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Roberto E. Wessels
Tom Wansbeek
Lammertjan Dam

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Abstract

We present a model to test the null hypothesis that firms organize their corporate governance arrangements optimally given the constraints they face. Following the literature, the model rejects the null if the conditional correlation between governance and performance is significantly different from zero. Our model provides a clean test of this hypothesis by controlling for measurement errors in all observed variables and avoiding simultaneous equation biases by casting our model as a reduced-form bivariate equation. We model governance, performance and the constraints on the firm's investment decisions as latent variables. Our estimate of the conditional correlation between our measures of governance and performance is statistically speaking equal to zero, which therefore provides empirical support for the in-equilibrium view proposed by Demsetz (1983), of corporate governance arrangements.

JEL-Code: C380, G340, L200, M520.

Keywords: corporate governance, optimal firm behavior, endogeneity, structural models, latent variables.

*Roberto E. Wessels**
Faculty of Economics and Business
University of Groningen
Groningen / The Netherlands
rewessels@frissestyn.nl

Tom Wansbeek
Faculty of Economics and Business
University of Groningen
Groningen / The Netherlands
t.j.wansbeek@rug.nl

Lammertjan Dam
Faculty of Economics and Business
University of Groningen
Groningen / The Netherlands
l.dam@rug.nl

*corresponding author

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1 Introduction

In order to be successful, firms must develop and maintain mutually beneficial relations with various counterparties such as employees, capital providers, communities, suppliers, customers, regulators and competitors, whose interests may conflict with those of the firms' owners.

Managing these conflicts is complicated, particularly so for large, exchange-listed firms, where the separation of ownership and control adds a layer of complexity as they are owned by shareholders but controlled by hired managers. Managers in these firms are hence expected to resolve conflicts of interest to which they often are an interested party. Our research focuses on this kind of firm by studying a sample of large, publicly traded firms, most of which belong or belonged to the S&P1500 index during the period of our sample (2000 to 2008).

These firms rely on complex mechanisms designed to monitor the performance of the managers but also to provide them with incentives to act in the interest of the shareholders. We refer to the collection of these mechanisms as the structure of corporate governance. Over the past thirty years, since the seminal work of Demsetz and Lehn (1985), academic researchers have devoted much energy to investigate whether firms with effective corporate governance arrangements are also be the firms with better financial performance.

Empirical research has been shaped by two contrasting approaches to how markets work, the in-equilibrium view and the out-of-equilibrium view, the former being credited to Demsetz (1983) and the latter to Berle and Means (1932). According to the in-equilibrium view, what we observe in the data is assumed to be the result of firms making value-maximizing decisions subject to constraints. This then suggests the conjecture that, if the equilibrium view is correct, we should not be able to observe any conditional correlation between governance and performance.

The proponents of the out-of-equilibrium view, on the other hand, hold that empirically observed correlations between measures of corporate governance and firm performance imply that firm performance can be improved by increasing the effectiveness of corporate governance. This position, incidentally, requires an explanation why firms apparently pass up on opportunities to improve their bottom line. One possible explanation is that an out-of-equilibrium situation arises when the balance of control over the firm is held by entrenched managers whose interests are not aligned with those of shareholders; see Bebchuk and Fried (2004) and the comments by Holmstrom (2005).

For a number of reasons, trying to distinguish between these two views is not straightforward. First, there are strong theoretical reasons to assume that governance and performance are functions of the same determinants. Unless this dependency on common determinants is accounted for, estimates of the correla-

tion between governance and performance will be biased, as has been argued by Hermalin and Weisbach (2003).

The model that we propose below avoids this issue by estimating a reduced-form version of structural model in which we postulate that firms choose their corporate governance arrangements in order to maximize their financial performance, subjects to constraints. The optimality of the observed choices can then be tested by the covariance between the residuals of a bivariate regression.

A second reason for the difficulty of distinguishing between the two views is that corporate governance arrangements are a black box, according to Cornelli, Kominek, and Ljungqvist (2013). Technically, corporate governance is a latent variable. Hence, corporate governance is often measured by a proxy variable assumed to correlate with the true but unobservable latent variable. For example, a measure of the firm's equity owned by the management or a measure of the size or structure of the board of directors.

Measuring corporate governance in this way has several drawbacks. First, proxy variables are by definition subject to measurement error, which induces endogeneity, cf. Erickson and Whited (2006). As the use of proxy variables is ubiquitous, proxies are an endemic cause of endogeneity.[1] Moreover, most proxies of corporate governance arrangements are correlated, reflecting the notion that corporate governance consists of several dimensions that can act as substitutes or complements. Examples of corporate governance mechanisms that work as complements are given in Cremers and Nair (2005); examples of mechanisms that work as substitutes are provided in Hartzell and Starks (2003).

In general, previous studies have skirted these issues by focusing on a single proxy of corporate governance and then implicitly drawing conclusions about the effects of changes in corporate governance in general under the assumption that "everything else" is kept constant.[2]

We take a very different approach by modeling corporate governance, firm performance and the investment opportunity set as latent variables.[3] This approach allows us to explicitly account for the measurement errors in proxy variables and to use several proxies of the same latent variable to account for the substitution and complementarity effects between different proxies. Surprisingly, this approach seems to be novel in this strand of the literature.

Our paper has two main results. First, we show that the unconditional correlation between corporate governance and financial performance is positive and statistically highly significant ($\rho = 0.694$, p-

[1] For a general treatment of endogeneity, see Roberts and Whited (2012), and for a (pessimistic) discussion of the generally applied remedies to endogeneity problems in empirical corporate finance, see Coles, Lemmon, and Meschke (2012).

