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by

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Abstract: Previous work on board size effects in closely held corporations has established a negative correlation between board size and firm performance. We argue that this work has been incomplete in analysing the causal relationship due to lack of ownership information and weak identification strategies in simultanous equation analysis. In the present paper we reexamine the causal relationship between board size and firm performance using a dataset of more than 5,000 small and medium sized closely held corporations with complete ownership information and detailed accounting data. We test the potential endogeneity of board size by using a new instrument given by the number of children of the founders of the firms. Our analysis shows that board size can be taken as exogenous in the performance equation. Furthermore, based on a flexible model specification we find that there is no empirical evidence of adverse board size effects in the typical range of three to six board members. Finally, we find a significantly negative board size effect in the minority of closely held firms which have comparatively large boards of seven or more members.

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1 Introduction

The organization of the corporate board has received significant attention in the media and in the business community not least because of the role played by the board of directors in Enron, WorldCom and other prominent business failures in the US and elsewhere. The structure of the board has strong implications for the governance and performance of firms (Hermalin and Weisbach, 2003). One crucial aspect of board organization is the optimal number of directors. Theoretically, based on Mancur Olson's arguments from the study of collective actions problems, Jensen (1993) and Lipton and Lorsch (1992) have argued that large corporate boards may be less efficient due to difficulties in solving the agency problem among the members of the board. These authors conclude that small corporate boards should therefore create more value than large boards. This conclusion is adequately summarized by Hermalin and Weisbach (2003);[1]

> 'The idea is that when boards become *too* big, agency problems (such as director free-riding) increase within the board and the board becomes more symbolic and less a part of the management process.'

Boards serves many roles in a corporation: it hires and monitor the management; it provides expert knowledge and business network useful for the top management; it represents individual owners' legitimate interest in maximizing the return of their investment, etc. etc. To allow for having directors that have core competencies in each of these areas, it is often necessary to

[1] Hermalin and Weisbach (2003) p. 13, their emphasis.

choose more than the minimum number of directors. Hence, a theoretically negative board size effect should not necessarily be present for small boards as is also indicated by the emphasis above.

The first empirical study of board size effects is Yermack (1996) who shows a significant negative relationship between board size and firm value in a sample of large publicly traded US corporations with board sizes in the range of 10 to 30. Later studies on publicly traded firms (e.g. Gertner and Kaplan (1996) and Wu (2000)) have confirmed this negative relationship.

Eisenberg, Sundgren and Wells (1998) analyzed the board size effect in a sample of almost 900 small and medium-sized closely held corporations in Finland. Most closely held corporations have between 3 and 7 directors. They find that there is a significant negative board size effect for boards in the range of 2 to 7 members. Increasing the size of the board e.g. from 3 to 4 members would lower the returns on assets (RoA) by approximately 2 percentage points according to their preferred estimate.

The empirical literature seems to have found a negative board size effect for all sizes of board - even the very small ones. This finding is rather striking, since the theoretical literature points out that the negative effect is expected to arise *only* when the board gets *too* large. In fact Jensen (1993) writes;

> 'When boards go beyond seven or eight people they are less likely to function effectively and are easier for the CEO to control.'

In the present analysis we question the negative board size effect on closely held corporations with small boards. Our departure is in the following argument: Board size is determined by observed as well as unobserved firm characteristics. An important determinant of board size (often not included

in the data) is the ownership structure of the firm. In particular, it is expected that the number of owners and the distribution of owners do affect board size. A corporation with a single owner tends to have a smaller board than firms with many owners. Board members, among other things, serve a distributional role as agents for individual owners (Bennedsen 2001). Eisenberg *et al.* recognize this relationship but they do not have data for ownership structure in their dataset. Even if detailed information on ownership is available there remains a more general concern that board size could be correlated with unobserved determinants of firm performance. This suggests that board size should be treated as an endogenous regressor in order to estimate its causal effect on performance.

In a simultaneous equation approach, Eisenberg *et al.* (Table 3) model board size as a function of performance, size, age and if the firm belongs to a corporate group or not, but no account is taken of ownership variables. The performance equation, on the other hand, models the RoA as a function of board size, board member payment disturbances, the size and age of the firm, and the change of total assets as a measure of growth opportunities. The identification of board size effects in the performance relationship *a priori* hinges on a single exclusion restriction, namely the exclusion of the corporate group dummy. Although this variable appears significant in the board size equation, the validity of excluding it from the performance equation is crucial for the interpretation of the estimated board size effect. This is not discussed by Eisenberg *et al.*

We reconsider the board size effect using a dataset on 5,555 Danish closely held corporations with detailed information about ownership and control

structures, which with respect to firm size and board size are very similar to the 879 Finnish firms used in Eisenberg *et al.* Our data set has six times as many observations and represents the population of closely held corporations in Denmark.

