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Measuring Firm Size in Empirical Corporate Finance

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Abstract

In empirical corporate finance, firm size is commonly used as an important, fundamental firm characteristic. However, no research comprehensively assesses the sensitivity of empirical results in corporate finance to different measures of firm size. This paper fills this hole by providing empirical evidence for a "measurement effect" in the "size effect". In particular, we examine the influences of employing different proxies (total assets, total sales, and market capitalization) of firm size in 20 prominent areas in empirical corporate finance research. We highlight several empirical implications. First, in most areas of corporate finance the coefficients of firm size measures are robust in sign and statistical significance. Second, the coefficients on regressors other than firm size often change sign and significance when different size measures are used. Unfortunately, this suggests that some previous studies are not robust to different firm size proxies. Third, the goodness of fit measured by R-squared also varies with different size measures, suggesting that some measures are more relevant than others in different situations. Fourth, different proxies capture different aspects of "firm size", and thus have different implications in corporate finance. Therefore, the choice of size measures needs both theoretical and empirical justification. Finally, our empirical assessment provides guidance to empirical corporate finance researchers who must use firm size measures in their work.

JEL Classifications: G3, G30, G31, G32, G34, G35, C23, C58, J31, J33.

Key Words: Firm size measures; Total assets; Total sales; Market capitalization; Empirical corporate finance.

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I. Introduction

Studies on the consequences and correlates of firm size can be traced back to a seminal article, Coase (1937), which raises the questions of how firm boundaries affect the allocation of resources and what determines firm boundaries. Both questions have received much attention in theoretical studies in economics and finance (e.g., Williamson (1975, 1986), Klein, Crawford, and Alchian (1978), and Grossman and Hart (1986)). Empirical researchers in corporate finance also consider firm size an important and fundamental firm characteristic, and, in many situations, observe a "size effect"—firm size affects the empirical results. For example, in capital structure, Frank and Goyal (2003) show that pecking order is only found in large firms; Rajan and Zingales (1995) discover that leverage increases with firm size. In mergers and acquisitions, Moeller, Schlingemann, and Stulz (2004) find that small firms have larger abnormal announcement returns; Vijh and Yang (2013) document that for cash offers, targetiveness (the probability of being targeted) decreases with firm size, but for stock offers they find an inverted-U relation.

Although firm size matters in empirical corporate finance, the existing literature is silent on the rationale for using a certain measure of firm size, and no paper provides a comprehensive assessment of the sensitivity of empirical results in corporate finance to different measures of firm size. An exception is Vijh and Yang (2013), who provide a list of firm size proxies and their corresponding coefficients in the literature on takeover likelihood models. Their study indicates that the sign and significance of the coefficients on firm size in different papers are sensitive to which firm size measure is being used. While Vijh and Yang (2013) suggest that firm size measures should receive more attention, they do not compare the results based on the same regression or conduct a broader assessment of firm size measures in the corporate finance literature.

We use 20 representative specifications, in the areas of executive compensation, board of directors, corporate control, financial policy, payout policy, investment policy, diversification, and firm performance, to study the influences (sign sensitivity, significance sensitivity, and R-squared sensitivity) of employing different measures of firm size. For each specification, we employ natural logarithm forms of three firm size measures: total assets, total sales, and market value of equity. We choose these three measures because, according to our survey of 100 research papers, they are the most popular firm size proxies in corporate finance. However, other measures, such as number of employees and net assets, also appear in empirical work.

We choose the 20 representative specifications from Coles, Daniel, and Naveen (2006), Comment and Schwert (1995), Core and Guay (1999), DeAngelo, DeAngelo, and Stulz (2006), Graham, Li, and Qiu (2012), Harford (1999), Harford, Mansi, and Maxwell (2008), Lemmon, Roberts, and Zender (2008), Linck, Netter, and Yang (2008) and Mehran (1995). For brevity and data availability, we select the same papers as those in Coles and Li (2012). Coles and Li (2012) assess firm, manager, and time fixed effects in these 20 prominent areas in empirical corporate finance. On the one hand, our project is modest. Using our data sample with year fixed effects and industry fixed effects, our empirical models resemble the corresponding benchmark specifications in these papers.[1] This allows an even-handed comparison between our results and those in the original papers and between results based on different firm size measures. On the other hand, our research thrust is ambitious in that we collect the data and perform the analysis for a large number of regression specifications across a wide spectrum of subfields in corporate finance.

[1] We introduce industry fixed effects because some benchmark papers employ 2-digit SIC controls (e.g. Coles, Daniel, and Naveen (2006)) and others include industrial firms (DeAngelo, DeAngelo, and Stulz (2006)) or manufacturing firms (Mehran (1995)). The industry fixed effects are widely documented in the empirical corporate finance research. We also tried firm fixed effects and obtained qualitatively similar results, although the implications, by looking at within-firm variations, are different from those of the original papers.

Although all firm size measures are significantly correlated, they are theoretically *and* empirically different. The correlation coefficients range from 0.64 to 0.81 in our sample. Because size is a firm fundamental variable, any subtle differences may have a critical impact on the dependent variable and other independent variables in the empirical study.[2] Our results indeed confirm this "measurement effect" in the "size effect" in empirical corporate finance. First, the coefficients on regressors often change sign and significance when we use different firm size measures. We observe sign changes and significance changes in almost all areas except dividend policy and executive compensation. Unfortunately, this suggests that when using different firm size proxies, some previous studies are not robust.[3] Researchers should either use all the important proxies as robustness checks, or provide a rationale for using a specific proxy. Results based on a single size measure should be interpreted with caution. Second, the goodness of fit measured by R-squared varies significantly with different firm size measures. Some size measures appear more "relevant" than others in different research areas, implying that they are better control variables to reduce omitted variable bias and improve the estimation of the main coefficients of interest. Different size proxies capture different aspects of "firm size", and thus have different implications. The choice of these firm size measures can be a theoretical and empirical question. Finally, we use our results to provide guidelines on the choice of the size measure. The sensitivity of empirical results to different size measures not only provides guidance for researchers who must use firm size proxies in empirical corporate finance research, but also sheds light on future research that

[2] Per our results, the firm size measures are consistently one of the most significant independent variables in all subfields of corporate finance. In 18 out of 20 subfields, the size proxy is statistically significant at the 1% level.

