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Abstract

This paper uses German evidence to address two questions about corporate governance. The effects of ownership on corporate governance have received much recent attention, but very little of this has been devoted to the appropriate way to measure firm ownership. The results of this paper show that the conclusions reached about the effects of ownership on corporate governance can depend critically on the particular ownership measure used, and that the widely-used weakest-link principle is wholly unsatisfactory as a means of dealing with the issues raised by pyramid ownership structures. The paper also shows that greater ownership concentration typically weakens the link between managerial pay and firm profitability. This is inconsistent with the hypothesis, emphasised in the recent literature on the USA, that large owners are a complement to, rather than a substitute for, such a link.

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1 Introduction

The view that managerial pay plays an important role in the solution of the agency problem arising from the separation of ownership and control in large firms has recently been questioned by Bertrand and Mullainathan (2000, 2001) and Bebchuk and Fried (2003, 2004). These authors argue that managerial pay is higher and less sensitive to firm performance in firms with widely-dispersed ownership, where managerial power is greatest, than it is in firms where managerial power is limited by the presence of a large outside shareholder or other factors associated with good corporate governance. Managerial pay does not, according to Bertrand and Mullainathan and Bebchuk and Fried, provide managers with the strongest incentives to act in owners' interests when firm ownership is widely dispersed, as principal-agent theory suggests, because in such firms managers essentially set their own pay. Rather, "principal-agent models work best [as explanations of managerial pay] when there are in fact individuals around to act as principals" (Bertrand and Mullainathan 2001, p. 929). In other words, linking managerial pay to firm performance is not a substitute for the absence of large outside owners: instead, the presence of large owners is required for such a link to exist.

The evidence adduced to support the view that large owners and other indicators of good corporate governance are complementary to managerial pay arrangements that link compensation to performance in line with the principal-agent model comes from the USA. A natural question to ask, therefore, is whether a similar relationship exists in other economies with different corporate governance characteristics. This paper provides evidence on the relationship between the sensitivity of managerial pay to firm performance and features of corporate governance in listed German firms. The German corporate governance system is very different from that of the USA or the UK. Listed firms in Germany, as in most countries (La Porta et al. 1999), usually have highly concentrated ownership, with only a small minority having dispersed ownership. All listed German firms are required to have both a supervisory and a management board. Responsibility for the operation of the firm rests with the management board, whose members cannot also serve on the supervisory board. The German *Aktiengesetz* (Stock Corporation Act) specifies that the main function of the supervisory board is control of the management

board, including its appointment, dismissal and remuneration. Codetermination laws require that employee representatives should typically comprise either one third or one half of the supervisory boards of listed firms. Employees are therefore formally able to influence the remuneration of senior managers of listed German firms. Section 2 of this paper describes these distinctive features of German corporate governance in greater detail, and considers how they might be expected to affect the sensitivity of managerial pay to firm performance.

The effect of firm ownership structure on pay-performance sensitivity is one major concern of this paper. A second objective of the paper is to provide evidence on the question of what is the appropriate measure of firm ownership. Recent literature has emphasised that owners of firms often exercise control via a chain of other firms – a pyramid (La Porta et al. 1999, Claessens et al. 2000, 2002, Faccio et al. 2001, Faccio and Lang 2002). However, it is not obvious how to use the voting rights at each tier of a pyramid to derive a measure of the control rights of the ultimate owners (those at the top of the pyramids). All the studies cited above have used the weakest-link principle (WLP), which assigns control rights to the ultimate owner on the basis of the minimum value of voting rights across the different links of a control chain. Despite its popularity in empirical studies, the WLP is an ad hoc measure with no theoretical underpinning. We therefore ask both whether there are better measures of ultimate ownership than the WLP and whether ownership measured at the ultimate level is empirically superior to ownership measured at the first-tier level (i.e., without tracing ownership through pyramid structures). Section 3 of the paper discusses the issues involved in measuring firm ownership and develops alternative measures of ownership, which are then tested empirically in section 6.

Empirical studies of managerial compensation consistently conclude that the elasticity of compensation to firm performance is very low, and that managerial pay is more strongly affected by firm size than by firm performance. Germany is no exception. Schmid (1997), Schwalbach and Grasshoff (1997), Grasshoff et al. (2000), and Elston and Goldberg (2003) all provide estimates confirming this finding for different samples of German firms: Schwalbach and Grasshoff, for example, estimate elasticities of about 0.06 with respect to performance and 0.18 with respect to size. The effects of ownership structure on the level of managerial compensation in

Germany have been investigated by Schmid and Elston and Goldberg: both studies find that more concentrated ownership lowers the level of managerial pay. However, the effects of ownership structure on the sensitivity of managerial pay to firm performance in Germany have not been studied, and a major objective of this paper is to provide evidence on this subject.[1] The effect of codetermination on the link between managerial compensation and firm performance in Germany has been investigated by Gorton and Schmid (2004), who find that this link is significantly weaker in firms where employee representatives comprise one half rather than one third of supervisory boards. Our analysis of the effect of codetermination on the sensitivity of managerial pay to firm performance yields a different conclusion: greater employee representation on the supervisory board does not lower this sensitivity.

The data used in this paper are derived from a sample of 271 listed German firms over the period 1989-93, and are described in section 4. The empirical analysis is presented in sections 5 and 6, and shows that, although the elasticity of managerial pay with respect to firm profitability is very low, it is affected by the ownership structure of the firm, and varies by type of largest owner. It also shows that the WLP is inadequate as a basis for assessing the effects of ownership on managerial pay, which casts serious doubt on its widespread use in analyses of ownership and corporate governance. The conclusions of the paper are set out in section 7.

2 The implications of the German corporate governance system for managerial pay

All listed German firms have both a supervisory and a management board. The main function of the former is to control the latter. Responsibility for the operation of the firm rests with the management board, whose members cannot also serve on the supervisory board. The management board is appointed and dismissed by the supervisory board, which also determines the pay of the managers, although the details of managerial contracts and remuneration are often delegated to a special sub-

[1] Kaplan (1994) examines whether the relationship between turnover of the managerial board and firm performance in Germany might be affected by the ownership structure of the firm, but finds no such evidence.

committee of the supervisory board. For the time period considered in this paper (1989-1993), the *Aktiengesetz* (Stock Corporation Act) specified explicitly that performance-related remuneration for members of the management board should be linked to the annual book profit of the firm.[2] Until the middle of the 1990s, this requirement had the effect of limiting pay for performance in German firms to bonuses which depended on accounting profits: share options were essentially non-existent as a component of managerial remuneration in the period under consideration.[3] Because of this clear statement in the *Aktiengesetz*, we use the return on equity (ROE), defined as the net profit in a year as reported in the accounts divided by the book value of equity capital in the previous year, as the relevant measure of firm performance in our empirical analysis.