We solve the potential endogeneity problem in the performance equation by the use of an instrumental variable approach, which is firmly grounded in the institutional setting surrounding most closely held corporations and in addition we explicitly consider the validity of the proposed instruments. Finding good instruments for board size is known to be a difficult task; we create an instrument which to our knowledge has not been applied before in the empirical board literature: We have obtained the names and social security numbers on all persons who have founded a firm in Denmark and on all close family members of these founders. Our core instrument for board size is the number of founders' children older than thirty years. We show that the instrument is correlated with the board size of these firms and provide evidence that the correlation is indeed associated with family considerations. In addition, we claim that the founders' family relations can be considered exogenous in this setting. Having a valid and credible instrumental variable enables us to empirically address the exogeneity status of board size in the performance equation and we find that there is little empirical evidence that board size should be endogenous.

The exogeneity of board size allows us to analyze the relationship between board size and performance in a much less restrictive framework than the one chosen by Eisenberg *et al.* Based on a more flexible model specification we conclude that there is no empirical evidence of adverse board size effects for

closely-held firms in the typical range of three to six board members. There is a significantly negative effect in the minority of firms which are have comparatively large boards of seven or more members. Thus, we find evidence of non-linearity as suggested by the theoretical literature and conclude that the negative board size effect occurs only when boards get *too* large as suggested by Hermalin and Weisbach and Jensen cited above.

The paper proceeds as follows: In the next section we describe the dataset and compare this to the Finnish data used in Eisenberg *et al.* Section 3 establishes in detail the source of exogenous variation in board size which we derive from founders' family relations. In Section 4 we present the main results using first a standard OLS based approach, then introducing the instrumental variables models, and finally estimating a more flexible model specification. We conclude and discuss our findings in Section 5.

2 The Data

Our data include the population of closely held corporations with limited liability in Denmark in 1999. The data originate from the annual reports, which all closely held corporations are obligated to submit to the Danish Ministry of Economic and Business Affairs. The data include financial items from both the income statement and the balance sheet, ownership information and the name and identity of CEO and board members.

Similar to most Western countries the Danish company law destinguishes between two types of closely held limited liability companies, a traditional

joint stock company and a less regulated version.[2] The two company types differ substantially in terms of boards, since 'A/S'-companies are obligated to have a corporate board with at least 3 members whereas it is voluntary to establish a board for firms incorporated as 'ApS'. We therefore only consider the population of joint stock companies (A/S) which in 1999 totals 14,103. We follow the standard selection criteria for performance evaluations and exclude regulated industries and financial intermediaries from the analysis. The number of firms thereby reduces to 7,960.[3] We further exclude a number of extremely small firms (primarily firms that were recently established) and firms that have changed industry or reporting standards. These criteria are described in the appendix. We end up with 5,555 firms that represent the population for this analysis.

In addition to the full sample we also examine the subsample of family-owned firms using the definition of family businesses set up by Bennedsen *et al.* (2004) based on current ownership characteristics. They define a firm as a family firm if members of a single family hold 50 percent or more of the equity. By this definition more than two-thirds of the firms in the sample are family firms.

Our main strategy in identifying the causal effect of board size on firm performance will be based on information that relate to the founders of the

[2] In Denmark the two types are denoted 'A/S' and 'ApS', respectively. The latter is the Danish equivalent of a US 'S-Corp' or a German 'GmbH'.

[3] *Inter alia* we exclude utilities, financial intermediaries, business services, community, social and personal service activities which are likely to be regulated industries. Thus, our sample consists of firms with primary industry affiliation within NACE groups 10 through 36 and 45 through 63.

firms. The founder information is available for approximately one-third of the firms in the gross sample of 5,555 firms.[4] For this sample of firms we are able to obtain personal information on the founders. The additional data on founders are from the Danish Commerce and Companies Agency, which is the agency that handles the registration of all Danish firms. The founder of a firm is defined as the legal person who filled in the forms and officially registered the firm with the Danish Commerce and Companies Agency. Approximately one third of the firms with personal founders have a single founder and around 90 percent of the firms have 3 or less founders. We consider firms with ten or less founders in order to limit the importance of special ownership arrangements with a very large number of individual owners or founders.[5] We collect names and CPR numbers (the social security number in Denmark) of each founder. We submit the CPR number to the CPR agency in the Ministry of Interior, the government department that administers the social security numbers. The agency then provides us with the family relations including names and CPR numbers of all nuclear family members. In total we are able to obtain the data on founders and their family for 1,836 firms.

The main reason for the substantial reduction in the number of observations is that the founder information only is available for firms that have been incorporated in 1986 or later. Similarly, the information is not available on firms which have been registrered by other corporations, by law firms, etc. Some firms have existed in another form before their incorporation date (e.g.

[4] We obtain an almost equally representation of family firms (with a coverage rate of 34.0 percent) and non-family firms (30.8 percent) in this sample. Whether the information is available or not should ideally reflect a random sampling.

[5] This excludes less than .4 per cent of firms with available founder information.

as ApS firms). These firms may have a registered firm age in the annual report which pre-dates 1986.[6] The requirements that there are at most ten founders and a further requirement (to be motivated by the IV approach adopted in Section 3) that the registrered firm age should be 25 years or less defines a sample of 1,836 observations with the necessary founder information.