[3] To provide even-handed comparisons, we attempted to use the same methodology and variable definitions in our experiments; we also tried the subsamples in the same time periods as in the original papers. The results are not qualitatively different, giving us confidence that our data and estimation are not so different from those papers. More importantly, we are not trying to argue against the results in the original papers. Instead, we test the sensitivity and robustness of the size measures in our larger, more comprehensive, and more recent data to raise awareness.

might incorporate measurement effects into other research fields, such as empirical asset pricing and empirical accounting.

A few caveats should be noted. First, we do not employ all possible measures of firm size; we only study the three most popular measures. Researchers can use some alternative size proxies such as enterprise value (market capitalization plus net debt), the number of employees, total profits, or net assets (total assets minus total liabilities) when the main measures are not available or irrelevant (e.g., market cap for private firms and total sales for start-up firms). Second, we might omit some important representative papers in specific sub-fields due to data and time constraints. Third, some linear models may lose power if the true relation between firm size and the dependent variable is non-linear. Fourth, most of our empirical results are based on year fixed effects and/or industry fixed effects. Introducing other considerations, such as firm fixed effects (for consideration of within-firm variations rather than cross-sectional variations) or manager fixed effects (for emphasis on corporate governance issues such as managerial compensation), might change our results and have different implications.

The outline of the article is as follows. Part II includes our research motivation, a literature review, and the measures of firm size. Part III describes our data and the sample. Part IV provides a discussion of the empirical results. Part V concludes.

II. Framework for Analysis and Literature Review

Coase (1937) states that firms are formed with boundaries to substitute markets in order to save transaction costs such as contracting and monitoring fees. For the effects of firm boundaries on firm behavior, Williamson (1975, 1986), Klein, Crawford, and Alchian (1978), and Grossman and Hart (1986) provide theoretical insights, while some recent works such as Holmstrom and

Kaplan (2001), Robinson (2008), and Seru (2014) present empirical evidence that links the theory of firm and corporate finance to firm activities such as capital allocation. Specifically, Bolton and Scharfstein (1998) review the relationship between corporate finance and the theory of firm and organizations.

As for the determinants of firm size, Kumar, Rajan, and Zingales (1999) comprehensively review the literature and classify the theories into four categories: technological theories (Lucas (1978), Rosen (1982), Kremer (1993), etc.), organizational theories (Williamson (1975, 1986), Klein, Crawford and Alchian (1978), Grossman and Hart (1986), Rajan and Zingales (1998b, 2001), Holmstrom (1999), Holmstrom and Roberts (1998), etc.), regulatory theories (Ringleb and Wiggins (1990), Hopenhayn (1992), etc.), and financial theories (Rajan and Zingales (1998a), etc.). Kumar, Rajan, and Zingales (1999) provide empirical evidence that the utility sector, R&D intensive industries, capital intensive industries, high wage industries, and industries that need little external financing all feature large firms.[4]

Several papers also investigate whether the measures of firm size are interchangeable in microeconomics and industrial organization, and these works are more associated with our goal to evaluate the effects of employing different firm size measures in empirical research. Smyth, Boyes, and Peseau (1975) first demonstrate that measures of firm size are only interchangeable when more rigorous technical conditions than correlation are met. Smyth, Boyes, and Peseau (1975) show that economies of scale are sensitive to different firm size measures. Jackson and Dunlevy (1982) employ an asymptotically valid procedure to test the null hypothesis of orthogonal least squares suggested by Smyth, Boyes, and Peseau (1975). However, most financial studies usually use firm size measures without examining correlations and other interrelationships among different firm

[4] Such evidence also motivates us to use industry fixed effects in our empirical investigations.

size measures. The empirical results in this paper support that the measures of firm size are indeed not interchangeable.

From the review above, we find that the overall assessment of firm size measures in empirical corporate finance has largely been ignored in the existing literature. However, this topic deserves attention. In most prominent areas of empirical corporate finance research, finance scholars employ firm size as an important firm characteristic, and in many situations, finance scholars have observed the "size effect"—firm size matters in determining the dependent variables. For example, it is well recognized that top-management compensation level increases with firm size (Jensen and Murphy (1990), Core, Holthausen, and Larcker (1999), etc.). Baker and Hall (2004) find that CEO marginal products increase substantially with firm size. Gabaix and Landier (2008) and Gabaix, Landier, and Sauvagnat (2014) show that small differences in CEO talent can result in substantial differences in CEO pay through the effect of firm size; in particular, larger firms usually have more skilled managers (Himmelberg and Hubbard (2000)).

Although the majority of the literature takes for granted that the choice of firm size measures is not a vital concern, we doubt the existence of selection bias of empirical results in some papers. Recent works (e.g. Vijh and Yang (2013, Appendix 2)) find that the sign and significance of the coefficients of size proxies in the literature of mergers and acquisitions are sensitive to different firm size measures. While Vijh and Yang (2013) indicate that firm size measures should receive more attention, they are silent on the assessment of firm size measures based on the same regression and the comprehensive assessment in broad corporate finance literature. In addition, Vijh and Yang (2013) have little to say on the sensitivity of the coefficients of regressors other than firm size when different firm size measures are employed. These

limitations in the existing literature motivate us to investigate the effects of different size measures comprehensively.

For the purpose of conducting a comprehensive empirical assessment of firm size measures in different sub-fields of empirical corporate finance, we follow the methodology of Coles and Li (2012), covering 20 prominent research areas in corporate finance: financial policy (book leverage, market leverage, and cash holdings), payout policy (dividend dummy), investment policy (CAPEX, R&D, and firm risk), diversification (Herfindahl index and business segments), firm performance (Tobin's Q, which is the sum of market capitalization of equity plus liabilities divided by total book assets, and ROA, which is the ratio of net income to total assets), mergers and acquisitions and corporate control (bidder, target, and poison pills), managerial compensation and incentives (delta, vega, and pay level), and board of directors (board size, board independence, and CEO duality).