In almost all cases, codetermination laws require the supervisory board to be composed of members elected separately by the owners and the employees of the firm.[4] There are three different forms of codetermination. Under *Montan* codetermination, which applies to certain coal and steel firms, the supervisory board has equal numbers of owner and employee representatives, together with a neutral member to break ties. A *Montan* firm also has a labour director on its management board, who (in contrast to the other members of the management board) cannot be appointed if a majority of the employee representatives on the supervisory board vote against the appointment. For firms not subject to *Montan* codetermination and having 2,000 or more employees, there are equal numbers of owner and employee representatives on the supervisory board. In these firms, the chairman of the supervisory board, who is elected either by a two-thirds majority or, if such a majority cannot be achieved, by the shareholder representatives alone, can cast a second vote to break ties. Such firms are also required to have a labour director on the

[2] § 86 of the *Aktiengesetz* stated that (authors' translation):
(1) The members of the management board can be awarded a participation in the profits in return for their activity. This should as a rule consist of a share of the annual profits of the company.
(2) If the members of the management board are awarded a share in the annual profits of the company, then the share is calculated according to the annual net profit, less an accumulated deficit from the preceding year and the amounts out of the annual net profit which, according to law or ordinance, are to be placed in retained earnings. Any stipulations to the contrary are null and void.

[3] § 86 of the *Aktiengesetz* was increasingly disregarded by large German companies from the middle of the 1990s (see Schwalbach 2001). It was deleted from the corporate code in 2002 by the *Transparenz- und Publizitätsgesetz* (Law on transparency and publicity).

[4] Certain types of firm are exempt from the requirement to have employee representatives on the supervisory board, but the firms analysed in this paper all have employee representatives.

management board, but this director can be appointed even if a majority of the employee representatives on the supervisory board vote against the appointment. Finally, for firms not subject to *Montan* codetermination and having fewer than 2,000 employees, one third of the supervisory board consists of employee representatives, and there is no requirement for a labour director to be on the management board.

The ownership of listed German firms is highly concentrated. We were able to obtain information about the voting rights held by the largest and the second-largest owner in 271 listed German firms at the end of 1991.[5] This sample (which is described fully in section 4) contains only 16 firms that do not have an identifiable largest owner. We treat these 16 firms as widely-held and set the voting rights of their largest owner to zero. The mean value of the voting rights controlled by the largest owner of the 271 firms in our sample is 58.23%, while the median value is 54.72%. Of these firms, 86% have a largest owner controlling 25% or more of the voting rights. 95 of the firms in our sample also have an identifiable second-largest owner: the mean value of the voting rights controlled by this owner, conditional on these being positive, is 20.75%, and the median value is 24.0%. This highly-concentrated ownership structure appears to give the owners of most listed German firms strong incentives to monitor the management to ensure that it acts in the interests of owners. Whether greater ownership concentration strengthens or weakens the link between managerial pay and firm performance is not obvious a priori. Greater monitoring of managers by owners might reduce the need for managers to be given incentives to act in owners' interests by having their pay linked to firm performance. However, according to the Bertrand-Mullainathan-Bebchuk-Fried view, greater ownership concentration should strengthen the link between managerial pay and profitability because large owners are complements to, not substitutes for, such a link.

It is also not obvious how codetermination should be expected to affect the sensitivity of managerial pay to firm performance. Employees may be in a particularly good position to monitor managers, but whether the presence of employee representatives on the body that determines managerial pay should be expected to

[5] We used three sources to obtain this ownership information: the Hoppenstedt Aktienführer, "Wer gehört zu wem" published by Commerzbank, and "Wegweiser durch deutsche Unternehmen" published by Bayerische Hypobank.

strengthen or weaken the link between managerial pay and firm performance is subject to the same ambiguity that applies to the effect of large owners on this link. Gorton and Schmid (2004) suggest that employees may have different objectives to those of the owners of a firm, so that greater influence of employee representatives on the supervisory board may weaken the pay-performance link, or even lead it to be negative. These authors find evidence that managerial pay is positively related to the ratio of the market to book value of equity in firms where employee representatives comprise one third of the supervisory board, but negatively related to this ratio in firms with equal representation of owners and employees on the supervisory board.

Our empirical analysis investigates the effects of both ownership structure and the extent of codetermination on the link between managerial pay and firm profitability. An analysis of the effects of ownership structure on the pay-profitability relationship requires us to consider how to measure firm ownership, especially in the case of pyramid ownership structures. So the next section discusses the appropriate measurement of firm ownership structure.

3 Alternative approaches to the measurement of firm ownership structures

A striking feature of the ownership structure of many listed German firms is the importance of pyramids: cases in which the owner of a firm exercises control via a chain of other firms. In our sample of 271 firms, 90 of the identifiable largest owners are other firms that in turn have one or more large owners. In some cases the latter are other firms that have large owners, which may also be firms with large owners, and so on. The general importance of pyramid ownership structures has been emphasised by La Porta et al. (1999). That paper has given rise to a substantial literature which takes for granted that the appropriate way to deal with pyramids is to trace ownership through the pyramid structure and identify the ultimate ownership of the firm.[6] The ultimate owners of a firm are the owners revealed by investigating the ownership of the immediate or first-tier owners, followed by the second-tier owners, and so on until all tiers have been exhausted.

[6] This literature includes Claessens et al. (2000), (2002), Faccio et al. (2001), and Faccio and Lang 2002

Although it is perfectly reasonable in principle to regard the ultimate owners of a firm as the relevant ones, there is an important practical problem in *measuring* the ultimate ownership of a firm, which is that no clear theoretical basis for so doing exists. The literature that has developed from La Porta et al. (1999) uses the approach to measurement of ultimate ownership introduced in that paper: the weakest-link principle (WLP). This principle assigns control rights to an ultimate owner on the basis of the minimum value of voting rights across the different links of a control chain. Thus, if an ultimate owner has 40% of the voting rights in firm A, and firm A has 20% of the voting rights in firm B, this owner has control rights of 20% in firm B according to the WLP. Despite its popularity in empirical studies, the WLP lacks a theoretical underpinning and can give rise to arbitrary and counter-intuitive rankings of ultimate owners.[7] One particular problem with the WLP as it has been used in many applications concerns its treatment of firms with two or more ultimate owners: in such cases control is assigned "to the shareholder with the largest … voting stake".[8] Simply dismissing the existence of more than one ultimate owner with significant control rights is not satisfactory, because many firms have more than one large owner.[9] Not all users of the WLP have followed La Porta et al. in ignoring all large owners except the largest, but the absence of a theoretical foundation for the WLP means that there is no clear basis for measuring the control rights of other large owners using this principle.