The gross sample of 5,555 firms can be compared to the sample of 879 Finnish firms analyzed by Eisenberg et al. (1998).[7] With an average board size of 3.7 and median assets of 7,590 the figures for the Danish firms are comparable to the corresponding numbers of 3.7 and 5,498 (converted to 1999-DKK) for the Finnish firms. Although the mean age of the Danish firms of 19.5 years is well above the mean age of 10.8 reported by Eisenberg *et al.* for the Finnish firms, we seem quite justified in comparing the two results of the two analyses. However, our sample is not comparable to the samples used by Yermack (1996) and others to study board size effects in large public traded firms with much larger firm and board sizes.

Main variables of the two samples and their relationships to board size can be compared in Table 1. It is clear from the table that both samples are dominated by small and medium-sized firms. The number of corporate board members appears to be positively related to firm size as measured by the assets of the firm and also to the number of owners of the firm. Indeed, most firms have a very concentrated ownership with an average number of owners around two.

[6] This is true for around 8 per cent of the firms with available founder information.

[7] Approximately 80 per cent of the Finnish firms are classified as active in manufacturing and trade.

Table 1 also provides evidence on the raw relationship between performance and board size. For both samples there is no visible differences between the average returns on assets (RoAs) of firms with 3, 4, 5 or 6 directors. Firms with 7 or more board members have on average lower RoAs although it should be noted that the latter category is quite thin. In conclusion, Table 1 illustrates that there is no clear pattern of increasing board size being associated with lower returns on assets in the raw Danish data.

3 Family Structure as Exogenous Variation in Board Size

We have established that most closely held corporations are small, have few owners and are family controlled. In the following we argue that exactly the fact that many closely-held corporations have strong family links provides us with a valuable source of variation in the governance characteristics that we will claim is exogenous in terms of corporate performance.

Specifically, the information on the family relationships of the founders of the firm will be used to establish valid instrumental variables for the relationship between corporate performance and corporate board size. We treat the latter as being potentially endogenous in the performance relationship and control for a rich set of determinants of current performance. Our candidate source of exogenous variation in board size is the number of founders' children. Two conditions must be satisfied for the instrumental variable estimation strategy to work: A systematic relationship should be established between the founder-related instrumental variable and the gover-

nance characteristic, in this case the current size of the corporate board; and the founder-related information in itself should not be related to the current performance of the firm, given the observable determinants of performance that we control for. We consider each condition in turn and provide evidence to substantiate our claims.

When considering the number of founders' children as a candidate instrument the core identifying argument is as follows: The size of the relevant 'pool' from which current members of the corporate board are selected, is increasing in the number of founders' children (above a certain age, taken to be 30 years). In addition, if a family member is admitted to the corporate board then—due to "equal treatment" considerations—it is likely that further family members are added. This creates a systematic tendency for corporate board size to vary with founders' family size. Ideally, we would like this mechanism to explain a significant proportion of board size variations.

Table 2 shows the mean number of founders and founders' children in firms with different board sizes. The evidence is provided for the gross sample of all firms and for family-owned firms. The table indicates that as a general tendency there is a positive relationship between board size and the number of founders' children in both samples although the relationship seems most pronounced in family-owned firms. Whether the overall positive correlation proves significant also when controlling for other determinants of board size will be evidenced by results from the first stage of the two-stage least squares estimation procedure applied in the next section. Since it is mainly family-related concerns that we expect to produce such a correlation our prior is that the relationship is statistically significant in family-owned forms but less

so in non-family firms.

Next, we need to establish that founder-related information is indeed exogenous to the performance relationship. That is, conditionally on observable determinants of current performance, there should be no correlation between the instrumental variable, in this case the number of founders' children, and unobservables that affect the current firm performance. Our main argument rests on the fact that the founders' fertility decisions and the decisions on the current board size are well separated in time. The separation is ensured by imposing an upper limit on firm age and a lower limit on the age of founders' children. Specifically, we adopt an upper firm age limit of 25 years and a lower limit on founder's children of 30 years.[8]

Our claim is that once we control for a sufficiently rich set of characteristics, including information on the distribution of ownership, there will be no further direct effects of the number of founders' children on current performance. This claim rules out e.g. that a founder can make fertility decisions based on characteristics of the firm she has founded or plans to found, other than those already included in the performance relationship. It is in order to limit the relevance of such "reverse causality" considerations that we impose the time lag of at least five years between fertility decisions that affect our founder-related information and the earliest date of foundation of any firm in the sample. Specifically, the firm age limit of 25 years and the consideration of founders' children who are 30 or older in 1999 ensures a separation of five

[8]By construction, firms in the gross sample are younger than the representative firm in the population. There could be further systematic age-related differences when compared to the full population of closely held corporations.

years between the fertility decisions that has determined founders' family size (the persons included have been born before 1970) and the foundation of firms which took place in 1975 at the earliest.[9]

There are of course reasons why the exclusion restriction imposed on the number of founders' children could be contestable. Even without any direct reverse causality link there could be a non-zero correlation between a founder's abilities in child-bearing and current unobservables in the performance of the firm. Innate ability in child-bearing and in managing a firm could be related (most likely positively). On the other hand, there is a trade-off between time invested in child-bearing and in acquiring management skills. A priori, there appears not to be a definite sign for any correlation.