We employ three firm size measures: total assets, total sales, and market value of equity. According to our survey, in which we investigate 100 empirical papers from top finance, accounting, and economics journals that use firm size measures on the topics of empirical corporate finance, these three measures are the most popular firm size proxies in empirical corporate finance research. We collect a total of 100 papers through *Google Scholar* by searching subfield key words, and the results are listed by descending number of citations. We only choose the papers that appear in top journals and use firm size measures in empirical studies. The papers are distributed across extensive areas in corporate finance, including capital structure, debt policy, payout policy, cash holdings, corporate investment and financial constraints, cross listings, CEO turnover, CEO compensation, board of directors, law and finance, ownership structure, mergers and acquisitions, and corporate control (see Appendix for detailed information on these papers).

We find that these three firm size proxies are used in 85 papers out of the 87 papers that use single measures, and the remaining 13 papers use multiple measures for robustness checks. Among these 87 papers, 49 papers use total assets, 20 papers use market capitalization, 16 papers use sales, and 2 papers use number of employees. We are aware that other measures, such as number of employees and net assets, also appear, though infrequently, in empirical finance works, but for conciseness we only use these three measures. In addition, most papers in empirical corporate finance use the logarithm form of firm size measures. In the 100 papers we surveyed, only 3 papers use the original form of the three size measures. This suggests that it is a rule of thumb in corporate finance to use log form to mitigate the high skewness of firm size data.

Interestingly, *Forbes Global 2000* uses four measures (assets, sales, profits, and market cap) to rank all the large companies in the world, and *Fortune 500* uses just two measures (sales and profits). Both employ sales and profits, but profits seldom appear as a proxy for firm size in academic research.

Every firm size measure exhibits advantages and disadvantages, and no measure can capture all characteristics of "firm size". Generally, total assets measures total firm resources, market capitalization involves firm growth opportunities and equity market condition, and total sales measures product market competition, and is not forward looking. In addition, researchers can use the number of employees, total profits, and net assets when the main measures are not available or irrelevant (e.g., market cap for private firms and total sales for start-up firms). Moreover, Hart and Oulton (1996) argue that net assets can be negative but sales are always positive. They also point out that the number of employees does not include the number of part-time workers, but nowadays part-time workers play an important role. Because every measure has pros and cons, Hart and Oulton (1996) suggest that, in practice, choosing which measure to use

depends on data availability. In addition, we think the choice of firm size measures also depends on the purpose of the specific study. For example, Prowse (1992) applies different firm size measures as the research purpose changes from the ownership of equity to the ownership of asset.

In sum, we find that the existing literature has little to say about the rationale of using a certain measure of firm size for specific corporate finance research, and no paper provides a comprehensive assessment of the sensitivity of empirical results in corporate finance to different measures of firm size. This hole in the literature motivates us to find evidence for a "measurement effect" in the "size effect", and to provide a general guideline to researchers who must use firm size, as a key variable or control variable, in their empirical corporate finance studies.

III. The Data

We extract data from multiple sources. Corporate governance data are from RiskMetrics Governance, director data are from RiskMetrics Directors, stock daily returns and prices are from CRSP, company diversification data are from Compustat Segment, corporate bond data are from Compustat Ratings, institutional holdings data are from Thomson Reuters, Executive data—up to five top executives per firm—are from ExecuComp, M&A deals and corporate control data are from SDC, and all other financial items are from Compustat Fundamentals. We restrict the observations to only those that match North American data from CRSP and Compustat for firms with fiscal years 1993-2006. In line with conventional tradition, we exclude data from the financial and utility sectors. See Table 1 for summary statistics of all the variables featured in our representative specifications from corresponding benchmark papers. Specifically, we report data properties and bivariate scattergrams of the alternative firm size measures in logarithm numbers for the regressions of firm performance (Tobin's Q and ROA) as an example. Table 2 Panel A

reports summary statistics of firm size measures for both raw numbers and logarithm numbers. Panel B presents the Pearson correlation coefficients of firm size measures across raw numbers and logarithm numbers. Figure 1 shows bivariate scattergrams of alternative firm sizes measured in logarithm numbers, which we employ in the regressions. We find that the correlation coefficients among log (assets), log (sales), and log (market value of equity) are between 0.77 and 0.92, and those among raw numbers are between 0.64 and 0.81. The highest correlation coefficient is between log (assets) and log (sales) (0.92), and the lowest correlation coefficient is between sales and log (market value of equity) (0.50). These correlations indicate that although all the size measures are significantly correlated, they are different and some are more correlated than others.

We also show the trends of the three different firm size measures over our testing period in Figure 2. Figure 2A is expressed in logarithm form and Figure 2B in original form in 2006 dollars. The average market capitalization in 2002 went down dramatically, consistent with the dot-com bubble burst. The bottom line is that time trends appear different for different measures, mainly because they capture different aspects of "firm size".

IV. Methodology and Empirical Results

We adopt the empirical methodologies in the benchmark papers by employing conventional short-panel techniques for basic empirical analysis. For each specification, we apply both basic OLS regressions and industry fixed effect regressions. Time fixed effects are included in every regression. We use industry fixed effect because some benchmark papers employ 2-digit SIC controls (e.g. Coles, Daniel, and Naveen (2006)) and others only include industrial firms (e.g. DeAngelo, DeAngelo, and Stulz (2006)) or manufacturing firms (e.g. Mehran (1995)). The

industry fixed effects and time fixed effects are widely used in the empirical corporate finance research.

We only use the benchmark papers for comparison, not to replicate their results per se, given that some papers use old data that are hard to track, that some papers do not employ year fixed effect and industry fixed effect, that some papers conduct different econometric specifications (cross-sectional vs. panel), and that the databases are adjusted over long periods. Fortunately, our results are by and large consistent with those in the benchmark papers.

We report our results in Table 3 through Table 13 and in Dang, Li, and Yang (2017), an online appendix to this paper, for 20 separate fields and summarize the results in Table 15 and Figure 3. We discuss the results in each field as follows.