An alternative approach to the measurement of the control rights of ultimate owners of firms is based on the Shapley-Shubik voting power index (SSI). The SSI makes a voter's power proportional to the number of times that the voter is pivotal in a sequential coalition of voters, i.e., the number of times that voter changes a sequential coalition from a losing to a winning one by entering it. If there are three voters (1, 2 and 3) and two votes are required to win, then there are six sequential coalitions containing all three players, as follows: {1,2,3}, {1,3,2}, {2,1,3}, {2,3,1}, {3,1,2}, {3,2,1}. The pivotal voter in each coalition is, respectively, 2, 3, 1, 3, 1, 2. The SSI for a particular voter is the number of times that voter is pivotal divided by

[7] See Edwards and Weichenrieder (2004) for a discussion of the weaknesses of the WLP.
[8] La Porta et al. (1999), page 478, definition of widely-held.
[9] Faccio et al. (2001) use the WLP and a threshold value of 20 per cent for voting rights to identify the largest ultimate owner in firms in their sample. They find that 45.3 per cent of the European firms in their sample with such a controlling owner had another ultimate owner with at least 10 per cent of the voting rights.

the number of times all voters are pivotal. In this example, there are six sequential coalitions and hence six pivotal voters in total. Each individual voter is pivotal twice, so each voter has a SSI of 33.33%. Edwards and Weichenrieder (2004) show that it is straightforward to apply the SSI to the measurement of the voting power of ultimate owners of firms. In the example used to illustrate the WLP above, the voting power in firm B of its ultimate owner can be expressed as the product of the SSI representing the ultimate owner's voting power in firm A and the SSI that represents firm A's voting power in firm B. A particular advantage of the SSI approach is that, in contrast to the WLP, it provides a clear and straightforward basis for measuring the control rights of any number of large owners.

Although the SSI-based approach to the measurement of ultimate ownership offers various advantages over the WLP, the absence of an accepted theory of pyramid ownership means that there is still no clear theoretical foundation for any measure of ultimate ownership of firms.[10] In these circumstances, an alternative approach to the measurement of firm ownership is to give up any attempt to look through pyramid ownership structures and focus instead on first-tier ownership, with pyramids treated as one of several different types of first-tier owner. Even if ownership is measured at the first tier rather than the ultimate level, there is still a strong case for measuring the control rights of first-tier owners by the SSI rather than by their voting rights, because an owner's power to determine the outcome of a vote by all owners is not, in general, accurately reflected by that owner's voting rights, as the extensive literature on voting power indices has shown (see Felsenthal and Machover 1998). As well as measuring firm ownership at the ultimate level using the WLP (UTWL) and the SSI (UTSSI), we therefore also measure firm ownership at the first-tier level using voting rights (FTVR) and the SSI (FTSSI).

Table 1 shows the control rights of the largest and second-largest owners of the 271 firms in our sample according to the four different measures. Since our application of the WLP follows that of its originators (La Porta et al. 1999), there is no UTWL measure of the control rights of second-largest owners. It is clear from

[10] Almeida and Wolfenzon (2005) have made a start on the development of a theory of pyramid ownership.

Table 1: Alternative measures of control rights of largest owners in sample of 271 listed German firms, 1991

Per cent	Ownership measure						
	FTVR		FTSSI		UTWL	UTSSI	
	Largest	Second-largest	Largest	Second-largest	Largest	Largest	Second-largest
100	13	0	184	0	12	156	0
>75 - <100	80	0	7	0	53	11	0
>50 - 75	89	0	10	0	98	13	0
>25 - 50	52	35	36	11	55	41	9
>0 - 25	21	60	18	40	37	34	57
0	16	176	16	220	16	16	205

Notes. The ownership measures are as follows: FTVR is first-tier ownership based on voting rights, FTSSI is first-tier ownership based on the Shapley-Shubik index, UTWL is ultimate ownership based on the weakest-link principle, and UTSSI is ultimate ownership based on the Shapley-Shubik index.

Table 1 that the main difference between the various ownership measures stems from whether ownership is measured by voting rights (FTVR and UTWL) or the SSI (FTSSI and UTSSI). The latter measures suggest that largest owners have much greater control rights than do the former, with roughly 60% of largest owners having complete control of the firm under the SSI measures compared to about 4% under the voting rights measures. Correspondingly, the FTVR measure suggests that second-largest owners are more numerous than is indicated by either the FTSSI or UTSSI measures, although this difference is not great. Neither general approach to ownership measurement shows much impact of tracing ownership through pyramids, but both suggest that the control rights of the largest owner are somewhat reduced when ownership is measured at the ultimate rather than the first-tier level. It is worth noting that the UTSSI measure identifies a second-largest owner in 24% of the firms, and also that more firms have second-largest owners according to this measure than according to the FTSSI measure.

The argument that a large owner of a firm has strong incentives to monitor the firm's management implicitly assumes that the large owner is an individual or a

family, since in such cases there is a clear relationship between the wealth of the owner and the profitability of the firm. This is not obviously the case when the large owner is an organisation controlled by agents. There may be no direct link between the interests of the agents who run this organisation and the profitability of the firm in question. If the incentives of the agents who control large owners of this type are not linked to firm profitability, then there may be little incentive for such owners to devote effort to monitoring management.

Many of the largest owners of the firms in our sample are not individuals or families, as Table 2 shows. Table 2 distinguishes seven different categories of first-tier largest owner, and six different categories of ultimate largest owner. The difference arises because one of the first-tier ownership categories is that of pyramid, i.e., a closely-held firm. Tracing through the pyramid to obtain ultimate ownership eliminates this ownership type. The other ownership types in Table 2 are widely-held domestic financial institutions, foreign firms, public-sector bodies, widely-held domestic non-financial firms and cooperatives, families (including foundations set up by families) with a member of the firm's management board having the same surname as the family, and families (including foundations set up by families) without a member of the firm's management board having the same surname as the family. We amalgamate widely-held domestic non-financial firms and cooperatives because there are very small numbers of each in our sample and these two organisational forms are similar, both being producers with dispersed ownership. The distinction between the two types of family ownership was made because of the possibility that the effect of family ownership on the monitoring of management depends on whether a family member is on the firm's management board. A family that is not actively involved in management is likely to want the firm to be run in such a way as to yield maximum profits, but if a family is involved in management it is possible that some of the return on its ownership stake is taken in the form of consumption of private benefits of control. In this latter case, it is not obvious that family ownership will strengthen the link between managerial pay and firm profitability. Of course it is possible that a family member with a different surname is on the management board, so this measure of active family involvement in management is not perfect, but it is the best available.

Table 2: Number of firms with different types of largest owner by ownership measure in sample of 271 listed German firms, 1991

Owner Type	First-tier measures	UTWL	UTSSI
Family on management board	37	37	37
Family not on management board	61	92	94
Widely-held domestic financial institution	9	33	32
Pyramids	90	-	-
Widely-held domestic non-financial firm or cooperative	10	17	17
Foreign firm	27	38	37
Public-sector body	17	38	38
Widely-held	16	16	16

As the figures in Table 2 show, there is no difference between the numbers of largest first-tier owners of various types according to whether ownership is measured by voting rights or the SSI, but there are small variations in the numbers of different largest ultimate owners according to the measure used. The proportional increase in the numbers of different types of largest owner consequent on the elimination of the pyramid category by changing focus from first-tier to ultimate ownership is greatest in the case of domestic financial institutions and public-sector bodies. Families in total account for 38% of all first-tier largest owners and 51% of all ultimate largest owners, but this means that a very substantial proportion of the largest owners of the firms in our sample are organisations run by agents, for which the incentive to devote effort to monitoring the management of the firms they own is not clear-cut. This point is given careful attention in Section 6 on the empirical analysis of the effects of ownership on the link between managerial pay and firm profitability.