Another potential source of correlation could derive from the process of CEO choice in family firms. The pool of management talent is non-decreasing in family size and if the CEO is chosen within the family, then family size should impact non-negatively on firm performance. However, the tendency to choose a family CEO and potentially neglect outside management talent is also increasing in family size as evidenced by recent findings in Bennedsen *et al.* (2004). Again, the net impact—if any—on firm performance appears ambiguous.

A final consideration in support of our claim that the number of founders' children is exogenous in firm performance is the fact that the claim is made

[9]Due to fact that we can only obtain founder data on firms that were registered as joint stock companies in after 1986 most firms are established in 1986 or later. Thus, for the majoirty of the firms the time lag between the feritlity decision and the establishment of the firm is above 15 years.

with respect to *original* founders of the firm. They are not necessarily closely related to the current owners or managers, although 74 per cent of the family-controlled firms are still owned by at least one of the original founders. The foundation of the firm in most cases took place years before the period in which we measure firm performance. Almost 90 per cent of the firms in the founder sample are five years or older. While the relationship between founders and current management and ownership is expected to be further weakened by this separation in time, our identifying strategy seeks to exploit that board size is a persistent phenomenon and in part determined by founders' family considerations.

In conclusion, the main exogeneity assumption is that any effect of founders' family relationships on current performance runs via the corporate board, not through other current aspects of the management of the firm. Although the core of this claim will remain an assumption, we obtain testable overidentifying restrictions when we add further instrumental variables to the analysis.

4 The Link between Board Size and Firm Performance

This section reexamines the empirical relationship between board size and firm performance. For comparison with previous literature, we first estimate the relationship by OLS using standard controls for size, age, and the degree of diversification of the firm as well as membership of a corporate group.[10] We then add the ownership and founder variables available in our data set

[10] Throughout we include industry dummies at the two-digit NACE level.

as additional controls. The second part of the empirical analysis uses the instrumental variable proposed as an exogenous source of variation in board size, the number of founders' children. Based on the conclusions from the IV analysis we then reconsider the performance equation with a more flexible specification of board size effects in the final subsection.

4.1 Basic Ordinary Least Squares Results

The dependent variable in the performance equation is the return on assets (RoA) of the firm in 1999. This performance measure is known to be quite noisy although there exists few good alternatives in analyzing the performance of closely-held firms. We enter the variable of main interest, the number of board members, linearly in the basic specification. Other studies have imposed a log transformation, e.g. Yermack (1996), or even used a twice log-transformed version as in Eisenberg *et al.* (1999). We note that the range of variation of board size is narrow and, if anything, the unconditional relationship between board size and performance in Table 1 suggests smaller effects of absolute changes in board size in small boards than in comparatively large boards, not larger effects as would be implied by a log transformation. We will use a linear specification for the main analysis and then explore the robustness of results in a flexible specification of board size below.

A standard set of controls for firm performance will be employed throughout the empirical analysis: The number of employees (in logs) and its square as a measure of the size of the firm; the age of the firm; and a dummy for the firm being part of a corporate group. A final control variable is a dummy for

whether the firm is diversified.[11]

Our rich data set also makes available some variables that are related to ownership. In particular, we have information on the number of owners. Ownership distribution - and in particular the number of owners - may have a direct impact on performance, since it is the main mechanism that aligns the interest of controlling and non-controlling owners (Bennedsen and Wolfenzon 2000). As is evident from Table 2, most firms indeed have very few owners with a gross sample average of two. Ownership is represented by a set of dummy variables for having two, three or four or more owners with single-owned firms as the reference category. A further firm characteristic which is related to ownership is the presence of a family CEO. Bennedsen *et al.* (2004) point out that most closely-held corporations are family-controlled and find that family control is associated with a tendency to select a member of the family as the CEO. In order to control for a potential negative performance effect of narrowing the pool of potential CEO candidates to the family we include a dummy for firms with this characteristic.

The final set of regressors control for the number of founders of the firm. In Table 2 we documented that the number of persons who founded the firm is clearly correlated with firm characteristics already included in the regression, in particular the size of the board. Still, there could well be other persistent determinants of performance which are unobserved and correlated with the number of founders. In order to proxy for such effects we therefore include dummy variables for having two or three or more founders in the regression.

[11] Both Yermack (1996) and Rajan, Servaes, and Zingales (2000) find evidence that more diversified firms are less profitable.