1. Firm Performance

We use Tobin's Q and ROA (return on assets) as measures of firm performance. For Tobin's Q, the representative specification is based on Mehran (1995, Table 4, Panel A, Column 4), which applies the log of total assets as the measure of firm size. Table 3 reports the results when we use Tobin's Q as the dependent variable. Industry fixed effect models are employed to be consistent with Mehran (1995), whose sample includes only manufacturing firms. When we use the log of market value of equity, we observe higher R^2 because market capitalization is in the nominator of Tobin's Q; thus, these results suffer from mechanical correlation. Total assets and sales have the same R^2: 0.22 for OLS and 0.28 for industry fixed effect respectively. The coefficients of all size measures are positive and significant at 1% level, while the coefficient of firm size in Mehran (1995) is negative. This is not surprising. Although the negative relation reflects that small firms have high growth opportunities, this only happens beyond some point as

the true relation between firm size and performance can be curvilinear, which suggests quadratic functional form. Neither too small nor too big is optimal, and this is one of the reasons why we observe firm growth and firm divesture in reality. This observation might also stem from the time trends of Tobin's Q and ROA in our data sample (1993-2006); in contrast, the benchmark paper uses cross-sectional data (the averages of 1979-1980). We also find that, for Tobin's Q, the sign of business risk (measured by standard deviation of percentage change in operating income) is sensitive to different firm size measures. Additionally, the coefficient of the percentage of managers' equity compensation turns insignificant when we use the log of market value of equity.

With ROA as the dependent variable, the representative specification refers to Mehran (1995, Table 4, Panel B, Column 4), which also applies the log of total assets as the measure of firm size. In Table 1 in the online appendix to this paper, we show that when market value of equity is used as firm size, R^2 increases sharply (Figure 3) for both OLS and industry fixed effect regressions, while the R^2s are similar if we use total assets or sales. We further find that the size proxy log of assets is not significant in the industry fixed effect regression. In addition, unlike the results for Tobin's Q, the sign and significance of the coefficients of business risk are robust. However, the sign of the percentage of managers' equity compensation and managers' delta both change to negative when firm size is measured by market value of equity, which suggests scholars should be especially careful about market value of equity for studies of firm performance.

It is worth noting that market value of equity is in the numerator of Tobin's Q, so it is possible that they are mechanically correlated, and thus affect empirical sensitivity such as goodness of fit. Therefore, a high R-squared does not necessarily suggest a good proxy of firm size. In Table 3 and Figure 3, we find the goodness of fit exhibits substantial changes when market capitalization is used as a firm size proxy.

2. Board Structure

Board structure has received much attention as an important topic in corporate governance. The existing literature covers three prominent board characteristics: independence, i.e. the proportion of outside directors (Weisbach (1988), Byrd and Hickman (1992), Brickley, Coles, and Terry (1994), etc.); size (Jensen (1993), Yermack (1996), Coles, Daniel, and Naveen (2008), etc.); and leadership, i.e. separation of CEO and Chairman of the Board (COB) (Baliga, Moyer, and Rao (1996) and Brickley, Coles, and Jarrel (1997), etc.).

We use Linck, Netter, and Yang (2008) for the examination of board structure, and, more specifically, board independence as in Linck, Netter, and Yang (2008, Table 4, Column 2). This benchmark paper uses the market value of equity as the firm size measure. We denote the proportion of non-executive board members as the dependent variable and report the results in Table 4. The positive sign of firm size indicates that big firms tend to have more outside directors. The sign and significance of coefficients of firm size are robust for both OLS and industry fixed effect models to different firm size measures. While the R^2s are similar, we observe that the sign and significance are sensitive for debt (total long term debt divided by total assets) and R&D (R&D expenditures divided by total assets) when we employ different firm size proxies. Fama and Jensen (1983) suggest that outside directors who bring valuable expertise and connections are beneficial to firms with complex operating or financial structures, thereby leading to larger and more independent boards. The pros of effective monitoring should dominate the monitoring costs that go hand in hand with firm complexity. Thus, Linck, Netter, and Yang (2008) predict that, as a proxy for growth opportunities, R&D expenditures, which increase monitoring and advising costs, are negatively related to board size and independence. However, debt proportion should be

positively related to board size and independence since debt proportion is a proxy for firm complexity and advising benefits. In our results, the coefficient of debt is positive, as predicted, but only significant when log of market value of equity is used. The coefficient for R&D is positive for OLS regression but negative for industry fixed effect regression, suggesting the results of industry fixed effect regressions are consistent with the theory. However, the significance is sensitive when we apply different firm size measures in the industry fixed regressions.

The representative specification of board size refers to Linck, Netter, and Yang (2008, Table 4, Column 1), and we report the results in the online appendix Table 2. The dependent variable is the number of directors on the board. The positive sign of firm size is also consistent with Linck, Netter, and Yang (2008), indicating that board size increases with firm size. The sign and significance of coefficients of firm size are robust to different size measures in both OLS and industry fixed effect regressions. The R^2s are quite similar. Once again, the abnormal results reside in the sign and significance of their coefficients on debt and R&D if different firm size measures are used.

We refer to Linck, Netter, and Yang (2008, Table 4, Column 3) for the study of board leadership (CEO duality). The dependent variable is the logit-transformed dummy variable that equals 1 if the CEO and COB positions are combined and 0 otherwise. The regressions are based on logistic models with and without industry fixed effects. Table 5 shows that the R^2s are quite similar. The positive sign of firm size suggests CEO duality increases with firm size. Different firm size measures do not change the sign and significance of firm size coefficients. The sensitivity of R&D still exists in our results of board leadership, suggesting scholars should pay special attention to this issue in the extensive study of board governance. Standard deviation of stock

returns, which is a proxy for information asymmetry that increases monitoring and advising costs, also has sensitive significance for different firm size measures.

3. Dividend Policy

We choose DeAngelo, DeAngelo, and Stulz (2006, Table 3, Column 1) as the benchmark paper for our analysis of payout policy. DeAngelo, DeAngelo, and Stulz (2006) apply the market value of equity as the size proxy. The dependent variable is a dummy variable that equals 1 if the firm pays out dividends and 0 otherwise. The regressions are based on logistic models with and without industry fixed effect. We report the results in Table 6. All results are robust: there were no changes in sign and significance of the regressors when different size proxies were used.