4 The Data

Our sample consists of 1145 observations on 271 listed non-financial German firms obtained by combining data from several sources. As has been noted in section 2, we collected information on the voting rights of the largest and second-largest owners of these firms at the end of 1991. To this we added balance sheet and profitability information for the years 1989-1993.[11] Finally we added remuneration data for the years 1998-1993, which was provided to us by Kienbaum, a German consulting firm that specializes in managerial remuneration policies. Kienbaum's yearly remuneration reports contain the total amount paid to the management board and the average number of management board members during a financial year. It is not possible to obtain any information about the compensation of individual members of the management board in the period 1989-93. The Kienbaum reports also include information about the size of the supervisory board. The 271 firms for which we were able to collect all the relevant pieces of information comprise a large fraction of the total of 563 German firms (including financial firms) that were listed in 1991.

Panel A of Table 3 contains descriptive statistics for the 1145 observations in our dataset. There is a very high degree of dispersion in the distributions of ROE and total assets (our measure of firm size). The distribution of the former is negatively skewed, while that of the latter is positively skewed. 16% of the observations have a negative ROE, and ROE is less than –100% in 13 cases, with its minimum value being –364%. There are five observations where ROE is greater than 100%, and the maximum value of ROE is 181%. The positive skewness of the distribution of total assets is reflected in the positive skewness of the distributions of management board remuneration per head, management board size and supervisory board size, although the degree of skewness in the distributions of these other variables is less pronounced. Panel B of Table 3 shows the codetermination status of the 271 firms in our sample. In a majority of cases, employee representatives comprise only one third of the supervisory board, and there are only four firms in our sample that are subject to *Montan* codetermination.

[11] This was taken from several issues of Hoppenstedt Aktienführer.

Table 3: Descriptive statistics

A. For 1145 observations

	Mean	Median	Standard deviation	Skewness
Remuneration per head (euros)	279,190	239,285	178,934	1.81
ROE	0.0509	0.0736	0.2730	-3.90
Total assets (thousand euros)	1,689,362	176,847	5,116,186	5.08
Management board size	3.72	3	2.37	2.68
Supervisory board size	10.27	9	5.37	0.57

B. For 271 firms

	Number of firms	Percentage of firms
Codetermination 1/3	159	58.67
Codetermination 1/2	108	39.85
Codetermination *Montan*	4	1.48

5 Empirical estimates of a simple model of managerial pay

We begin our empirical analysis by investigating the relationship between managerial pay and firm profitability without considering whether this link is affected by ownership structure. The basic model we estimate is

$$\ln C_{it} = \beta_1 ROE_{it} + \beta_2 \ln ASSETS_{it} + \beta_3 MB_{it} + \beta_4 SB_{it} + a_i + b_t + \varepsilon_{it}, i = 1,..., N, t = 1,..., T$$

where C denotes per capita remuneration of the management board, *ASSETS* the balance sheet figure for the total assets of a firm, *MB* the size of the management board, *SB* the size of the supervisory board, a_i a firm fixed effect and b_t a time fixed effect. The *ASSETS* variable is included as a measure of firm size, and is expected to have a positive effect on managerial pay. Management board size is included as an explanatory variable to allow for the possibility that total managerial pay is not simply

proportional to board size. Supervisory board size is included as an explanatory variable because a number of studies have found that the size of the managerial pay-setting committee affects pay.

Equation (4.1) in Table 4 shows the results obtained when this model is estimated on the full sample of 1145 observations by least squares (LS hereafter), with standard errors that are robust to cross-sectional heteroscedasticity and within-firm serial correlation. Although firm size is estimated to have a significantly positive effect on pay, and management board size a significantly negative one, the estimated effect of profitability on managerial pay is not significantly different from zero even at the 0.10 level. However, the estimated effect of profitability on pay in (4.1) is strongly influenced by the observation with a value of –364%, as is shown by equation (4.2), which reestimates the model with this observation excluded. The estimated coefficient of ROE has now almost doubled in size and is significant at the 0.01 level, while there are only modest changes in the estimated effects of the other three variables. But, although the estimated coefficient of ROE in equation (4.2) is statistically significant, it corresponds to an effect on managerial pay that is very small. Evaluated at the sample mean value of ROE, the estimate of 0.25246 corresponds to an elasticity of managerial pay with respect to profitability of only 0.0137.

A possible problem with using LS to estimate our basic model of managerial pay is that profitability may be correlated with the error term in the regression. Suppose, for example, that firm profitability is partly the result of managerial quality (an unobserveable variable), and managerial pay is correlated with managerial quality. Then the LS estimate of the coefficient of the profitability variable in the regression will be biased and not show the causal effect of firm profitability on managerial pay. We used profitability and dividend per share lagged one year as instrumental variables in order to assess the extent of this possible bias in the LS estimate of profitability in the managerial pay regression. The null hypothesis that there is no statistically significant difference between the instrumental variables and LS estimates of our

Table 4: Alternative estimates of the simple relationship between managerial pay and firm profitability.

Dependent variable: log remuneration per capita			
Equation number	4.1	4.2	4.3
Estimation method	LS	LS	LAV
Explanatory variables			
ROE	0.13570	0.25246***	0.22422***
	(0.11319)	(0.05551)	(0.05003)
Ln(Assets)	0.19964***	0.20089***	0.17892***
	(0.05719)	(0.05387)	(0.05095)
MB size	-0.07558***	-0.06824***	-0.06177***
	(0.01887)	(0.01659)	(0.01302)
SB size	0.01503	0.01685	0.00505
	(0.01158)	(0.01155)	(0.00695)
R^2 (within)	0.1218	0.1552	0.1126
Observations	1145	1144	1145

Notes: (a) Equations (4.1) and (4.3) use all observations while equation (4.2) drops one observation with profitability of –364% as described in the text. (b) *** denotes significance at the 0.01 level. (c) Bracketed figures are standard errors. In equations (4.1) and (4.2) these are robust to cross-sectional heteroscedasticity and within-firm serial correlation, while in equation (4.3) they are bootstrapped. (d) All equations contained a full set of time and firm dummies, the coefficients of which are not reported. (e) The R^2 (within) measure reported for equation (4.3) is the squared correlation between the predicted and the actual values of the time-demeaned dependent variable.

basic regression model was not rejected by a Hausman test.[12] For the remainder of the paper, therefore, we maintain the hypothesis that profitability is uncorrelated with the error term in the regressions we estimate.

It is clear from equations (4.1) and (4.2) that the LS estimates of our basic regression model are strongly influenced by a single outlying value of profitability.