Table 3 reports the basic OLS regressions. The regression in column (1) includes only board size and the standard controls, (2) adds information on ownership and the presence of a family CEO, and (3) also has the founder dummy variables. (1) and (2) can be estimated for the gross sample of 5,555 firms whereas the regression in (3) is reported only for the sample of 1,335 family-controlled firms. Most effects of the standard controls are consistent across the specifications.[12] We find that firm size has an increasing although concave effect on performance. More diversified firms have lower profits whereas the corporate group dummy is insignificant. Older firms seem slightly less profitable than younger firms in the gross sample. The age effect is not significant in the sample of family-controlled firms which is mainly due to the fact that firms in the latter sample are selected to be 25 years old or younger.

The performance effect of changes in board size in the gross sample is found to be negative although small and insignificant. Adding ownership information and information on the number of founders does not change that conclusion. The ownership dummies are marginally significant when added in column (2) whereas the founder dummies could well be excluded from the regression in column (3) based on the family-controlled sample.

The consistency of the above results and their *ceteris paribus* interpretation clearly rely on the exogeneity of all regressors in the performance equation, including the board size variable. The next section examines the empirical validity of this assumption.

[12]Indeed throughout most of the empirical analysis. Only where there are exceptions from this will it be noted in the following.

4.2 Instrumental Variables Estimation Results

The main issue is whether board size variations are endogeneous in the performance equation and if any inconsistency would matter materially for the estimated board size effect. As argued in the introduction, there might be unobserved performance determinants which are also related to board size. If that is the case, the OLS results do not identify the causal effect of board size variations on performance. The fact that the above regressions include a rich set of controls should be a partial remedy for this problem. To further investigate the exogeneity issue, we will employ our proposed instrumental variable, the number of founders' children, as a source of exogenous variation in board size. Our main identifying argument is that once we have controlled for a rich set of potential performance determinants, including ownership variables and the number of founders, then the variations in the number of founders' children should be unrelated to unobserved firm characteristics.

Table 4 reports instrumental variables estimation results based on the extended specification of the structural performance equation. Firms included in this table are family-controlled firms founded no more than 25 years ago, for which we have valid founder information.

The performance equation is estimated in a two-stage least squares procedure. The first stage is a regression of board size on the instrumental variables and on all other exogenous variables in the model. The second-stage regression then includes the predicted value of board size from the first-stage regression along with the exogenous determinants of performance. Table 4 contains two sets of results. Column (1) uses the exclusion of the number of founders' children from the performance equation to exactly identify the

performance relationship. Column (2) adds its square as an additional instrument. This yields a testable overidentifying restriction.

The signs of most effects in column (1) are unchanged compared to the extended OLS results in Table 3. Some effects have increased in magnitude which also holds for their standard errors. The effect of board size is negative and larger in numerical value than in the OLS regression, but remains insignificant. The overidentified case in column (2) shows reduced standard errors but the board size effect remains insignificant.

The relative precision of the instrumental variables estimates clearly rely on the strength of the instrument applied here. A test of the validity of the instrument is provided by the test of identification reported in the lower part of Table 4. This is a test of a significant relationship between the potentially endogenous regressor, board size, and the instrumental variable, the number of founders' children, conditional on the set of included exogenous regressors in the performance equation. In the case of no significance we would have a "weak instruments" problem. Staiger and Stock (1997) argue that F-tests of significance should be at least 5 for an instrumental variable not to be weak in this sense. The number of founders' children qualify as a valid instrument on this criterion with an F-test of identification of 9.70 and a very low p-value.

Having established a significant correlation between our proposed source of exogenous variation and the size of the board, we can then use the instrumental variable to address the potentially critical question of exogeneity of board size in the performance equation. Table 4 reports the Hausman exogeneity test[13] of the significance of differences between the OLS estimates in

[13]The particular form of the test performed here is a residual-addition test, see e.g.

Table 3 (which are consistent and efficient if board size turns out exogenous), and the IV results in column (1) if Table 4 (which are consistent in any case). Based on the founders' children instrument there is no evidence that board size is endogenous in the performance equation as the exogeneity test has a $p-$value of 28 per cent. The OLS results are therefore to be preferred on the grounds of efficiency.

The robustness of this conclusion is checked in column (2) by adding the number of founders' children squared to the set of instruments. This adds flexibility to the reduced-form relationship and the test of excluding both instruments from the first-stage regression is again very significant. The conclusion that board size is exogenous also remains unaltered. Moreover, having two instruments and one potentially endogenous variable we can test one overidentifying restriction which easily passes the Sargan test provided in Table 4. This adds credibility to the core of the identifying argument we made in Section 3.

In conclusion, we have established that the number of founders' children is a valid instrument for the performance equation. Both the OLS and IV estimates of the effect of board size on firm performance are negative although insignificant. Having a valid instrument we can then address the exogeneity question raised in the introduction. We find that there is no empirical evidence that the size of the corporate board is endogeneous to the performance relationship.

Davidson and MacKinnon (1993). The test is based on adding the residual of the first stage regression to the structural performance equation and testing its significance.