4. Financial Policy

We examine capital structure (book leverage and market leverage) and cash holdings in this section. We investigate both book leverage and market leverage because Frank and Goyal (2009) find that firm size has different effects on book leverage and market leverage. The benchmark paper we select for capital structure is Lemmon, Roberts, and Zender (2008), which uses the log of sales as the measure of firm size. The benchmark specification for book leverage refers to Lemmon, Roberts, and Zender (2008, Table II, Panel A, Column 3). We report the results for book leverage in Table 9. All firm size measures are significant, and the sign is positive when we use total assets and sales, but the sign turns out to be negative when we use market value of equity. This change might be due to mechanical correlation, as leverage is one minus equity ratio. The other obvious change is that the sign and significance of the cash flow volatilities is sensitive

if we apply different firm size measures. The R^2 is lower for the log of sales in the industry fixed effect regressions.

We refer to Lemmon, Roberts, and Zender (2008, Table II, Panel A, Column 6) for the study of market leverage. Results are in the online appendix Table 3. Similar to the results for book leverage, the sign of the coefficient for firm size is positive when we use total assets and sales, but turns negative when we use market value of equity. In addition, the sign and significance of the cash flow volatilities are also sensitive to different size measures. The goodness of fit is lower, with a difference of about 0.03-0.04 for the log of sales in the industry fixed effect regressions. The coefficient of dividend payer is not significant if we use the log of total assets in the pooled OLS regression.

The analysis for cash holdings is based on Harford, Mansi, and Maxwell (2008, Table 3, Column 1), which applies the natural log of total assets as firm size measure and the natural log of cash/sales ratio as the dependent variable. We report the results in Table 8. In pooled OLS regressions, only the coefficient of firm size measured by the log of sales is significant, while all the firm size coefficients are significant in the industry fixed effect model. The sign of firm size is negative if the log of sales is used, consistent with the conventional wisdom that small firms have financial constraints, limited access to external financing, and higher marginal probability of bankruptcy. But when we use the log of assets and the log of market value of equity, the signs are positive in the industry fixed effect regressions. The significance of inside ownership, pay sensitivity, and institutional ownership is sensitive, especially in the industry fixed effect model. In addition, both the sign and the significance of cash flow are sensitive to different size measures. We do not observe obvious differences in goodness of fit across the regressions.

5. Compensation Policy

We build on Coles, Daniel, and Naveen (2006) for vega (the sensitivity of managerial compensation to stock volatility) and delta (the sensitivity of managerial compensation to stock price, i.e. the pay-performance sensitivity). For vega, we use the same independent variables as in Coles, Daniel, and Naveen (2006, Table 3, Panel A, Column 2), who apply the log of sales as firm size. We consider industry fixed effect because Coles, Daniel, and Naveen (2006) employ 2-digit SIC control. The empirical results are reported in the online appendix Table 4. The sign is positive for different firm size proxies, consistent with Coles, Daniel, and Naveen (2006). The sign and sensitivity are not robust for the coefficients of market-to-book ratio and book leverage level. The R-squared does not change.

We refer to Coles, Daniel, and Naveen (2006, Table 3, Panel A, Column 2) for delta and report the results in the online appendix Table 5. The sign of firm size is positive when we apply different measures of firm size, indicating that larger firms have larger pay-performance sensitivity. The results for other regressors are robust, except for the firm risk. We find that the coefficient of firm risk is significant in the OLS regressions, but when we add industry fixed effect it is no longer significant, though the sign remains positive. The goodness of fit remains the same across different regressions.

For executive pay level (i.e. total compensation), we refer to Graham, Li, and Qiu (2012, Table 4, Panel A, Column 1). Graham, Li, and Qiu (2012) use the log of assets as firm size proxy. We report the results in Table 9. The sign is positive for different firm size measures, which is consistent with the fact that larger firms have higher top-management pay levels. The results are robust for the coefficient of stock return, but not for the lagged stock return. In addition, the results are robust for lagged ROA, but not for ROA. Thus, we should pay special attention to whether it

is best to use lagged terms or current terms as asset performance in determining executive pay level. We also find the significance for coefficients of stock return volatility and gender changes slightly across different regressions. We do not observe obvious differences in goodness of fit.

6. Investment Policy

We refer to Coles, Daniel, and Naveen (2006) for the studies of investment policy (CAPEX, R&D, and firm risk). For firm size measures, Coles, Daniel, and Naveen (2006) use the log of sales. In Table 10, we use the R&D (the research and development expenditures scaled by assets) as the dependent variable, and the independent variables are based on Coles, Daniel, and Naveen (2006, Table 3, Panel A, Column 1). The coefficients of different firm size measures are all significantly negative, which means small firms tend to invest in riskier projects, but large, mature firms are less involved in risky investments. The results for several regressors are not robust, especially for cash compensation and stock return. Another obvious change lies in R-squared, which is sharply lower if we use the log of sales.

For the examination of CAPEX (net capital expenditures scaled by assets), we refer to Coles, Daniel, and Naveen (2006, Table 3, Panel B, Column 1). We report the results in the online appendix Table 6. Theoretically, CAPEX corresponds to safer investment policy when compared with R&D and leverage, so we have significantly positive coefficients for firm size, except that the coefficient is not significant when we use the log of market value of equity as the firm size measure in the pooled OLS regressions. In addition, the coefficient of stock return becomes insignificant when we employ the log of sales as firm size proxy.

In Table 11 we report the results for firm risk (stock return volatility). We use the independent variables in Coles, Daniel, and Naveen (2006, Table 9, Column 1). The coefficients

of different firm size measures are all significantly negative, indicating that small firms have high stock return variances. We find that the coefficients are not robust for vega, cash compensation, market to book ratio, book leverage, or tenure. These results indicate that the choice of firm size is vital in determining firm risk as measured by stock return volatility.

7. Diversification

We focus on the Herfindahl index and business segments for the studies of diversification. We refer to Coles, Daniel, and Naveen (2006) as the benchmark paper. The Herfindahl index is defined as the sum of the square of segment sales divided by the square of firm sales. Our choices of explanatory variables resemble those in Coles, Daniel, and Naveen (2006, Table 4, Panel A, Column 1). Table 12 reports the results. The sign of firm size is significantly negative, implying that large firms have high levels of diversification, which is consistent with the fact that large firms have better capability to diversify revenue concentration across different business segments. The models with industry fixed effect produce robust results, with two exceptions: the coefficient of lagged delta becomes insignificant when we use the log of sales, and the coefficient of lagged vega becomes significant when we use the log of assets. Additionally, the coefficient of ROA changes sign for different firm size measures. When it comes to the results of OLS regressions without industry fixed effect, in addition to these sensitive variables, we find stock return and tenure have changes in the significance of their coefficients.