[2] For a critical view of this practice see Coles, Daniel, and Naveen (2008), p.3, and Adams, Hermalin and Weisbach (2010), p.62.

[3] For textbook treatments of models with latent variables, see Wansbeek and Meijer (2000) and Skrondal and Rabe-Hesketh (2004).

value=0.000). This result can be interpreted, absent other considerations, that an increase in our measure of corporate governance is associated with an increase in our measure of financial performance. We could show this by running a regression of performance on governance, showing that the regression coefficient is statistically highly significant.

However, in this case, the correlation is measuring association and not causation since the estimate does not take into consideration the opportunities and constraints that firms face when taking allocation decisions. In fact, the estimated unconditional correlation is a measure of what the relation between governance and performance would be if governance were a free good; Jensen and Meckling (1976) refer to this kind of reasoning as Nirvana analysis.

Perhaps more realistically, the in-equilibrium view implies that, if technical and market conditions vary across firms such that firms operating in different markets and industries face different investment opportunities, we should not expect corporate governance arrangements and financial performance across firms to be correlated once the differences in opportunities and constraints across firms are taken into account.

To test the hypothesis that markets are in equilibrium, we estimate a bivariate, reduced-form model in which governance and performance are functions of the investment opportunity set and of unobserved other variables, collected in the error terms. We can reject the in-equilibrium view if the covariance between the error terms significantly differs from zero as that would indicate that governance and performance share a common source of (residual) variability after accounting for the variation in the investment opportunity set.

Our second main result is that we estimate the covariance to be -0.13, with a *t*-value of -0.53, and so we have no reason to reject the in-equilibrium view. In other words, the correlation between governance and performance conditional on the firm's investment opportunity set is zero. Note that we can exclude the interpretation that this result is due to governance and performance being generally unrelated, as we already showed that the unconditional correlation between governance and performance is large and statistically significant.

Finally, we note that not all observed corporate governance arrangements are freely chosen by the firms. Some features of corporate governance are the result of legal or regulatory requirements. Recent examples of regulatory changes are the Sarbanes-Oxley Act of 2002, which set new standards for how companies report their results, see Chhaochharia and Grinstein (2007); the requirement that the majority of the members of the board of directors of all NYSE and NASDAQ listed firms be independent (Coles et al., 2008, and Duchin, Matsusaka, and Ozbas (2010); and the introduction of gender quotas for boards of directors, recently intro-

duced in Norway (Ahern and Dittmar, 2012, and Bøhren and Staubo, 2013). These studies provide evidence that such exogenous changes can have large value-destroying effects on firms.

Our results also suggest that if the constraints imposed by legal requirements and regulations are binding from above, performance in the new optimum will be strictly lower than in the optimum prior to the regulatory change.There can be all kinds of reasons why such changes should be imposed on firms. One reason could be that there are externalities that firms do not take into account when considering their corporate governance arrangements, like the systemic risks posed by financial firms which has lead to these firms being subject to industry-specific forms of regulatory controls. Whatever the reason, contributing to the improvement of the financial performance of firms is not one of them.

The paper proceeds as follows. In the next section we present the model used to test the equilibrium view. We discuss the specification and how the model is estimated. To estimate the model we also need to specify the proxies used to measure the latent variables of the model. These proxies are discussed with reference to the literature in Section 3. The results are presented and discussed in Section 4. The conclusions of the paper are summarized in Section 5.

2 A model of the relation between corporate governance and firm financial performance.

With the index i denoting firms, let G_i be corporate governance, F_i financial performance, and I_i the investment opportunity set. We propose a structural model with the following characteristics. First, G_i and F_i are endogenous, and I_i is exogenous. Second, G_i is a determinant of F_i but not vice versa. Third and most importantly, the way G_i is a quadratic determinant of F_i which allows for a solution for optimal G_i. Thus,

$$G_i = \kappa + \theta I_i + u_{1i} \quad (1)$$

$$F_i = \alpha + \lambda I_i + \beta(G_i - \kappa^* - \theta^* I_i)^2 + u_{2i}. \quad (2)$$

The error terms u_{2i} and u_{1i} have mean zero, variances σ^2_{u1} and σ^2_{u2}, respectively, and their covariance is γ.

There three important aspects to this set of equations. First, note that both governance and financial performance are driven by an underlying investment opportunity set; ignoring this would result in an endogeneity bias in the relation between governance and financial performance. Second, we allow for, but do not impose, a non-linear relationship between corporate governance and financial performance. As such, we can explicitly test whether firms are "out-of-equilibrium" or "in-equilibrium" and in the derivation that

follows we show under which assumptions we can interpret a conditional correlation of the error terms of the two equations that is equal to zero as firms being in equilibrium. Conversely, a conditional correlation unequal to zero implies that firms are out of equilibrium, i.e. they behave non-optimally. Third, governance and financial performance are conceptual constructs; they are latent variables. We also show how we deal in this issue.