[12] We lost 99 observations as a result of using lagged profitability and dividend per share as instruments, including the observation with ROE=-364%. The instruments were both individually significant at the 0.05 level in the first-stage regression, and the value of the F statistic for their joint significance in the first-stage regression was 4.97. The overidentifying restriction that, conditional on one instrument being uncorrelated with the error in the regression, the other is also uncorrelated, was not rejected.

While it may be justifiable to drop this observation, it is unlikely to be the only outlier. Rather than devoting a lot of effort to identifying all possible outliers, an alternative approach is to use methods of estimation that are less sensitive to the presence of outliers than is LS. The case for using robust estimators is strengthened by the fact that the Bera-Jarque test for normality of the true disturbances computed using the residuals from regression equations (4.1) and (4.2) strongly rejects the null hypothesis of normality in both cases. When the disturbances are not normally distributed, the LS estimator is not efficient, and robust regression methods of estimation and inference are more efficient than least squares.

Equation (4.3) in Table 4 shows the results of estimating our basic regression model of managerial pay using all 1145 observations by least absolute values (LAV), a robust regression method which minimises the sum of the absolute values of the residuals. This method estimates the effects of the explanatory variables on the conditional median of the dependent variable rather than the conditional mean. By comparison with LS, the parameter estimates obtained by LAV are robust to outliers because the effect of large residuals on these estimates is relatively smaller: LS attaches more importance to large residuals because each residual is squared. The standard errors reported for equation (4.3) are obtained using bootstrapped resampling with 200 replications. The point estimate of the effect of profitability on managerial pay in (4.3) is similar, though not identical, to that in (4.2) and it is significant at the 0.01 level. The LAV estimate of the effect of the size variable in (4.3) is somewhat smaller than the corresponding estimates in (4.1) and (4.2), while the LAV estimate of the effect of supervisory board size has fallen by two-thirds compared with the LS ones. These results suggests that the problems of using LS to estimate the simple model of managerial pay in this section are not restricted to outliers in the profitability observations. In the next section, we therefore use both LS and LAV to estimate the effects of ownership structure and codetermination on the link between managerial pay and firm profitability.

6 Empirical estimates of the effect of ownership structure and codetermination on the sensitivity of managerial pay to profitability

We now extend the analysis of the previous section to consider whether the relationship between managerial pay and profitability is affected by the ownership structure of the firm and the extent of co-determination in it. To investigate the effect of ownership structure, we estimated four regression models corresponding to the four different ownership measures discussed in section 3. In each model, denoted respectively as the FTVR, FTSSI, UTWL and UTSSI models, the log of remuneration per capita is regressed on ROE and variables that are constructed by interacting measures of the control rights of the largest and second-largest owners of the firm in 1991 (CR1 and CR2 henceforth) with the firm's ROE in each of the five years from 1989-93. Note that, since we adopt the La Porta et al. version of the WLP, there is no measure of CR2 in the UTWL model.

Our empirical analysis requires the assumption that ownership in 1991 (the one year for which we have detailed information on ownership) is constant over the five-year period 1989-93 for which we have data on the other variables in the regression models. In the absence of data on ownership in other years, this assumption cannot be tested, but there is some support for it in the finding of Gorton and Schmid (2004, page 875) that the ownership structure of the largest 250 listed non-financial German firms is very stable over exactly the period 1989-93.[13] Since our ownership measures do not vary over time, it is not possible for us to estimate any effects of ownership on the level of managerial pay using a fixed-effects model: we can only estimate the effects of ownership on the sensitivity of pay to profitability in this way.[14]

Since, as discussed in section 3, it is not obvious that all types of largest owner have the same incentives to monitor management, we used dummy variables for different types of largest owners to allow the effect of ownership on the pay-profitability link to differ by type of largest owner. The ownership types distinguished

[13] Gorton and Schmid find that control in the firms in their sample changes , on average, once every 17 years.
[14] Hausman tests consistently rejected the random effects specification, which would allow estimates of the effects of ownership on the level of managerial pay.

in the first-tier ownership models were widely-held domestic financial firms (Fin), widely-held domestic non-financial firms or cooperatives (Firm), public sector bodies (Pub), domestic firms that had an identifiable large owner and thus formed part of a pyramid (Pyr), foreign owners (For), and two types of family ownership according to whether there was (FamOn) or was not (FamOff) a member of the management board with the same surname as the family. In the ultimate-tier ownership models, the pyramid category disappeared because firms owned as part of a pyramid were assigned to ultimate owners in one of the other six categories.

Our information about codetermination status is also for the single year 1991, and we assume that codetermination status is constant over 1989-93. Any errors introduced by this assumption are small. To investigate the effects of codetermination on the relationship between managerial pay and profitability, we interacted ROE with dummy variables indicating the proportion of a firm's supervisory board members made up by employee representatives. This proportion can take three values: one half (Codet1/2), 10/21 for coal and steel companies (Codet*Montan*), or one third. The category excluded was that with one third of the supervisory board being employee representatives, so each model estimated included two ROE-employee representation interactive variables.

Since it is easier to own a large fraction of a small firm than to own a similar fraction of a large firm, ownership concentration tends to be negatively correlated with firm size. To rule out the possibility that any influence of ownership structure on pay-profitability sensitivity might simply reflect a size effect, we also included a variable that interacts ROE with our firm size measure, Ln(Assets). The proportion of supervisory board members who are employee representatives is correlated with firm size, so including a firm size-ROE interactive term also ensures that any impact of the ROE-codetermination interaction terms does reflect a genuine effect of codetermination on the sensitivity of pay to profitability. We also included variables that interact ROE with the size of the management board and the size of the supervisory board.

Each of the four regression models corresponding to the different measures of ownership was estimated by two different methods: LS and LAV. The case for using

the LAV estimator is that the Bera-Jarque test for normality of the true disturbances computed using the residuals from the models estimated by LS strongly rejects the null hypothesis of normality in all cases. Since there are eight regressions that might be discussed, it is useful to consider the results of non-nested tests that attempt to identify whether there is a preferred ownership measure. Table 5 shows the results, for each estimation method, of testing the four models against each other using the J test. When the models are estimated by LS (with standard errors that are robust to cross-sectional heteroscedasticity and within-firm serial correlation), the J tests suggest that there is no fully satisfactory model: each of the four is rejected by at least one other, although the rejections of the FTVR and UTSSI models are only at the 0.10 level. However, when the models are estimated by LAV (with bootstrapped standard errors), neither the FTVR nor the UTSSI models are rejected by any of the other three models. We therefore present results only for the FTVR and UTSSI models in the following analysis of the effects of ownership structure and codetermination on the sensitivity of managerial pay to profitability.