In addition, we examine the number of operating business segments that also capture the diversification. We use the same explanatory variables as in Coles, Daniel, and Naveen (2006, Table 4, Panel A, Column 1). The dependent variable is the logarithm of the number of business segments. We report the results in the online appendix Table 7. As expected, our results show that

firm size has a positive effect on the number of business segments. When we use different size measures for the regressions with industry fixed effect, the coefficients of lagged vega and ROA are not robust.

8. Corporate Control

We use Probit specifications to study the mergers and acquisitions and corporate control. We cover three topics in this section: propensity to bid, propensity to be a target, and poison pill adoption as an antitakeover device. For the propensity to bid, we use the bidder dummy as the dependent variable, which is 1 if a firm announces a bid in a specific year and 0 otherwise. The explanatory variables resemble those in Harford (1999, Table III, Column 1). Harford (1999) uses the log of total assets as the measure of firm size. As shown in the online appendix Table 8, the coefficient is significantly positive for each firm size measure, which is consistent with the results in Harford (1999). The positive sign of firm size implies that large firms tend to announce bids, as these firms have higher absolute levels of cash holdings or market capitalization to participate in mergers and acquisitions activities. However, we find that the results for other regressors are not robust whether industry fixed effects are employed or not: the significance and/or sign change for abnormal returns, noncash working capital, market-to-book ratio, and price-to-earnings ratio. The main changes reside in the usage of market value of equity. Also, the R-squared is higher when we employ the market value of equity for the industry fixed effect regressions.

For the examination of the propensity to be a target, we use the independent variables in Comment and Schwert (1995, Table 3, Column 1). The dependent variable is a target dummy, which is 1 if a company is announced as a target of a successful M&A deal in a specific year and 0 otherwise. Comment and Schwert (1995) use the log of total assets as the measure of firm size.

In contrast to Comment and Schwert (1995), our results (Table 13) show the coefficient to be significantly positive for each firm size measure across different regressions, suggesting that larger firms are more likely to be targeted in M&A. The sign and/or significance change for sales growth and leverage when we use the log of sales, regardless of whether the industry fixed effect is used. In addition, the R-squared is smaller when we use the log of sales. Furthermore, the market-to-book ratio becomes insignificant when we use the log of assets.

We also use Comment and Schwert (1995) as the benchmark paper to study poison pill adoption as an antitakeover device. The dependent variable is equal to 1 if a firm has the poison pill in place in a specific year and 0 otherwise. The independent variables resemble those in Comment and Schwert (1995, Table 3, Column 4). In contrast to Comment and Schwert (1995), in our results (the online appendix Table 9) the coefficient of each firm size measure is significantly negative, suggesting larger firms are less likely to adopt poison pill. When the log of sales is used, the sign of the coefficient of share law changes from negative to positive. The coefficient of leverage level is only significant in the regressions without industry fixed effect when we use the log of assets, and it is also significant in the regressions with industry fixed effect when we use the log of sales. The log of market value of equity leads to insignificant coefficient of leverage. The goodness of fit is lower when we use the log of sales in the industry fixed effect regressions.

V. Robustness Check

1. Endogeneity Problem

As we follow the benchmark papers, we assume that the explanatory variables do not affect both dependent variable and firm size. We believe that firm size is a more important fundamental firm characteristic than other control variables, based on the theoretical and empirical works in the

corporate finance literature and our experiments in this paper. Therefore, it is more likely that the causality runs from the firm size to corporate policies. However, since we cannot entirely rule out collinear problem, researchers should be cautious about the "bad control" problem in econometrics.

To mitigate the endogeneity problem, more and more researchers consider firm fixed effects to control for time-invariant firm specific information. With the firm fixed effect model, we study within-firm variations with different implications from those in the original papers we follow, most of which focus on cross-sectional variations. In additional untabulated analysis, we find the within-firm results are still sensitive (sometimes even more than the cross-sectional results) to firm size measures, suggesting that researchers be more cautious in selecting firm size proxies.

It is also possible that some relationships that we study are not static. For robustness, we use GMM to estimate dynamic models, although none of the benchmark papers mention that dynamic models should be used. For many tests, the Arellano-Bond test of auto-correlation cannot reject H0: no auto-correlation in error terms. Although the GMM may not be a good model for many corporate finance subfields, the (unreported) results are still robust and the sensitivity to different size measures still exists.

2. Measurement Error

The size proxies, with potential measurement errors or random noise, might affect the coefficients in the regressions by chance. To test whether our results are driven by the measurement errors of the firm size measures, we conduct the simulation study, which involves the following details:

1) Determine a certain standard deviation for the noises (default value is 5%). We have also tried 10%, 20%, and 40%, which provide consistent results.

2) Generate N random numbers from a zero-mean normal distribution with the selected standard deviation, where N represents the number of distinct values of the firm size variable for each firm year.[5]
3) By denoting the generated random numbers as $\varepsilon_1, \varepsilon_2, \dots, \varepsilon_N$, the observations of the selected size variable, which is denoted as $x_1, x_2, \dots, x_N$, are now modified to $(1+\varepsilon_1)x_1, (1+\varepsilon_2)x_2, \dots, (1+\varepsilon_N)x_N$.
4) Re-fit the model with the modified size variable and obtain the corresponding fitted coefficients, t-values, and significance.
5) Repeat steps 2-4 for different size variables.
6) Repeat the above steps 1,000 times and summarize the distribution of the number of coefficient changes in sign, magnitude, and significance.

We perform this simulation study on all 20 models. For each model, we make 4 tables:

1) A table of frequency for sign changes of the fitted coefficients compared with the original model for all independent variables.
2) A table of frequency for significance changes (the change of significance levels, for example, from "**" to "*") of the fitted coefficients compared with the original model for all independent variables.
3) A table of average magnitude changes of the fitted coefficient compared with the original model for all independent variables, where the magnitude is computed as

$$\Delta_{Magnitude} = \frac{C_{Simulated} - C_{Original}}{|C_{Original}|}$$

for each independent variable in the model.

