	0,31	0,21	0,08	.	0,11	0,40	0,14	0,49	**0,01**	0,21	0,27	0,79		
	n	**161**	161	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	**15**	15	14	14		
b2amr	Corr.coeff.	**0,43**	-0,04	0,22	-0,14	-0,01	-0,19	0,08	*	0,14	-0,17	*	*	0,32	*	0,20	-0,16	0,12	-0,24	-0,01	-0,24	-0,01	-0,14		
	p-value	**0,00**	0,61	0,12	0,32	0,97	0,31	0,79	.	0,64	0,57	.	.	0,22	.	0,48	0,57	0,69	0,42	0,97	0,38	0,98	0,62		
	n	**161**	161	52	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14		
b2c0.5	Corr.coeff.	**0,58**	0,06	0,26	-0,06	-0,20	0,01	0,00	*	-0,31	-0,05	-0,43	0,04	0,33	*	-0,22	-0,40	-0,04	0,45	-0,06	0,43	-0,44	-0,35		
	p-value	**0,00**	0,47	0,07	0,66	0,30	0,96	1,00	.	0,27	0,87	0,14	0,90	0,21	.	0,42	0,14	0,90	0,11	0,83	0,11	0,11	0,22		
	n	**161**	161	52	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14		
b2c1	Corr.coeff.	**0,65**	**0,20**	**0,35**	-0,02	-0,12	-0,20	-0,02	*	-0,12	-0,23	-0,43	-0,03	0,35	*	-0,24	-0,37	0,20	-0,17	0,20	-0,19	**-0,53**	-0,31		
	p-value	**0,00**	**0,01**	**0,01**	0,86	0,55	0,29	0,94	.	0,68	0,42	0,14	0,91	0,18	.	0,40	0,17	0,50	0,56	0,46	0,51	**0,05**	0,28		
	n	**161**	**161**	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	**14**	14		
b2c3	Corr.coeff.	**0,71**	**0,20**	**0,39**	0,00	-0,14	-0,11	-0,06	*	-0,17	-0,14	-0,42	0,02	0,28	*	-0,24	-0,37	0,21	0,03	0,10	0,00	**-0,53**	-0,31		
	p-value	**0,00**	**0,01**	**0,00**	1,00	0,46	0,58	0,84	.	0,57	0,63	0,16	0,95	0,30	.	0,39	0,17	0,47	0,91	0,73	1,00	**0,05**	0,28		
	n	**161**	**161**	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	**14**	14		
b2c5	Corr.coeff.	**0,70**	**0,21**	**0,36**	0,02	-0,22	-0,04	-0,09	*	-0,25	-0,05	-0,47	0,07	0,18	*	-0,26	-0,37	0,16	0,17	0,02	0,19	**-0,61**	-0,31		
	p-value	**0,00**	**0,01**	**0,01**	0,89	0,26	0,82	0,74	.	0,39	0,87	0,11	0,82	0,50	.	0,35	0,17	0,59	0,56	0,94	0,51	**0,02**	0,28		
	n	**161**	**161**	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	**14**	14		
ss2amr	Corr.coeff.	**0,43**	-0,04	0,22	-0,14	-0,02	-0,19	0,06	*	0,14	-0,17	*	*	0,29	*	0,20	-0,16	0,13	-0,23	-0,02	-0,24	-0,02	-0,14		
	p-value	**0,00**	0,61	0,12	0,32	0,94	0,32	0,83	.	0,64	0,57	.	.	0,28	.	0,48	0,57	0,66	0,43	0,96	0,39	0,94	0,62		
	n	**161**	161	52	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14		
ss2c0.5	Corr.coeff.	**0,68**	**0,21**	**0,35**	0,02	-0,20	-0,01	-0,09	*	-0,22	-0,04	-0,36	0,14	0,13	*	-0,30	-0,31	0,19	0,17	0,03	0,19	-0,51	-0,17		
	p-value	**0,00**	**0,01**	**0,01**	0,87	0,29	0,95	0,74	.	0,44	0,89	0,23	0,65	0,63	.	0,28	0,26	0,51	0,56	0,92	0,51	0,06	0,56		
	n	**161**	**161**	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14		
ss2c1	Corr.coeff.	**0,68**	**0,21**	**0,36**	0,03	-0,17	0,01	-0,09	*	-0,07	0,01	-0,23	0,20	0,13	*	-0,16	-0,25	0,19	0,17	0,05	0,19	-0,51	-0,17		
	p-value	**0,00**	**0,01**	**0,01**	0,84	0,36	0,98	0,74	.	0,81	0,96	0,45	0,51	0,63	.	0,57	0,37	0,51	0,56	0,86	0,51	0,06	0,56		
	n	**161**	**161**	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14		
ss2c3	Corr.coeff.	**0,69**	**0,19**	**0,40**	-0,08	-0,06	-0,34	-0,09	*	0,22	-0,49	0,03	-0,26	0,13	*	-0,16	-0,25	0,28	-0,38	0,26	-0,43	-0,51	-0,17		
	p-value	**0,00**	**0,02**	**0,00**	0,57	0,74	0,07	0,74	.	0,44	0,07	0,93	0,39	0,63	.	0,57	0,37	0,34	0,18	0,35	0,11	0,06	0,56		
	n	**161**	**161**	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14		
ss2c5	Corr.coeff.	**0,68**	**0,22**	**0,35**	0,03	-0,21	0,02	-0,09	*	-0,12	0,06	-0,27	0,25	0,08	*	-0,16	-0,25	0,13	0,24	-0,02	0,25	-0,53	-0,17		
	p-value	**0,00**	**0,01**	**0,01**	0,81	0,27	0,91	0,74	.	0,68	0,84	0,37	0,40	0,76	.	0,57	0,37	0,65	0,41	0,93	0,37	0,05	0,56		
	n	**161**	**161**	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14		
ss2co	Corr.coeff.	**0,66**	0,13	**0,35**	-0,03	-0,19	-0,03	-0,09	*	-0,18	-0,09	-0,33	0,08	0,16	*	-0,25	-0,37	0,19	0,17	0,05	0,19	-0,52	-0,24		
	p-value	**0,00**	0,09	**0,01**	0,83	0,34	0,89	0,74	.	0,54	0,75	0,27	0,80	0,56	.	0,37	0,17	0,51	0,56	0,86	0,51	0,06	0,41		
	n	**161**	161	**52**	52	29	29	15	15	14	14	13	13	16	16	15	15	14	14	15	15	14	14		