Let $I_i \sim (\mu_I, \sigma_I^2)$. We assume the distribution to be symmetric, so $\mathrm{E}(\tilde{I}_i^3) = 0$. Let $\tilde{I}_i \equiv I_i - \mu_I$. Substitution of (1) in (2) gives the reduced-form equation

$$
\begin{aligned}
F_i &= \alpha + \lambda I_i + \beta\left[(\kappa - \kappa^*) + (\theta - \theta^*)I_i + u_{1i}\right]^2 + u_{2i} \\
&= (\alpha + \lambda\mu_I) + \lambda\tilde{I}_i + \beta\left[\{(\kappa - \kappa^*) + (\theta - \theta^*)\mu_I\} + (\theta - \theta^*)\tilde{I}_i + u_{1i}\right]^2 + u_{2i} \\
&\equiv \alpha_+ + \lambda\tilde{I}_i + \beta\left[c + \Delta_\theta\tilde{I}_i + u_{1i}\right]^2 + u_{2i} \\
&= \alpha_+ + \lambda\tilde{I}_i + \beta\left[c^2 + \Delta_\theta^2\tilde{I}_i^2 + u_{1i}^2 + 2c\Delta_\theta\tilde{I}_i + 2cu_{1i} + 2\Delta_\theta\tilde{I}_i u_{1i}\right] + u_{2i} \\
&= (\alpha_+ + \beta c^2) + (\lambda + 2\beta c\Delta_\theta)\tilde{I}_i + \beta\left[\Delta_\theta^2\tilde{I}_i^2 + u_{1i}^2 + 2cu_{1i} + 2\Delta_\theta\tilde{I}_i u_{1i}\right] + u_{2i} \\
&= (\alpha_+ + \beta c^2 + \beta\Delta_\theta^2\sigma_I^2 + \beta\sigma_{u1}^2) + (\lambda + 2\beta c\Delta_\theta)\tilde{I}_i + \beta\left[\Delta_\theta^2(\tilde{I}_i^2 - \sigma_I^2) + (u_{1i}^2 - \sigma_{u1}^2) + 2cu_{1i} + 2\Delta_\theta\tilde{I}_i u_{1i}\right] + u_{2i} \\
&\equiv \alpha_\ddagger + \lambda_+\tilde{I}_i + (\beta w_i + u_{2i}) \\
&\equiv \alpha_\ddagger + \lambda_+\tilde{I}_i + e_i.
\end{aligned}
$$

Notice that $\mathrm{E}(e_i) = 0$, and also $\mathrm{E}(\tilde{I}_i e_i) = 0$ since $\mathrm{E}(\tilde{I}_i^3) = 0$; the regressor and the error term have covariance zero. Substituting for $\tilde{I}_i$ yields

$$F_i = (\alpha_\ddagger - \lambda_+\mu_I) + \lambda_+ I_i + e_i. \tag{3}$$

Equations (1) and (3) are the reduced form of our structural model. They show how the reduced-form parameters relate to the structural parameters. The latter are not identified. This need not worry us since we are only interested in the correlation between e_i and u_{1i} and not in the structural parameters. This correlation (or rather, covariance), then equals

$$\mathrm{E}(e_i u_{1i}) = \beta\,\mathrm{E}(w_i u_{1i}) + \gamma = 2\beta c\sigma_{u1}^2 + \gamma,$$

where $c \equiv (\kappa - \kappa^*) + (\theta - \theta^*)\mu_I$. We can estimate this covariance by simply estimating the reduced-form model.

What does a finding of a covariance equal to zero mean? Excluding a freak constellation of parameter values, it means that $\gamma = 0$, and $\kappa = \kappa^*$ and $\theta = \theta^*$, so that governance on average is being optimally determined and deviations from the optimum are not systematic in the sense of being correlated with the opportunity set. This gives a precise meaning to the notion of "equilibrium view."

Again, none of the three variables can be directly observed; they are latent variables. So our estimation will be indirect, through the use of proxy variables in a factor analysis structure. So, for the latent variable G_i we postulate the model with k (say) proxies

$$\begin{aligned} y_{1i} &= G_i\lambda_1 + \varepsilon_{1i} \\ &\vdots \\ y_{ki} &= G_i\lambda_k + \varepsilon_{ki}, \end{aligned}$$

where the ys denote proxy variables as functions of the latent variable C, with "factor loadings" $\lambda_1, \ldots, \lambda_k$; the εs are the error terms. We have the same structure for the other two latent variables, F_i and I_i, with different proxies.

The proxies used in our model are discussed in more detail in the next section.

3 The proxies of corporate governance, firm performance, and the investment opportunity set

In this section we discuss the proxy variables that will be used to measure the latent variables of our model, G, F and I from Section 2. To make them easily readable amidst a variety of other variables, we write them in the mnemonically easier form *CORP-GOV*, *FIN-PERF*, and *INV-OPP* from now on; we use italic capitals to denote latent variables and straight capitals for proxies. Our data sampling procedures are described in Appendix 1. The sources of the data and a description of how the variables have been constructed are given in Appendix 2.

3.1 The proxies of corporate governance

CORP-GOV, or G, is the latent variable used to characterize the effectiveness of the arrangements firms put in place to align the interests of the providers of capital with the interests of those who control and manage the firm. This is a complex and multifaceted concept which is not directly observable. In our model, it is measured indirectly using four proxy variables chosen to reflect the salient aspects of the structure of corporate governance.

Our first proxy BSIZE (i.e. y_1) is a measure of the structure of the board of directors. BSIZE is measured as the logarithm of 1 plus the number of board members. According to Adams et al. (2010), the board of directors is the most important mechanism of the firm's corporate governance. In studying the role of the

board, the literature has relied on measuring the structure and the composition of the board (Coles et al., 2008); how the board members are compensated (Ryan and Wiggins, 2004); whether the board members have business dealings with the firm or are independent (Cohen, Frazzini, and Malloy, 2012); whether they hold concurrent appointments at other boards and are there fore maybe too busy (Fich and Shivdasani, 2006); and even their geographical proximity to the firm (Lehn et al., 2009).

BSIZE as a measure of the board of directors, has received considerable attention in the literature following concerns (Jensen, 1993) that if the size of the board became (too) large its effectiveness would decrease. Early empirical studies (Yermack, 1996) showed that firms with smaller boards performed on average better that firms with large boards. Later studies (Boone, Field, Karpoff, and Raheja (2007), Coles et al. (2008), and Linck, Netter, and Yang (2008), showed that board size is being endogenously determined as a function of the firm's advising and monitoring requirements.