Table 5: Non-nested tests of alternative regression models

Tested model	Alternative model			
	FTVR	FTSSI	UTWL	UTSSI
1. Least squares estimates				
FTVR	-	R*	NR	R*
FTSSI	R**	-	NR	R*
UTWL	R*	R**	-	R**
UTSSI	R*	NR	NR	-
2. Least absolute value estimates				
FTVR	-	NR	NR	NR
FTSSI	NR	-	NR	R**
UTWL	R**	R**	-	R*
UTSSI	NR	NR	NR	-

Notes: Each cell shows the result, for a particular estimation method, of testing the row model against the column model by a J test. R indicates that the row model was rejected by the column model, and NR indicates that the row model was not rejected by the column model. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels respectively.

One point that emerges very clearly from Table 5 is that the UTWL model is wholly inadequate as a basis for assessing the effects of ownership on the pay-profitability link. For both estimation methods, the UTWL model is rejected by all the other models, although only at the 0.10 level in two of the six cases. This clear rejection of the UTWL model by all other ownership models raises serious questions about the very widespread use of the weakest link principle as a basis for empirical studies of firm ownership, a matter to which we return in the conclusion of this paper.

Table 6 shows the results of estimating the FTVR and UTSSI regression models by LS and LAV. These results show that the sensitivity of managerial pay to firm profitability increases with firm size, other things equal. But the other variables that are interacted with ROE typically do not have an effect on managerial pay that is significantly different from zero. The codetermination variables never have a significant effect on the link between pay and profitability. Although some ownership variables have a significant effect on the sensitivity of pay to profitability, the effect is often only significant at the 0.10 level, and no ownership variable is estimated to have a significant effect on this sensitivity in all four regression equations.

Given the results in Table 6, it is natural to test the hypotheses that there are no effects of ownership or codetermination on the link between managerial pay and firm profitability. For all four regression equations in Table 6, the null hypothesis that the coefficients of the two codetermination-ROE variables were both zero was not rejected. The null hypothesis that the coefficients of all the ownership-ROE variables were zero was rejected at the 0.05 level for three of the four equations in Table 6: the exception was the FTVR model estimated by LAV, for which this null hypothesis was rejected at the 0.10 level. These results suggest that it is worth estimating restricted versions of the regression equations in Table 6. The results of doing so are shown in Table 7. The regressions reported in this table incorporate the restrictions (all of which are acceptable at the 0.05 level) that the coefficients of some ownership-ROE variables were zero, and that the coefficients of the Codet1/2*ROE and Codet*Montan*ROE variables are equal. The interactive variable StrongerCodet*ROE in Table 7 is constructed using the dummy variable StrongerCodet, which takes the value one if employee representation on the supervisory board is equal to one half or 10/21.

Table 6: Alternative estimates of a general model of managerial pay

Dependent variable: log remuneration per capita				
Ownership measure	FTVR		UTSSI	
Estimation method	LS	LAV	LS	LAV
Explanatory variables				
ROE	-1.46556**	-1.39147**	-1.55369***	-1.33640**
	(0.57167)	(0.55880)	(0.52455)	(0.63899)
Ln(Assets)	0.18551***	0.15169***	0.18673***	0.12913***
	(0.05923)	(0.04179)	(0.05935)	(0.04499)
Ln(Assets)*ROE	0.17546***	0.17146***	0.18799***	0.17565***
	(0.05652)	(0.05621)	(0.05228)	(0.06544)
MB size	-0.06490***	-0.05844***	-0.06726***	-0.05974***
	(0.01712)	(0.01422)	(0.01718)	(0.01407)
MB size*ROE	-0.08189	-0.07887*	-0.06406	-0.03196
	(0.04998)	(0.04319)	(0.05028)	(0.04988)
SB size	0.01456	-0.00105	0.01656	0.00237
	(0.01348)	(0.00823)	(0.01300)	(0.00840)
SB size*ROE	-0.02010	-0.01664	-0.02205	-0.02796
	(0.01764)	(0.01739)	(0.01835)	(0.01994)
CR1FamOff*ROE	0.02127	-0.13916	-0.17029	-0.33759***
	(0.25594)	(0.22262)	(0.15160)	(0.13098)
CR1FamOn*ROE	0.49355*	0.64243*	0.24315	0.21551
	(0.27659)	(0.37351)	(0.15077)	(0.27298)
CR1Firm*ROE	0.26924	0.33313	-0.11864	-0.08759
	(0.17076)	(0.32148)	(0.19276)	(0.26810)
CR1Pyr*ROE	-0.11035	-0.05826		
	(0.19758)	(0.20344)		
CR1Fin*ROE	-1.71069**	-2.01477	-0.87570*	-1.10829*
	(0.81448)	(1.48705)	(0.51621)	(0.56724)
CR1For*ROE	0.36045	0.47068	0.22142	0.21720
	(0.26535)	(0.55363)	(0.22040)	(0.43421)
CR1Pub*ROE	-0.09807	-0.18160	-0.12933	-0.24084
	(0.24003)	(0.26047)	(0.18024)	(0.16695)
CR2*ROE	-0.57793	-0.58924*	-0.83321*	-1.06932*
	(0.40379)	(0.32463)	(0.49922)	(0.62409)
Codet1/2*ROE	0.20548	0.06202	0.18165	0.13273
	(0.21913)	(0.16577)	(0.20258)	(0.16739)
Codet*Montan*ROE	0.41924	0.34407	0.28297	0.27698
	(0.28738)	(0.30687)	(0.23889)	(0.29430)
R^2 (within)	0.1940	0.1819	0.1947	0.1820

Notes. (a) *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels respectively. (b) Bracketed figures are standard errors. For the LS estimates, these are robust to cross-sectional heteroscedasticity and within-firm serial correlation, while for the LAV estimates they are bootstrapped. (c) All equations contained a full set of time and firm dummies, the coefficients of which are not reported. (d) The R^2 (within) measure reported for the LAV estimates is the squared correlation between the predicted and the actual values of the time-demeaned dependent variable.

The results in Table 7 show that some forms of ownership do have statistically significant effects on the link between pay and profitability, although no ownership effect is significant in all four regression equations. According to three of the four equations in Table 7, if the largest owner of a firm is a widely-held domestic financial institution, then (other things equal) there is a statistically significant reduction in the pay-profitability link. This effect is also negative, though not significant, in the fourth equation. Similarly, according to three of the four equations, if a firm has a second-largest owner, then (other things equal) there is a statistically significant reduction in the pay-profitability link. In the fourth equation this effect is also negative, though not significant.

There are also some effects of family and public-sector ownership on the pay-profitability link, but these are less clear. The estimates of the FTVR model in Table 7 show that, for firms with a largest owner that is a family with no member on the management board, the pay-profitability link is unaffected by the largest owner's holding. For firms with a largest owner that is a family with a member on the management board, the sensitivity of pay to profitability increases with the largest owner's holding. The estimates of the UTSSI model in Table 7 yield different conclusions. For firms with a largest owner that is a family with a member on the management board, the pay-profitability link is unaffected by the largest owner's holding, but for firms with a largest owner that is a family with no member on the management board, the sensitivity of pay to profitability falls with the largest owner's holding. The estimates of the FTVR model show that public-sector largest owners have no effect on the pay-profitability link, but the estimates of the UTSSI model suggest that the sensitivity of pay to profitability falls with the holding of such largest owners, although this latter effect is only significant according to the LAV estimates.