[5] Here we assume that the measurement error is firm-year specific. We also tried firm-specific and year-specific noises and obtained similar results.

4) A table of average magnitude changes of the adjusted R square for each model.

Tables 10-13 in the online appendix are the 4 example tables made for the 6 models of Firm Performance-Tobin's Q in Table 3. All the other tables and the simulation program are available upon request.

Overall, we find that the measurement error of reasonable magnitude does not change our results. For example, the signs of the independent variables rarely change in the 1,000 simulations even for a fairly large noise (20% standard deviation). The significance does not change significantly either. The results are summarized in Table 14 for sign change and significant change in Panels A and B respectively.

VI. Summary, Guidelines, and Limitations

We summarize our results in Table 15, and hereby provide a *general* guideline to researchers who may use firm size, whether as key variable or control variable, in their empirical corporate finance studies.

First, in most areas of corporate finance the coefficients of firm size measures are robust in sign and statistical significance. However, when studying firm performance and capital structure, researchers should consider empirical sensitivity because market capitalization, as a size proxy, can be mechanically correlated with the dependent variables.

Second, the coefficients on regressors other than firm size often change sign and significance. We observe sign changes and significance changes (change from significant to insignificant) in almost all examined areas except dividend policy and delta (Table 15 Panel C). Unfortunately, this suggests that some previous studies are not robust to using different firm size

proxies. Researchers should either use all the important firm size measures as robustness checks or provide a rationale for using any specific measure.

Third, the goodness of fit measured by R-squared also varies when we use different firm size measures (Figure 3 and Table 15, Panel B). The variation indicates that some size measures are more relevant than others in certain areas. In particular, total assets seems more relevant for executive compensation, firm diversification, capital structure, and investment policy, but not for firm performance and risk; total sales matters more for dividend policy, cash holdings, but not for investment, diversification, and M&A; market cap increases the goodness of fit more for firm risk, capital structure, investment, and M&A, but not for corporate governance. Although a size proxy that delivers a higher goodness of fit alone cannot justify a good model specification, researchers should not ignore abnormal changes in goodness of fit.

Fourth, in terms of research areas that are robust to size measures, Table 15, Panel C on Sensitivity of Regressor (Other than Firm Size) Coefficient can serve as a guide. The most robust areas are dividend policy, executive compensation, and then capital structure, meaning that the choice of the size measures may not matter much in those areas. The least robust areas include M&A and firm diversification, suggesting that researchers should select size proxies with consideration for sensitivity tests.

Fifth, different size proxies capture different aspects of "firm size", and thus have different implications in corporate finance. For example, market cap is more market oriented and forward looking, reflecting only the ownership of equity, while total assets measures the firm's total resources. Total sales are more related to product market and are not forward looking. The choice of these firm size measures can be a theoretical and empirical question. For example, if researchers want to control for the company's "size" in its product market, then they should use total sales; if

researchers want to control for the size in stock market, then they should use market cap; if the size refers to the total resources from which the company can generate profit, then researchers should use total assets.

We have some guidelines for future research. First, we do not employ all possible measures of firm size; we only study the most popular three measures. Researchers can use some alternative size proxies such as enterprise value (market capitalization plus net debt), the number of employees, total profits, or net assets (total assets minus total liabilities) when the main measures are not available or are irrelevant (e.g., market cap for private firms and total sales for start-up firms). Second, we might omit some important representative papers in specific sub-fields due to data and time constraints. Third, some linear models may lose power if the true relation between firm size and the dependent variable is non-linear (such as quadratic form). Fourth, most of our empirical results are based on year fixed effects and/or industry fixed effects. Introducing other considerations, such as firm fixed effects (for consideration of within-firm variations of interest rather than cross-sectional variations) or manager fixed effects (for emphasis on corporate governance issues such as managerial compensation), might change our results and have different implications.

Appendix: A survey of 100 empirical corporate finance papers that use firm size measures

Paper Sources by journal:

Sources	# of Articles
Journal of Financial Economics	50
Journal of Finance	34
Review of Financial Studies	8
Journal of Accounting and Economics	4
Quarterly Journal of Economics	1
Journal of Political Economy	1
Journal of Accounting Research	1
The Accounting Review	1

By field:

Sources	# of Articles
Mergers and Acquisitions	13
Cash Holdings	12
Executive Compensation	12
Ownership Structure	11
Capital Structure	9
Board of Directors	8
Law and Finance	7
Dividend Policy	6
Corporate Investment	6
CEO Turnover	6
Debt Policy	5
Cross Listings	5

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Table 1: Summary Statistics

Table 1 presents summary statistics for the samples of the panel data from 1993 to 2006. Please refer to the corresponding benchmark papers for the variable definitions. All dollar values are stated in 2006 dollars.

	Mean	Median	Stdev
Linck, Netter, and Yang (2008): Board of Directors			
LogAssets	7.86	7.69	1.48
LogSales	7.86	7.70	1.50
LogMVE	7.99	7.85	1.65
Board size	9.52	9.00	2.57
Board independence	0.68	0.71	0.17
Board leadership	0.80	1.00	0.40
Debt	0.19	0.18	0.15
LogSegments	0.82	1.10	0.69
FirmAge	23.62	25.67	11.33
MTB	2.15	1.67	1.44
R&D	0.04	0.01	0.06
RETSTD	0.43	0.37	0.21
CEO_Own	0.005	0.00	0.03
Director_Own	0.04	0.01	0.08
FCF	0.08	0.06	0.10
Performance	0.04	0.003	0.18
Lag(CEO_Chair)	0.80	1.00	0.40
Lemmon, Roberts, and Zender (2008): Leverage			
LogAssets	7.86	7.68	1.48
LogSales	7.40	7.36	1.65
LogMVE	7.98	7.85	1.65
Book Leverage	0.23	0.22	0.19
Initial book leverage	0.21	0.19	0.19
Market Leverage	0.21	0.16	0.21
Initial market leverage	0.20	0.15	0.20
Profitability	0.14	0.14	0.12
Cash Flow Volatility	0.05	0.03	0.06
Tangibility	0.3	0.25	0.21
Dividend Payer	0.56	1.00	0.50
Harford, Mansi, and Maxwell (2008): Cash Holdings			
LogAssets	7.86	7.68	1.48
LogSales	7.49	7.43	1.64
LogMVE	7.98	7.85	1.65
Cash Holdings	-2.83	-2.80	1.70
Gindex	7.32	8.00	4.61
Inside Ownership	0.002	0.001	0.004