The second proxy of *CORP-GOV* (i.e. y_2) is a measure of the CEO's compensation package (CEO-COMP). Fahlenbrach (2009) argues and provides some evidence showing that the CEO's compensation package is an important instrument the board of directors uses to manage the conflicts of interest between shareholders and management.

Despite many efforts to shine a light on executive compensation practices, see the review in Murphy (2012), measuring the size and composition of the CEO's compensation package pay remains a difficult task, to put it mildly. In part the reason for this is that the data collected refers only to what firms are legally required to report. Another reason is that compensation is provided under many different guises and time dimensions: salary, bonus, equity options, outright and restricted stock grants, and retirement benefits which must be translated into dollar values before they can be added to give an estimate of the size of the package.

Our definition of CEO-COMP is taken from Frydman and Saks (2010). In addition, we follow Gabaix and Landier (2008) by assuming that a CEO's productivity is a function of firm size and scale the dollar amount of compensation by the firm's total assets to adjust for this.

The number of institutions holding shares in the firm, INST-INV, is the third proxy of *CORP-GOV* (i.e. y_3). We measure INST-INV by the log of 1 plus the number of institutions holding shares in the firm.

Institutional investors have no formal role in the firm's corporate governance structure other than that of being a shareholder. But the size of the institutions and the influence they can wield turns them into shareholders that are to be regarded by management as being more equal than other shareholders. In Almazan and Suarez (2003) and Hartzell and Starks (2003) evidence is presented indicating that institu-

tional investors actively monitor the CEO's compensation packages of the firms they invest in. In Bushee, Carter, and Gerakos (2009) and McCahery, Starks, and Sautner (2010) evidence is presented suggesting that institutional investors select the firms in which they invest on the basis of how they evaluate the corporate governance practices of the target firm.

Our final proxy of *CORP-GOV* is SHR-OWN (i.e. y_4), the percentage of the firm's outstanding shares owned outright by the firm's management. The measure does not include option grants which are accounted for in CEO-COMP. In the early literature(i.e. Demsetz and Lehn (1985) and Morck, Shleifer, and Vishny (1998), when the term corporate governance had not yet gained currency, share ownership by management was used to measure the scope of potential conflicts between management and shareholders. A more recent paper by Coles et al. (2012) continues that tradition but includes options granted to management in the measure). We include SHR-OWN as a proxy to facilitate comparison.

3.2 The proxies of financial performance

The concept of *FIN-PERF*, or F, is perhaps not a black-box like *CORP-GOV*, yet there seems to be little agreement in the literature as to how firm financial performance should be measured.

There are three types of measures: measures of the firm's relative value, such as Tobin's Q; accounting measures of financial performance, such as ROA and returns on the firm's equity derived from stock market prices. The lack of consensus as to how financial performance should be measured suggests that we can safely assume that no "true" measure exists and that all these observable performance measurements are to some degree subject to errors of measurement.

Our model uses three proxies to measure performance: FCF, a measure of the firm's free cash-flow, which uses accounting data in its calculation; STK-RET, the market return of the firm's equity and VOL, a measure of the volatility of the firm's stock returns. FCF is a proxy of the free cash-flow concept due to Jensen (1986). According to Jensen, free cash-flow measures the resources generated by the firm that management could distribute to the shareholders in the form of dividends without impairing the current value of the firm. FCF is very similar to the more commonly used ROA performance measure. The difference with FCF is that ROA includes the effects of discretionary accruals and deferrals of certain cash flows to earlier or later periods and is therefore susceptible to what is euphemistically referred to as earnings management.

According to Holmstrom and Tirole (1993), STK-RET, the market determined return on the firm's equity, reflects the aggregate market's assessment of the firm's financial outlook and is therefore a valid proxy of the firm's financial performance.

VOL measures the volatility of the firm's equity returns. VOL is not a commonly used as a proxy of firm performance. An exception is perhaps Demsetz and Lehn (1985), who use volatility as a proxy for the instability of the firm's environment. Here we follow the accounting (Dichev and Tang, 2009) and asset pricing literature (Ang, Hodrick, Xing, and Zhang, 2006) which finds evidence that stock returns and the volatility of stock returns are significantly negatively correlated, suggesting that volatility is a proxy of *FIN-PERF*.

3.3 The proxies of the investment opportunity set

The firm's investment opportunity set, *INV-OPP*, or I is the only exogenous variable in our model. In the framework of the equilibrium view, *INV-OPP* is the determinant variable driving the choices over corporate governance arrangements and financial performance.

Our approach to measuring *INV-OPP* is not entirely without precedent. At least three earlier papers have measured *INV-OPP* using similar methods and similar proxy variables: Gaver and Gaver (1993), Guay (1999), and Coles et al. (2008).

To measure the latent variable *INV-OPP* we rely on three proxies. The first is SPINDEX, a categorical variable that classifies a firm into one of four categories depending on whether it belongs to one of the three indices that make up the S&P1500 and, if so, to which of the three sub-indices it belongs. SPINDEX captures both the differences in size between firms and the differences in the firm's complexity arising from the differences in exposure, compliance and disclosure requirements that come with being included in one the major stock market index. The measure is increasing in the importance of the index with the S&P500 categorized as the most important.

The second proxy is RD-SE, a measure of the firms' expenditures on intangible assets . These assets, which are often part of long-lasting projects, are difficult to value and require specific expertise in order to be effectively monitored. There is some evidence that corporate governance arrangements are associated with the specific monitoring requirements of this type of investments, (see Boone et al., 2007, and Coles et al., 2008).