The results in Table 7 provide almost no evidence that stronger employee representation on the supervisory board strengthens the link between pay and profitability. The estimated coefficient of StrongerCodet*ROE is not statistically significant in three of the four regressions, and in the fourth it is only significant at the 0.10 level. However, it should be noted that the sign of this coefficient is always positive.

Table 7: Alternative estimates of a restricted model of managerial pay

Dependent variable: log remuneration per capita				
Ownership measure	FTVR		UTSSI	
Estimation method	LS	LAV	LS	LAV
Explanatory variables				
ROE	-1.34725**	-1.39198***	-1.35265***	-1.16689**
	(0.56051)	(0.52032)	(0.46631)	(0.57953)
Ln(Assets)	0.19758***	0.15540***	0.19171***	0.15235***
	(0.05738)	(0.04226)	(0.05946)	(0.04500)
Ln(Assets)*ROE	0.16086***	0.16285***	0.17798***	0.16969***
	(0.05645)	(0.05414)	(0.04995)	(0.06085)
MB size	-0.06513***	-0.06218***	-0.06855***	-0.05699***
	(0.01682)	(0.01351)	(0.01729)	(0.01423)
MB size*ROE	-0.06955	-0.06563*	-0.05847	-0.04261
	(0.04421)	(0.03813)	(0.04764)	(0.05117)
SB size	0.01590	0.00284	0.01713	0.00122
	(0.01312)	(0.00834)	(0.01261)	(0.00855)
SB size*ROE	-0.01765	-0.01838	-0.02173	-0.02132
	(0.01557)	(0.01312)	(0.01824)	(0.01765)
CR1FamOff*ROE	-	-	-0.28088**	-0.46363***
	-	-	(0.13094)	(0.12382)
CR1FamOn*ROE	0.47198**	0.72119**	-	-
	(0.23824)	(0.31038)	-	-
CR1Fin*ROE	-1.73327**	-2.27340	-1.06361**	-1.31146**
	(0.82460)	(1.40837)	(0.50124)	(0.53128)
CR1Pub*ROE	-	-	-0.22061	-0.35633**
	-	-	(0.17371)	(0.15411)
CR2*ROE	-0.61587	-0.59744**	-1.09069**	-1.22495**
	(0.41498)	(0.29700)	(0.43148)	(0.59310)
StrongerCodet*ROE	0.22392	0.25361*	0.16134	0.07042
	(0.17313)	(0.13754)	(0.20651)	(0.14760)
R^2 (within)	0.1894	0.1810	0.1909	0.1820

Notes. (a) *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels respectively. (b) Bracketed figures are standard errors. For the LS estimates, these are robust to cross-sectional heteroscedasticity and within-firm serial correlation, while for the LAV estimates they are bootstrapped. (c) All equations contained a full set of time and firm dummies, the coefficients of which are not reported. (d) The R^2 (within) measure reported for the LAV estimates is the squared correlation between the predicted and the actual values of the time-demeaned dependent variable.

Table 8 shows the relationships implied by the models in Table 7 between the sensitivity of managerial pay to firm profitability and the various corporate governance variables. The first row of Table 8 shows, for different estimation methods and ownership measures, the estimated coefficient of ROE for a widely-held firm that has sample mean values of firm size, management board, supervisory board

Table 8: Alternative estimates of the effects of ownership and co-determination on the managerial pay-profitability relationship

Ownership measure	FTVR		UTSSI	
Estimation method	LS	LAV	LS	LAV
Effect of:				
1. Widely-held	0.28989***	0.28919***	0.46849***	0.57718***
	(0.07365)	(0.05636)	(0.07355)	(0.07581)
2. FamOff			0.23377**	0.18974***
			(0.09950)	(0.06514)
3. FamOn	0.59357***	0.75322***		
	(0.14510)	(0.19680)		
4. Fin	-0.18436	-0.33283	0.07046	0.08640
	(0.21995)	(0.38082)	(0.19111)	(0.20041)
5. Pub			0.30686***	0.31612***
			(0.11141)	(0.09925)
6. Largest	0.31573***	0.33210***	0.31842***	0.34903***
	(0.06788)	(0.05627)	(0.05942)	(0.04772)
7. 2nd largest	0.18792**	0.20810***	0.16315***	0.17465**
	(0.08351)	(0.05815)	(0.06093)	(0.07342)
8. Codet 1/3	0.17706**	0.18231***	0.21444***	0.27869***
	(0.07525)	(0.06689)	(0.08067)	(0.07409)
9. StrongerCodet	0.40097***	0.43593***	0.37578***	0.34911***
	(0.13603)	(0.10226)	(0.15054)	(0.09575)

Notes. (a) *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 levels respectively. (b) Bracketed figures are standard errors. For the LS estimates, these are robust to cross-sectional heteroscedasticity and within-firm serial correlation, while for the LAV estimates they are bootstrapped.

and co-determination variables.[15] The LS and LAV estimates of this coefficient in the FTVR model are almost identical. However, there is a difference between the LS and LAV estimates of this coefficient in the UTSSI model. For both estimation methods this effect is substantially larger in the UTSSI than the FTVR model, although even the largest coefficient estimate (0.57718) corresponds to an elasticity of only 0.0294 evaluated at the sample mean value of ROE. Since some forms of largest owner are estimated to have no statistically significant effects on the pay-profitability link, the estimated coefficient in the FTVR models for widely-held firms also applies to firms with largest owners of the following types: widely-held domestic non-financial firms, pyramids, public-sector bodies, foreigners and families with no members on the management board. Similarly, the estimated coefficient in the UTSSI models for

[15] A widely-held firm is one in which the largest and second-largest owner's control rights are both zero.

widely-held firms also applies to firms with largest owners of the following types: widely-held domestic non-financial firms, foreigners and families with members on the management board.

The next four rows of Table 8 show, for alternative estimation methods and ownership measures, the estimated coefficient of ROE for firms that have a single large owner of different types and sample mean values of firm size, management board, supervisory board and co-determination variables. For each type of owner, the coefficient was obtained by setting control rights equal to the sample mean value of control rights held by largest owners of this type (conditional on these being positive). The FTVR model estimates of the coefficient of ROE for largest owners that are families with a member on the management board are substantially greater larger than those for widely-held firms, but still economically small: the coefficient of 0.75322 corresponds to an elasticity of 0.0384 at the sample mean. The UTSSI model estimates of the coefficient of ROE for largest owners that are families with no member on the management board are smaller than those for widely-held firms by a factor of one half or more: although it is significantly different from zero, the coefficient of 0.18974 corresponds to an elasticity of only 0.00966 at the sample mean. For largest owners that are widely-held financial institutions, the estimated coefficient of ROE is never significantly different from zero, and in the FTVR both point estimates are actually negative. The LS and LAV estimates of the coefficient of ROE for public-sector largest owners in the UTSSI model are very similar, though only the latter is significantly different from the estimate for widely-held firms.