4.3 Flexible Ordinary Least Squares Results

The finding that board size variations can be treated empirically as exogenous in the performance equation allows us to become more flexible on the functional form of board size effects.[14] We apply two different approaches: The first approach uses the fact that board size is an integer to construct dummy variables for boards of four, five, six and seven (or more) members. The second approach uses a piecewise linear approach similar to that applied by Morck, Shleifer, and Vishny (1988). It specifies a linear relationship between board size and RoA but allows for different slopes in small (six or fewer members) and large boards (seven or more members). We combine these respecifications of the board size variables with the extended OLS specification from Table 3, column (2). The effects of other performance determinants as reported in Table 5 are seen to be largely unaltered by introducing a flexible board size specification.

The unrestricted dummy variable specification in column (1) suggests a small positive but insignificant effect of boards of five or six members. Boards with seven or more members are associated with a significantly lower RoA. The F-test of excluding dummies for small boards of six or less members is easily accepted. The restricted specification reported in column (2) shows a strongly significant effect of large boards.

For the piecewise linear approach we allow for a change in the slope of the board size—performance relationship at six board members. The breakpoint

[14] See Davidson and MacKinnon (1993, section 7.6) for a discussion of potential problems with IV estimation when the endogenous regressor enters non-linearly in the structual equation.

at six is suggested both by the dummy specification and by the unconditional RoAs reported for each board size in Table 1. Again, the effect is found to be insignificant in small boards. Increasing the board size appears to be associated with a significantly lower RoA only in the comparatively large boards with seven or more members.

The results of the flexible models are thus supportive of the prediction by Jensen (1993) and Lipton and Lorsch (1992) that negative board size effects due to agency problems become relevant in board with seven or more members. Our findings are also consistent with Yermack's (1996) finding of a negative board size effect in boards of seven or more members. On the other hand, our results are contrary to the findings of Eisenberg *et al.* (1998) on two accounts. First, we find no evidence of negative board size effects in small boards. Secondly, the magnitude of the board size effect in boards of seven or more members is much smaller than that estimated by Eisenberg *et al.* The estimates reported in Table 5, column (4) predict that increasing the size of the board e.g. from six to seven members would lower the RoA by somewhat less than half a percentage point. The Eisenberg *et al.* estimates an effect of more than two percentage points of a similar change.

5 Discussion

A substantial contribution of this paper is to offer firm evidence that a major concern in the literature, that the estimation of the performance effect of corporate board size suffers from endogeneity problems, seems largely unfounded in our sample of closely-held corporations. In order to substantiate

this claim we exploited a novel source of exogenous variations in board size due to family-related concerns of the personal funder of the firm. This instrumental variable strategy allows us to address the exogeneity issue directly for the majority of closely-held corporations that are family-owned. Establishing a valid instrument allowed us to empirically test the endogeneity of board size.

Based on the finding that board size variations can be regarded as exogenous in the performance equation we then analyzed a flexible model specification. Our results show a picture of board size effects in the performance of small and medium-sized closely-held corporations that aligns with the theoretical literature. First, we find no performance effects in closely held corporations of varying the board size at levels below six members, which is the typical range of board size in closely held corporations.

Secondly, we find a significantly negative effect of increasing the size of the boards at board sizes of seven members or more. This is consistent with the findings of Yermack (1996) on listed US corporations and shows that a negative board size extends to small and medium-sized closely-held firms but only to the minority of firms that have comparatively large boards. The performance of the great majority of closely-held firms shows no signs of being adversely affected by small increases in the size of their boards. This finding substantiates a prediction of the theoretical literature, that the negative board size effect occurs when boards become *too* large.

Overall, our analysis challenges the existence of a negative board size effect for small boards in closely held corporations. As theory suggests there are good reasons not to choose the minimum board size as long as the number

of directors does not become *too* big.

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Appendix A

This appendix describes the criteria we used in the data selection. The total population of closely held corporations in Denmark totals 14,103 firms in 1999. We exclude 345 firms that did not report their industry classicifation. We further exclude 6,143 firms which operate in regulated industries; utilities (25), financial indermediation, business services and community, social and personal service activities (6118).[15] We further drop 1,404 firms that were not active in 1998 and therefore did not report book value of assets. Similarly, we exclude 175 firms with no employees and 109 firms that reported extraordinary profits due to sales of assets in the beginning of the period. We further dropped 243 firms that changed industry at the two-digit NACE level or where under bankruptcy before 1999. Finally, we excluded 129 extremely small firms that reported beginning-of-period assets of less than DKK 1,000,000 (appr. USD 170,000 with 1999 exchange rate). This leaves 5,555 firms that represent the population for this analysis.

All of the above selection criteria are imposed to avoid any major changes in valuation principles, firms under restructuring, firms with extreme growth due to recent establishment, etc. While some of the adjustments could potentially be related to the current performance of the firm, none of the conclusions reported in this paper are altered by these selection criteria.

[15] Number of firms in parenthesis.