Our final proxy is MTOB, the ratio of the market value to the book value of the firm, an approximation of Tobin's Q (Tobin and Brainard, 1977). The idea to treat MTOB as a measure of the firms ex ante growth opportunities is due to Myers (1977).

An early application of MTOB as a determinant of corporate financial policies is Smith and Watts (1992). The development of MTOB as a standard proxy for the firm's growth opportunities started with a series

of pioneering papers on the relation between corporate governance and firm performance (see Boone et al., 2007; Linck et al., 2008 and Lehn et al., 2009). What is interesting to note is that these studies, recognizing that the investment opportunity set is unobservable, also used factor analysis techniques to construct variables using similar proxies and techniques as those used in this paper.

We also note that there is also a considerable literature, starting with Morck et al. (1998) and more recently Coles et al. (2012), in which MTOB serves as a proxy for firm performance. Arguing against this practice Demsetz and Villalonga (2001) consider MTOB to be measure of relative value, thus skewed towards so-called growth firms and therefore not an unbiased reflection of the firm's performance. Dybvig and Warachka (2015) argue that for theoretical reasons Tobin's Q does not measure financial performance.

3.4 Data

We sample firms from the years 2000 through 2008 (9 years); the sources of the data are listed in Appendix 1. Our initial sample consists of 15339 firm/year observations. We drop 1087 observations belonging to firms with no assets, no sales, no employees, and no shares outstanding or with negative book equity. We then drop a further 3010 observations from firms belonging to the financial or utility sectors. At this point the sample consists of 11242 observations.

We then select, in each year, firms with complete data records, meaning that in order for a firm to be included in the sample it must have a complete record, in at least one year, of the 10 variables used in our model. This leaves us with with 8567 observations. The missing information pertains mostly to the beginning of the sample period. Out of the 2675 dropped observations, 2062 were lost because no information was available on the composition of the board of directors; 325 because of missing information on the CEO's compensation; 65 had no stock market returns. Some firms missed more than one variable in a given year, which is why the sum of the missing observations is larger than the total number of deleted firm/years.

Before estimating the model, the data has been adjusted as follows. First, all observations have been winsorized at the 1% and 99% level. Next, from each variable we subtract the industry and time period mean and add back the overall mean. Using the adjusted variables as our unit of analysis is equivalent to using the residual of a variable regressed on time and industry dummies. The transformation adjusts the data for the impact of shocks that affect all firms in a given time period while the correction for industry effects addresses the finding in the literature that firms tend to emulate their industry peers (Leary and Roberts, 2014)

The observations belonging to the same firm are averaged over time resulting in a cross-section of 1551 firms. This data was then standardized to variables with mean zero and unit standard deviation and used as the input for our estimation model. The data are summarized in Appendix 2.

There are two reasons for collapsing the panel data set into a cross-section. First, changes in corporate governance happen infrequently. Because we only have nine years of data, any result we find will be to a large extent a cross-sectional result. Second, there may be timing issues; a change in corporate governance may not have a contemporaneous effect on financial performance, but could require a few years to materialize. An issue is then to figure out how many lags in estimating a dynamic panel model is appropriate. By focusing on differences in the cross section of medium-term averages of both financial performance and governance, we acknowledge that we perhaps loose some power in our tests and ignore potential dynamic relationships, but we argue that doing so allows for a "cleaner" interpretation of the results.

4 Model and estimation

With the proxies thus introduced and motivated,the relation between the latent variables and the proxies can be represented as in Figure 1. We now formulate the model to be finally estimated. We start from the two reduced-form equations from Section 2,

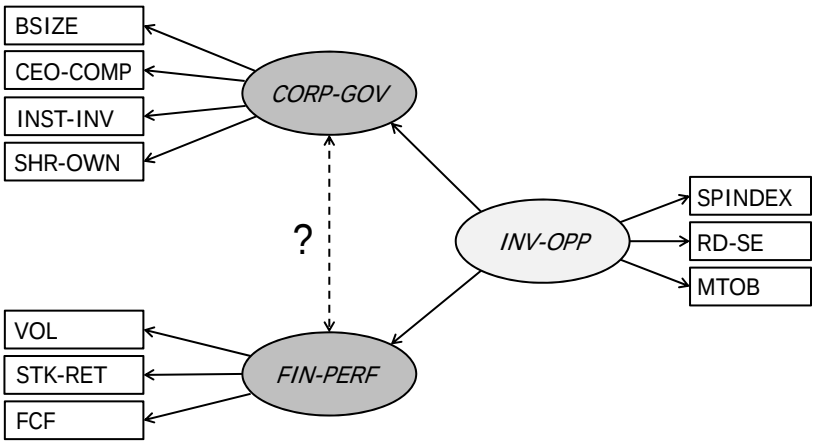
$$\begin{aligned} G_i &= \kappa + \theta I_i + u_{1i} \\ F_i &= (\alpha_\ddagger - \lambda_\dagger \mu_I) + \lambda_\dagger I_i + e_i, \end{aligned}$$

demean the variables, omit subscripts indicating firms, use the longer notation *CORP-GOV* and *FIN-PERF*, and add the modeling of the proxies. The resulting equations of the model to be finally estimated are given in Table 1.

The top panel of the table contains the regressions of governance and performance on the investment opportunities, the "structural model". The two error terms, u_1 and e, are allowed to correlate, as is indicated in the last column of the table. Whether this correlation is significantly different from zero is the main issue at stake in this paper.