Rows 6 and 7 of Table 8 show how the pay-profitability relationship is affected by the presence of a second-largest owner. In both rows, the control rights of all types of largest owner are set equal to their full sample mean values, as are the firm size, management board, supervisory board and co-determination variables. Row 6 shows the estimated coefficient of ROE when the control rights of the second-largest owner are zero, while row 7 shows the estimated coefficient of ROE when the second-largest owner's control rights are set equal to their sample mean value (conditional on these being positive). The presence of a second-largest owner is estimated to reduce the sensitivity of managerial pay to profitability by between a third and a half, and in three of the four cases this reduction is statistically significant.

Rows 8 and 9 of Table 8 show how the pay-profitability relationship is affected by different degrees of employee representation on the supervisory board. In both rows, the control rights of largest and second-largest owners are set equal to their full sample mean values, as are the firm size, management board and supervisory board variables. Row 8 shows the estimated coefficient of ROE for a firm in which employee representatives comprise one third of the supervisory board, while row 9 shows this coefficient estimate for a firm in which such representatives comprise one half or 10/21 of the supervisory board. Although there is very limited evidence that the differences are statistically significant, the point estimates consistently show that the link between managerial pay and profitability is stronger in firms with stronger employee representation on the supervisory board. These results show clearly that greater employee representation on the supervisory board does not lower the sensitivity of pay to profitability, and leave open the possibility that it actually increases this sensitivity.

Our results about the effect of greater employee representation on the sensitivity of managerial pay to firm profitability differ from Gorton and Schmid's findings that managerial compensation is positively related to firm performance as measured by the ratio of market to book value of equity for firms operating under one third codetermination, but negatively related to firm performance so measured for firms operating under equal codetermination. The difference between our findings and those of Gorton and Schmid may be because we measure firm performance by the return on equity, for the reasons given in section 2 above, while Gorton and Schmid use the ratio of market to book value of equity. It may also be due to the fact that we use a parametric approach to estimating the effects of codetermination on pay-performance sensitivity, while Gorton and Schmid use a non-parametric nearest-neighbour approach. Our results show that greater employee representation on the supervisory board does not weaken the link between managerial pay and the measure of firm performance that was specified in the *Aktiengesetz* for the relevant time period, namely accounting profitability. Greater employee representation does not, therefore, necessarily lead to managerial incentives that are counter to owners' interests.

The results reported in this section show that the relationship between managerial pay and firm profitability in listed German firms is influenced by firm ownership structure. However, not all types of largest owner affect the link between pay and profitability. Furthermore, the estimated effects of ownership on the relationship between pay and profitability depend partly on how ownership is measured. This is particularly the case for largest owners that are families. If the UTSSI measure of ownership is used, then family largest owners with no members on the management board lower the sensitivity of pay to profitability, while those with family members on the management board do not. These results are consistent with an interpretation according to which the monitoring of the management board by largest family owners that are not actively involved in the management of a firm allows the link between managerial pay and profitability to be weakened, while largest family owners that are actively involved in management do not play the role of outside monitors and thus have no effect on the pay-profitability link. However, if the FTVR measure of ownership is used, then family largest owners with no members on the management board do not affect the sensitivity of pay to profitability, while those who have family members on the management board strengthen it. The latter finding is contrary to the view that a family actively involved in management is in a position to take some of the returns from its ownership stake in the form of private benefits of control and thus will weaken the pay-profitability link. A possible explanation of this finding is that in such firms the sensitivity of managerial pay to profitability is enhanced in order to ensure that other owners are willing to hold equity in the firm. The general point, however, is that, on a purely empirical basis, the FTVR and UTSSI models are equally satisfactory, but they yield very different results about the effects of family ownership on the pay-profitability link.

The results reported in this section provide almost no support for the view that the presence of large owners is a complement to, rather than a substitute for, a link between managerial pay and firm profitability. When ownership structure does have an effect on the link between pay and profitability, it is usually to weaken this link. The only evidence of large owners strengthening the pay-profitability link comes from the FTVR model estimates of the effect of largest family owners actively involved in management.

A final point to note about the results reported in this section is the very small size of the estimated pay-profitability link in listed German firms. Although there is evidence that some forms of ownership change the pay-profitability sensitivity by a large proportion of the value taken by this link for widely-held firms, the general level of the estimated elasticities of managerial pay with respect to profitability is extremely low.

7 Conclusion

This paper has shown that the ownership structure of listed German firms has some effect on the sensitivity of managerial pay to firm profitability. However, this sensitivity is unaffected by some types of large owners, showing that it is important to allow for differences in the effects of different types of owner when analysing the role of ownership in corporate governance. Furthermore, the effects of ownership that have been found in this paper mostly weaken the pay-profitability link, which is inconsistent with the hypothesis, emphasised in the recent literature on the USA, that large owners are a complement to, rather than a substitute for, such a link. The paper has also shown that greater employee representation on the supervisory board does not lower the sensitivity of managerial pay to firm profitability.

As well as these specific conclusions about the effects of German corporate governance features on managerial remuneration, the paper yields some general conclusions about the measurement of firm ownership in studies of corporate governance. It has shown that there are several ways in which ownership might be measured, and that different ownership measures give different results about the effects of ownership on managerial pay. Four different ownership measures were used in the empirical analysis in this paper, of which two (the FTVR and UTSSI measures) were equally good and superior to the other two on empirical grounds. However, the FTVR and UTSSI measures produced different results concerning the effects of large owners on the link between pay and profitability, particularly so in the case of family ownership. The fact that different ownership measures give different conclusions about the effects of large owners on managerial pay in Germany indicates the need for further research that establishes a satisfactory theoretical and empirical basis for the

measurement of firm ownership. The recent interest in the effects of ownership on corporate governance has been pursued without much attention being paid to the question of what is the appropriate way to measure firm ownership. The results of this paper show that the conclusions reached about the effects of ownership on corporate governance can depend critically on the particular ownership measure used. This is highly unsatisfactory, and the question of how to measure firm ownership must be addressed if the literature on ownership and corporate governance is to make progress.

This paper has shown clearly that the ownership measure that has been extensively used in the recent literature on the economic effects of concentrated firm ownership following its introduction by La Porta et al. (1999) – that in which ownership is measured at the ultimate tier of pyramid structures using the weakest-link principle – is inadequate as a basis for assessing the effects of ownership on managerial pay in listed German firms. The version of the WLP that has been used in this paper is the one that (following La Porta et al.) only takes account of the largest owner of a firm. It is possible that the WLP would perform better if it was extended to include second-largest owners, although there is no clear basis on which to do so. However, many recent studies have used the La Porta et al. version of the WLP, so that the present paper's finding that this version of the WLP is inadequate raises serious questions about its use in other analyses of ownership and corporate governance. This reinforces the general conclusion that further work is required to develop an empirically satisfactory ownership measure for use in analyses of the economic effects of different firm ownership structures.

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