Table 1: Descriptive statistics on ownership, assets and returns on assets for different board size categories

This table reports the mean and medians number of *owners*, book value of *assets* and return on assets (*RoA*) for board size categories ranging from 3 to 7+. Medians are reported in parentheses. *Gross sample* is the full sample of firms used in the analysis (see Section 2), whereas *Founder information* is the sub sample of firms for which we were able to obtain information on the founder of the firm (see Section 2 for further details).

	Gross sample				**Founder information**			
Board Size	n	Owners	Assets	RoA	n	Owners	Assets	RoA
3	3,372	1.70 (1.00)	11,135 (6,125)	0.0770 (0.0702)	1,243	1.62 (1.00)	7,800 (4,817)	0.0918 (0.0866)
4	1,186	2.21 (2.00)	33,855 (7,979)	0.0783 (0.0760)	377	2.15 (2.00)	54,870 (6,101)	0.0903 (0.0851)
5	649	2.74 (2.00)	28,003 (13,837)	0.0794 (0.0753)	150	2.70 (2.00)	23,909 (9,235)	0.0912 (0.0933)
6	224	3.12 (3.00)	153,466 (24,981)	0.0792 (0.0713)	42	3.24 (3.00)	37,969 (16,801)	0.1130 (0.1095)
7+	124	3.86 (3.00)	311,620 (63,258)	0.0388 (0.0535)	24	3.54 (3.00)	130,493 (16,839)	0.0476 (0.0483)
All	5,555	2.04 (2.00)	30,403 (7,590)	0.0768 (0.0716)	1,836	1.88 (2.00)	21,075 (5,499)	0.0913 (0.0879)

Table 2: The link between founder and the founder's family characteristics and board size
This table reports the mean number of founders and mean number of founders' children aged above 30 for board size categories ranging from 3 to 7+. *Gross sample* is the full sample of firms used in the analysis (see Section 2), whereas *Family controlled* is the subsample of family firms where a single family holds a majority of the ownership. *Founder information* is the subsample of firms for which we were able to obtain information on the founder of the firm (see Section 2 for further details).

	Gross sample & founder information			**Family controlled & founder information**		
Board Size	n	Founders	Children (Age 30+)	n	Founders	Children (Age 30+)
3	1,243	2.25	0.92	1,001	2,22	0.91
4	377	2.37	1.11	231	2,32	1.25
5	150	2.57	1.33	81	2,59	1.54
6	42	2.50	1.50	14	2,36	1.21
7+	24	2.75	1.75	8	3,38	3.50
All	1,836	2.31	1.02	1,335	2.27	1.02

Table 3: OLS estimates of board size and firm performance

The dependent variable is return on assets (RoA). Numbers in parenthesis are t-statistics, whereas numbers in brackets are p-values. Each equation also includes intercept and industry dummies on the two-digit NACE level. *, ** and *** denotes significance at the 10, 5 and 1 percent level in a two-sided test.

	(1)	(2)	(3)
Estimation method	OLS	OLS	OLS
A. Board variables			
Board size	-0.0011	-0.0016	-0.0043
	(-0.68)	(-0.97)	(-1.04)
B. Controls			
Employees (log)	0.0136***	0.0129***	0.0216**
	(3.64)	(3.42)	(2.11)
Employees (log, squared)	-0.002***	-0.0019***	-0.0044**
	(-3.33)	(-3.22)	(-2.02)
Firm age	-0.0006***	-0.0006***	-4E-05
	(-6.13)	(-6.11)	(-0.06)
Diversification	-0.0067**	-0.0067**	-0.0082
	(-2.07)	(-2.08)	(-1.19)
Corporate group	0.0053	0.0064	0.0378
	(0.82)	(0.98)	(1.28)
C. Ownership			
Two owners		0.0106***	0.0140*
		(2.76)	(1.87)
Three owners		0.0001	-0.0030
		(0.02)	(-0.20)
Four or more owners		0.0098*	0.0147
		(1.71)	(0.94)
Family CEO		0.0026	0.0078
		(0.66)	(0.56)
D. Founders			
Two founders			-0.0019
			(-0.16)
Three or more founders			0.0107
			(1.57)
N	5,555	5,555	1,335
R-sq.	0.032	0.032	0.070

Table 4: IV estimates of board size and firm performance

The dependent variable is return on assets (RoA). We use *Number of founders children aged above 30* as instrument for board size (see Section 3 for a motivation of the instrument). The table reports the second stage from the two-stage-least-squares estimation. *Identification* is a F-test of the validity of the instrument. *Exogeneity* is a Hausman exogeneity test of the significance of differences between the OLS estimates and the IV results. *Overidentification restrictions* is the Sargan test of overidentifying restrictions. Numbers in parentheses are t-statistics, whereas numbers in brackets are p-values. Each equation also includes intercept and industry dummies on the two-digit NACE level. *, ** and *** denotes significance at the 10, 5 and 1 percent level in a two-sided test.