The other three panels of the table, the "measurement model" together, contain the equations linking the three latent variables to the ten proxies. In the basic specification of our model, the matrix containing the ten variances and 45 covariances of the error terms is specified to be diagonal. So we start with 45 restrictions on this matrix. The software used to estimate the model provides diagnostic tools to evaluate these restrictions. This led us to free four of the 45 restricted error covariances. As is indicated in the last column of the table,

Figure 1: The Relation between the Latent Variables and the Proxies



Notes: This figure shows the nature of the relations in our structural equation model (SEM). The latent variables are corporate governance (*CORP-GOV*), financial performance (*FIN-PERF*), and the investment opportunity set (*INV-OPP*). The observed proxies for corporate governance are board size (BSIZE), CEO compensation (CEO-COMP), institutional investors (INST-INV), and outstanding shares held by management (SHR-OWN). The observed proxies for financial performance are stock return volatility (VOL), stock returns (STK-RET), and free cash flow (FCF), and . The observed proxies for the investment opportunity set are index category (SPINDEX), investments in intangible assets (RD-SE), and market-to-book value (MTOB). For detailed definition of the sources and proxy variable construction, we refer to the main text and Appendix 1.

The question mark and the dotted line symbolize our main research question, which is whether there is residual covariance between *CORP-GOV* and *FIN-PERF* after accounting for the effect of *INV-OPP*

these are the error covariances involving BSIZE and INST-INV, CEO-COMP and STK-RET, STK-RET and RD-SE, and STK-RET and MTOB.

There are plausible reasons for finding statistically significant covariances between these error terms. For instance, BSIZE and INST-INV are both highly correlated with firm size. Large firms tend to have large boards and institutional investors tend to invest in the stock of large companies; CEO-COMP and STK-RET tend to move in response to common economic factors; STK-RET and RD-SE are negatively correlated since growth firms are highly dependent on financing by issuing equity, which is difficult to do when equity markets are losing value; and STK-RET and MTOB are mechanically correlated as the numerator of MTOB moves in unison with STK-RET, while the denominator changes much more slowly as new stock is issued or profits are retained. All variables in the model are standardized to have mean zero and variance one. For the

Table 1: Main Model Equations

CORP-GOV	=	θ	$*$	*INV-OPP*	+	u_1	$(\sim e)$
FIN-PERF	=	$\lambda_\dagger$	$*$	*INV-OPP*	+	e	$(\sim u_1)$
BSIZE	=	λ_1	$*$	*CORP-GOV*	+	ε_1	$(\sim \varepsilon_3)$
CEO-COMP	=	λ_2	$*$	*CORP-GOV*	+	ε_2	$(\sim \varepsilon_6)$
INST-INV	=	λ_3	$*$	*CORP-GOV*	+	ε_3	$(\sim \varepsilon_1)$
SHR-OWN	=	λ_4	$*$	*CORP-GOV*	+	ε_4	
VOL	=	λ_5	$*$	*FIN-PERF*	+	ε_5	
STK-RET	=	λ_6	$*$	*FIN-PERF*	+	ε_6	$(\sim \varepsilon_2, \varepsilon_9, \varepsilon_{10})$
FCF	=	λ_7	$*$	*FIN-PERF*	+	ε_7	
SPINDEX	=	λ_8	$*$	*INV-OPP*	+	ε_8	
RD-SE	=	λ_9	$*$	*INV-OPP*	+	ε_9	$(\sim \varepsilon_6)$
MTOB	=	λ_{10}	$*$	*INV-OPP*	+	ε_{10}	$(\sim \varepsilon_6)$

Notes: This table shows the equations for our structural equation model (SEM). For some of the equation, the error is correlated with the error term in one or more of the other equations; this is indicated in the last column. The latent variables are corporate governance (*CORP-GOV*), financial performance (*FIN-PERF*), and the investment opportunity set (*INV-OPP*). The observed proxies for corporate governance are board size (BSIZE), CEO compensation (CEO-COMP), institutional investors (INST-INV), and outstanding shares held by management (SHR-OWN). The observed proxies for financial performance are stock return volatility (VOL), stock returns (STK-RET), and free cash flow (FCF), and . The observed proxies for the investment opportunity set are index category (SPINDEX), investments in intangible assets (RD-SE), and market-to-book value (MTOB). For detailed definition of the sources and proxy variable construction, we refer to the main text and Appendix 1.

observed variables this means a data transformation. For the latent variables it is a simplifying assumption that can be made without any loss of generality.

The model is essentially estimated in a GMM framework. The data are condensed in their covariance matrix, which in the case of standardized variables is an observed correlation matrix. Under the model, the elements of the matrix can be expressed as functions of the model parameters, whose number preferably is much less than the number of elements in the matrix; the theory implies a testable structure on the data. Estimation in this context essentially means that parameter values are sought that lead to a theoretical structure that resembles the observed structure as closely as possible.

Here, we adopt this procedure. We have ten proxies and hence, taking the symmetry of the correlation matrix into account, 55 variances and covariances available for estimation purposes. The number of parameters driving these 55 variances and covariances is 29, that is, two $\beta, \lambda_\dagger, \lambda_1, \ldots, \lambda_{10}$, three parameters in the covariance structure of u_1 and e, ten variances of the ε's, and the four covariances between them that were allowed to be non-zero. So there are 55-29=26 degrees of freedom in estimating the model. The model was estimated with the SEM module in STATA version 12, by weighted least squares.

5 Results

Our main empirical results concern the regressions of governance and performance on investment opportunities. The results, displayed in Table 5 (t-values in parentheses) clearly indicate that the investment opportunity set is a significant determinant of corporate governance and financial performance. The regressions explain 68% of the variance of *CORP-GOV* and 63% of the variance of *FIN-PERF*. Firms with larger investment opportunities have more effective governance and better performance. The main finding, though, of Table 5, is put in bold and concerns the residual covariance between governance and performance, i.e., the covariance after controlling for the effect of the investment opportunities. Our estimate is -0.13, with a t-value of 0.25. Based on this result we cannot reject the null hypothesis; the result provides support for the equilibrium view expressed in Demsetz (1983).