Notes: *: The correlation coefficient cannot be calculated because at least one of the variables is constant. The variables are defined in Table 6. Cells with bold type comprise a correlation coefficient with a p-value below 5%. Shaded cells comprise a negative correlation coefficient. 43.27% is the sample median of the unknown voting rights, 15.03% is the sample median of the size of the second largest bloc, and 5.865% is the sample median of the standard deviation of the two largest blocs. v2mod1 is equal to v2 if v1<50%, thus the results are not shown twice.

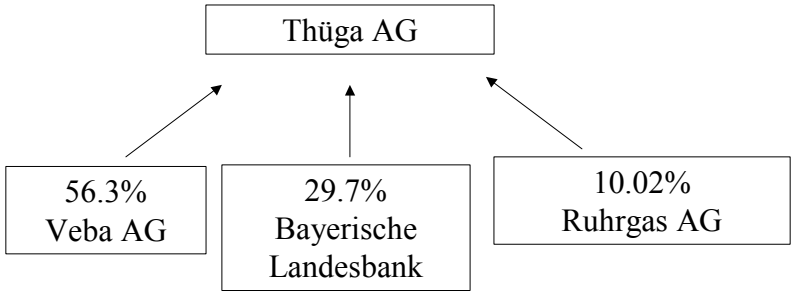
Appendix: Determination of Ultimate Owners: Example and Additional Information

Figure 2: Voting Rights Structure of the Thüga AG as of 30.9.1996



Source: Prigge & Kehren (2006: 220). The remaining votes are dispersed. Thüga AG is a German utility and thus not part of the sample; moreover, the year 1996 is not part of the time period analyzed.

Figure 3: Ultimate Voting Rights Structure of the Thüga AG as of 30.9.1996



Source: Prigge & Kehren (2006: 220). There are two shareholders in Bayerische Landesbank, each holding a 50% stake. Under the assumption that the Bavarian Savings Bank Association is not so close to the state to justify the merging of its stake with that of the State of Bavaria, none of them has a dominating position. As a consequence, Bayerische Landesbank is the ultimate shareholder as well.

There are three cases in which voting rights are not analyzed on a single entity but on a group basis: (1) Section 22 Securities Trading Act requires that

voting rights which are part of a voting rights pool have to be dealt with as if there was a single owner. The data are shown in the data base of the BAWe accordingly. However, shareholders often do not place all of their voting rights in the pool. But it seems reasonable to assume that a shareholder does exercise his voting rights which are not part of the pool in the same way as the pool's voting rights are used. Therefore, the non-pool shares are added to the pool. (2) According to section 22 Securities Trading Act, voting rights of family members have only to be aggregated when they fall under contractual agreements on the exercise of voting rights. Again, it seems plausible to add those voting rights which are not subject of such a contract to the family pool. (3) The top private banks and insurance companies in Germany were said to be closely interwoven during the period of analysis, particularly by capital and personal links. Therefore, Allianz Holding, Bayerische Hypotheken- und Wechsel-Bank, Bayerische Vereinsbank (both merged on 1.9.1998 to the Bayerische Hypo- und Vereinsbank), Commerzbank, Deutsche Bank, Dresdner Bank, and Münchener Rückversicherung are aggregated to the core group of the financial sector and are treated as a single person.[22]

[22] Adams (1994: 151) calls these corporations the "seven core corporations of the private financial sector [translated by the author]". See Höpner & Krempel (2004: 340) for a visual presentation of linkage in 1996. The procedure in this article follows Wenger & Kaserer (1998: 507; 525, fn. 65) who investigate eight large banks and insurance companies aggregately in their empirical analysis. Since then, capital and personal linkage between financial companies and in the German corporate sector in general seems to have decreased; see Höpner & Krempel (2004), Vitols (2005), and Prigge (2006).