	(1)	(2)
Estimation method	IV	IV
A. Board variables		
Board size	-0.0344	-0.0183
	(-1.19)	(-1.07)
B. Controls		
Employees (log)	0.0178	0.0198*
	(1.60)	(1.87)
Employees (log, squared)	-0.0025	-0.0035
	(-0.86)	(-1.40)
Firm age	0.0003	0.0001
	(0.34)	(0.14)
Diversification	-0.0086	-0.0084
	(-1.22)	(-1.26)
Corporate group	0.0389	0.0382
	(1.30)	(1.29)
C. Ownership		
Two owners	0.0672**	0.0153**
	(2.08)	(1.98)
Three owners	0.0063	0.0013
	(0.35)	(0.08)
Four or more owners	0.0383	0.0257
	(1.33)	(1.14)
Family CEO	0.0040	0.0060
	(0.27)	(0.42)
D. Founders		
Two founders	0.0006	-0.0007
	(0.05)	(-0.06)
Three or more founders	0.0111	0.0109
	(1.62)	(1.60)
Identification	9.70	7.29
	[0.002]	[0.001]
Exogeneity	1.16	0.63
	[0.282]	[0.428]
Overidentifying restrictions		0.94
		[0.333]
N	1,335	1,335
RMSE	0.114	0.110

Table 5: OLS estimates of board size and firm performance

The dependent variable is return on assets (RoA). Numbers in parenthesis are t-statistics, whereas numbers in brackets are p-values. Each equation also includes intercept and industry dummies on the two-digit NACE level. *, ** and *** denotes significance at the 10, 5 and 1 percent level in a two-sided test.

	(1)	(2)	(3)	(4)
Estimation method	OLS	OLS	OLS	OLS
A. Board variables				
Dummy for board size = 4	-2.8E-6			
	(-0.00)			
Dummy for board size = 5	0.0021			
	(-0.39)			
Dummy for board size = 6	0.003			
	(-0.37)			
Dummy for board size ≥ 7	-0.0335***	-0.0347***		
	(-2.92)	(-3.19)		
Board size			0.0013	
			(0.65)	
Board size * Dummy for			-0.0046***	-0.0040***
board size ≥ 7			(-2.96)	(-3.14)
B. Controls				
Employees (log)	0.0116***	0.0116***	0.0116***	0.0116***
	(3.04)	(-3.06)	(3.04)	(3.04)
Employees (log, squared)	-0.0017***	-0.0016***	-0.0017***	-0.0016***
	(-2.74)	(-2.74)	(-2.75)	(-2.72)
Firm age	-0.0006***	-0.0006***	-0.0006***	-0.0006***
	(-6.13)	(-6.11)	(-6.13)	(-6.11)
Diversification	-0.007**	-0.007**	-0.0070**	-0.0069**
	(-2.15)	(-2.15)	(-2.16)	(-2.14)
Corporate group	0.0064	0.0065	0.0064	0.0066
	(0.98)	(1.00)	(0.99)	(1.00)
C. Ownership				
Two owners	0.0100**	0.0101**	0.0098**	0.0100**
	(2.59)	(2.62)	(2.56)	(2.62)
Three owners	-0.0005	-0.0003	-0.0008	-0.0003
	(-0.10)	(-0.05)	(-0.15)	(-0.06)
Four or more owners	0.0095	0.0102*	0.0090	0.0099*
	(1.66)	(1.86)	(1.57)	(1.81)
Family CEO	0.0026	0.0024	0.0027	0.0025
	(0.64)	(0.60)	(0.67)	(0.62)
N	5,555	5,555	5,555	5,555
R-sq.	0.03	0.03	0.03	0.03

Table 6: Descriptive statistics on regression variables

This table summarizes the mean, median, standard deviation, minimum and maximum of the variables used in the regressions throughout the paper. Panel A shows the statistics for the *Gross sample*, whereas Panel B shows the *Family controlled with founder information*. *Gross sample* is the full sample of firms used in the analysis (see Section 2), whereas *Family controlled with founder information* is the sub sample of family firms where a single family holds a majority of the ownership for which we were able to obtain information on the founder of the firm (see Section 2 for further details).

	Mean	**Median**	**Std.dev.**	**Minimum**	**Maximum**
Panel A: Gross sample (n=5,555)					
Return on Assets	0.0768	0.0716	0.117	-0.8400	1.408
Board size	3.67	3	1.070	3	12
Employees	37.3	12	311.0	1	18,270
Firm age	19.5	15	16.89	1	344
Diversification	0.478	0	0.500	0	1
Corporate group	0.062	0	0.242	0	1
Number of owners	2.035	2	1.261	1	16
Family CEO	0.650	1	0.477	0	1
Panel B: Family controlled with founder information (n=1,335)					
Return on Assets	0.0914	0.0877	0.114	-0.8069	0.5666
Board size	3.35	3	0.736	3	10
Employees	14.9	9	34.37	1	763
Firm age	9.5	9	3.763	1	25
Diversification	0.410	0	0.492	0	1
Corporate group	0.018	0	0.133	0	1
Number of owners	1.543	1	0.854	1	9
Family CEO	0.942	1	0.235	0	1
Number of founders	2.271	3	1.065	1	9