Table 2: The Relationship between Corporate Governance, Financial Performance, and Investment Opportunities

	INV-OPP	error cov. mat.		R^2
CORP-GOV	0.83	0.32		0.68
	(11.58)	(2.72)		
FIN-PERF	0.79	$-$ **0.13**	0.37	0.63
	(12.28)	(**$-$0.53**)	(0.36)	

Notes: This table shows the estimation results, with t-statistics in parentheses, for the top two equations in Table 1, for a cross-section of time-series averages of 1551 U.S. firms, for the period 2000-2008. The first column shows the effect of changes in the investment opportunity set on corporate governance and financial performance. Column two and three constitute the covariance matrix of the error terms of the two equations. Our focus is on the conditional covariance between governance and financial performance, highlighted in boldface. The chi-square value is 204.8, with 26 degrees of freedom; the high value is due to the combination of a large sample size and a model that is only an approximation, like every model. The normed fit index is 0.712; the RMSEA is 0.067, with $p \leq 0.05$. Sources: see Appendix 1.

In the first column of Table 3 we list the proxy variables of *CORP-GOV*, *FIN-PERF* and *INV-OPP*. In the next three columns we show the regression coefficients associated with the latent variable shown at the top of the column. In the final column, we show the R^2 of the regression of the proxy on the latent variable, which is a measure of the quality of one particular variable as a proxy for the underlying latent variable by which it is driven.

We interpret the latent variable *CORP-GOV* as measuring the effectiveness of effective corporate governance arrangements, the higher the value the more effective the arrangements. The coefficient of the regression of BSIZE on *CORP-GOV* is large, positive and highly significant. Under our interpretation of

CORP-GOV this result indicates that larger boards of directors are associated with more effective of corporate governance arrangements. This result supports the previous results by Coles et al. (2008). However, the size effect does decrease as BSIZE increases since we have measured BSIZE in logarithms.

The regression coefficient of CEO-COMP on *CORP-GOV* is negative and highly significant, indicating that less effective corporate governance is, the larger the compensation packages become.

The large and positive coefficient of the regression of INV-INST on *CORP-GOV* provides support for the conjecture that share ownership by institutional investors is influenced by the firm's corporate governance arrangements, cf. Bushee et al. (2009) and McCahery et al. (2010).

Judging by the R^2, the proxy measuring management share ownership, SHR-OWN, is by far the weakest of the four proxies of *CORP-GOV*. In addition, the sign of the regression coefficient is negative, implying that as corporate governance becomes more effective, share ownership decreases. This result would suggest that corporate governance considerations do not play a significant role in determining share ownership by management. This is rather surprising given the importance that the literature has given to the study of share ownership by management as a mechanism for mitigating conflicts of interest. One interpretation of the result is that the productivity of share ownership in dealing with conflicts of interest, especially for larger firms, is relatively low. Share ownership is a costly way of trying to solve a problem that can apparently be solved more effectively by alternative arrangements.

The estimated regression coefficients of VOL, STK-RET and FCF on *FIN-PERF* are all statistically significant and the R^2 of the three regressions are reasonably high, ranging from 0.30 to 0.53, suggesting that all three proxies are plausible functions of the same underlying latent variable. In the data, STK-RET and FCF are positively correlated but both are negatively correlated to VOL. Accordingly, the regression results indicate that STK-RET and FCF are increasing in *FIN-PERF*, and that VOL is decreasing in *FIN-PERF*. This result is consistent with the conjecture of Black (1976) that volatility and stock returns are inversely related because rising stock prices decrease leverage, which tends to decrease volatility.

The results of regressing proxies on *INV-OPP* have one surprise, and that is that RD-SE is negatively related to *INV-OPP*. In the data, research and development expenditures scaled by total assets are negatively correlated with SPINDEX, a proxy of size and complexity, indicating that as firms get larger and more complex, RD SE expenditures increase at lower rate than the increase in the firm's size. Thus the results indicate that when the firm's investment opportunities increase, research and development expenditures tend to increase less than proportionally. Why this is the case is not immediately evident.

As a final step we estimate the unconditional relation between corporate governance and firm financial

Table 3: Estimations of Measurement Equations of Corporate Governance, Financial Performance, and Investment Opportunities

	CORP-GOV	*FIN-PERF*	*INV-OPP*
BSIZE	0.67		
	(14.90)		
CEO-COMP	−0.45		
	(−11.00)		
INST-INV	0.78		
	(14.61)		
SHR-OWN	−0.14		
	(−4.48)		
VOL		−0.73	
		(−18.00)	
STK-RET		0.37	
		(7.60)	
FCF		0.55	
		(15.46)	
SPINDEX			0.45
			(13.79)
RD-SE			−0.15
			(−3.49)
MTOB			0.54
			(10.40)

Notes: This table shows the estimation results for the bottom ten equations in Table 1, for a cross-section of time-series averages of 1551 U.S. firms, for the period 2000-2008. The latent variables are corporate governance (*CORP-GOV*), financial performance (*FIN-PERF*), and the investment opportunity set (*INV-OPP*). The observed proxies for corporate governance are board size (BSIZE), CEO compensation (CEO-COMP), institutional investors (INST-INV), and outstanding shares held by management (SHR-OWN). The observed proxies for financial performance are stock return volatility (VOL), stock returns (STK-RET), and free cash flow (FCF), and . The observed proxies for the investment opportunity set are index category (SPINDEX), investments in intangible assets (RD-SE), and market-to-book value (MTOB). For detailed definition of the sources and proxy variable construction, we refer to Section 3 and Appendix 1; t-statistics are in parentheses.

performance by dropping INV-OPP from the model. The results are very similar to the results for the full model as reported above and are available from the authors on request. The correlation between *CORP-GOV* and *FIN-PERF* is 0.57, with a t-value of 12.25. Thus, our main result showing that corporate governance and firm performance are conditionally unrelated is not due to governance and performance being generally unrelated.

6 Conclusion

Based on our empirical results, we conclude that observed corporate governance arrangements and firm performance, on average, are the result of firms making value-maximizing decisions subject to constraint. The outcome of these decisions represent an equilibrium.

We reach this conclusion by taking a fairly simple approach to testing hypotheses when the true variables of interest are either unobservable or latent, or can only be measured with error and there are structural relations between these variables. Given that in empirical corporate finance very many areas of interest are covered by this description, we believe that the approach can fruitfully be applied to a wide range of research questions.

Our results have clear policy implications for the regulation of corporate governance. In fact, the results imply that policies mandating changes in corporate governance arrangements which when binding from above, are likely to have negative effects on firm performance. This is ironic since these policy changes are often promoted as being beneficial for shareholders.

Appendix 1: Definition and sources of the observable variables

BSIZE: the logarithm of 1 plus the number of members of the board of directors. Measured as the logarithm of 1 plus the number of board members. Source Riskmetrics.

CEO-COMP: Annual total compensation of the CEO divided by total assets. Sources Execucomp and Compustat.

FCF: free cash-flow. Operating income after depreciation divided by the market value of equity. Source Compustat.

INST-INV: the logarithm of 1 plus the number of institutional investors holding shares in the firm. Source Thompson-Reuters Institutional.

MTOB: the market-to-book ratio. Measured as the market value of the firm divided by its book value. Source Compustat.

RD-SE: the sum of expenditures on research and development, selling expenses and advertising divided by total assets. Source Compustat.

SHR-OWN: percentage of total shares owned by the executive officers of the firm. Source Execucomp.

SPINDEX: a categorical variable indicating the whether or not the firm is included of one of the three sub-indices constituting the S&P1500 index and if so, in which one of the three indices. The possible values for the variable are: 0=not included in the index; 1=S&P400 (small capitalization firms); 2=S&P600 (mid-size capitalization firms); 3=S&P500 (large capitalization firms). Source Compustat.

STK-RET: stock market return. Measured as the annualized total return on common stock estimated using with 36 monthly observations. Source CRSP.

VOL: standard deviation of returns. Estimated using 36 months of total returns observations. Source CRSP.

Appendix 2: Descriptive statistics

Table 4: Mean, standard deviation, minimum, and maximum of the proxy variables

	mean	s.d.	min.	max.
BSIZE	2.164	0.252	1.609	2.708
CEO-COMP	3.155	3.842	0.080	23.689
INST-INV	5.098	1.097	0.000	7.065
SHR-OWN	3.023	6.989	0.000	38.700
VOL	0.122	0.058	0.041	0.332
STK-RET	0.087	0.183	-0.332	0.691
FCF	0.115	0.081	-0.194	0.333
SPINDEX	2.051	0.780	0.000	3.000
RD-SE	0.291	0.220	0.000	1.016
MTOB	1.921	1.174	0.670	7.108

Notes: Figures based on the original data ($N = 8567$), before winsorizing, adjusting for industry and time effects, and averaging over time. The observed proxies for corporate governance are board size (BSIZE), CEO compensation (CEO-COMP), institutional investors (INST-INV), and outstanding shares held by management (SHR-OWN). The observed proxies for financial performance are stock return volatility (VOL), stock returns (STK-RET), and free cash flow (FCF), and . The observed proxies for the investment opportunity set are index category (SPINDEX), investments in intangible assets (RD-SE), and market-to-book value (MTOB). For detailed definition of the sources and proxy variable construction, we refer to Section 3 and Appendix 1.

Table 5: Correlation between the proxy variables

	BSIZE	CEO-COMP	INST-INV	SHR-OWN	VOL	STK-RET	FCF	SPINDEX	RD-SE	MTOB
BSIZE	1.000									
CEO-COMP	-0.342	1.000								
INST-INV	0.324	-0.245	1.000							
SHR-OWN	-0.163	0.012	-0.098	1.000						
VOL	-0.330	0.383	-0.308	0.033	1.000					
STK-RET	-0.066	0.129	0.181	0.011	-0.159	1.000				
FCF	0.076	-0.161	0.241	-0.055	-0.388	0.386	1.000			
SPINDEX	0.255	-0.113	0.357	-0.092	-0.196	0.023	0.079	1.000		
RD-SE	-0.128	0.290	-0.120	0.035	0.180	-0.085	-0.111	-0.031	1.000	
MTOB	0.007	0.196	0.276	-0.005	-0.081	0.467	0.279	0.171	0.179	1.000

Notes: Figures based on the data ($N = 1551$), after winsorizing, adjusting for industry and time effects, and averaging over time.The observed proxies for corporate governance are board size (BSIZE), CEO compensation (CEO-COMP), institutional investors (INST-INV), and outstanding shares held by management (SHR-OWN). The observed proxies for financial performance are stock return volatility (VOL), stock returns (STK-RET), and free cash flow (FCF), and . The observed proxies for the investment opportunity set are index category (SPINDEX), investments in intangible assets (RD-SE), and market-to-book value (MTOB). For detailed definition of the sources and proxy variable construction, we refer to the Section 3 and Appendix 1.

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