Delta	0.22	0.04	0.59
Institutional ownership	10.62	0.00	25.00
Leverage	0.21	0.16	0.20
Cash flow	0.07	0.04	0.11
Working capital	0.07	0.06	0.15
CF Volatility	0.40	0.04	1.62
R&D	0.04	0.01	0.07
CapEx	0.04	0.03	0.05
Acquisition	0.03	0.00	0.06
Dividend indicator	0.57	1.00	0.49
Bond indicator	0.58	1.00	0.49
DeAngelo, DeAngelo, and Stultz (2006): Payout policy			
LogAssets	7.84	7.65	1.47
LogSales	7.84	7.67	1.50
LogMVE	7.96	7.84	1.65
Dividend payout	0.60	1.00	0.49
RE/TE	0.04	0.00	0.20
TE/TA	0.06	0.04	0.06
Sales growth	0.07	0.07	0.22
Mehran (1995): Firm Performance			
LogAssets	7.84	7.65	1.47
LogSales	7.84	7.67	1.50
LogMVE	7.96	7.84	1.65
Tobin's Q	2.15	1.68	1.43
ROA	14.48	14.09	9.44
% of managers' equity compensation	0.58	0.61	0.23
% of shares held by all outside blockholders	0.18	0.00	0.31
% of outside directors	0.68	0.70	0.17
Std of % change in operating income	0.44	0.34	0.36
Graham, Li, and Qiu (2012): Executive Pay Level			
LogAssets	7.84	7.65	1.47
LogSales	7.83	7.67	1.50
LogMVE	7.96	7.84	1.65
Tobin's Q	2.16	1.66	1.52
Stock Return	0.16	0.09	0.56
ROA	0.14	0.14	0.13
Stock Volatility	4.42	3.42	3.56
Director	0.33	0.00	0.47
Tenure	3.40	0.00	7.83
CEO	0.18	0.00	0.38
Female	0.05	0.00	0.21

Coles, Daniel, and Naveen (2006): Delta and Vega			
LogAssets	7.84	7.65	1.47
LogSales	7.83	7.67	1.50
LogMVE	7.96	7.84	1.65
Vega	0.05	0.01	0.11
Delta	0.22	0.04	0.59
Tobin's Q	2.16	1.66	1.52
Book Leverage	0.23	0.22	0.19
R & D	0.04	0.01	0.08
CAPEX	0.04	0.03	0.05
Firm Risk	0.35	0.32	0.17
Cash Compensation	0.85	0.60	0.90
Tenure	3.40	0.00	7.83
Surplus Cash	0.06	0.04	0.11
Coles, Daniel, and Naveen (2006): Investment Policy			
LogAssets	7.84	7.65	1.47
LogSales	7.40	7.36	1.65
LogMVE	7.96	7.68	1.65
R & D	0.04	0.01	0.07
Delta	0.41E-3	0.03E-3	1.00E-3
Vega	0.18E-2	0.02E-2	0.55E-2
Cash Compensation	0.07E-2	0.05E-2	0.11E-2
Tobin's Q	2.17	1.67	1.52
Surplus Cash	0.07	0.04	0.11
Sales Growth	0.10	0.08	0.28
Stock Returns	0.01	0.00	0.58
Book Leverage	0.23	0.22	0.18
Tenure	0.34	0.00	0.79
Firm Risk	2.74	2.67	0.93
CAPEX	0.05	0.03	0.05
Coles, Daniel, and Naveen (2006): Diversification			
LogAssets	7.77	7.60	1.44
LogSales	7.34	7.30	1.63
LogMVE	7.89	7.78	1.62
Herfindahl Index	0.65	0.69	0.68
Vega	0.39E-3	0.03E-3	0.95E-3
Delta	0.18E-2	0.02E-2	0.54E-2
Cash Compensation	0.07E-2	0.05E-2	0.11E-2
Tobin's Q	2.17	1.66	1.54
ROA	0.14	0.14	0.12
Stock Return	0.01	0.11E-2	0.60
Sales Growth	0.10	0.08	0.28
Dividend Cut	0.27	0.00	0.44

CEO Turnover	0.16	0.00	0.37
Book Leverage	0.22	0.22	0.18
Tenure	3.37	0.00	7.78
Harford (1999): Bidder			
LogAssets	7.42	7.35	1.60
LogSales	7.40	7.36	1.66
LogMVE	8.00	7.87	1.66
Bidder Dummy	0.12	0.00	0.33
Abnormal Return	1.08	0.09	55.38
Sales Growth	0.11	0.08	0.30
Liquidity	0.07	0.07	0.15
Leverage	0.23	0.22	0.18
Tobin's Q	2.21	1.69	1.57
Price-to-Earnings	-2.84	0.00	15.12
Comment and Schwert (1995): Target and Poison Pill			
Target Dummy	0.02	0.00	0.15
LogAssets	7.84	7.65	1.48
LogSales	7.40	7.35	1.65
LogMVE	7.96	7.84	1.65
Poison Pill	0.62	1.00	0.49
Control Share Law	0.17	0.00	0.38
Business Combination Law	0.69	1.00	0.46
Abnormal Return	1.09	0.08	56.15
Sales growth	0.10	0.08	0.28
Liquidity	0.07	0.07	0.15
Leverage	0.23	0.22	0.18
Tobin's Q	2.17	1.67	1.52
Price-to-earnings	-2.80	0.00	15.19

Table 2: Firm Size Measures for Firm Performance Regression

Panel A: Summary Statistics

This table presents summary statistics of firm size measures that we use for the regressions of Tobin's Q and ROA. "Assets", "sales" and "mve" denote total assets, total sales and market value of equity respectively. The data are for the fiscal years 1993-2006.

Variable	N	Mean	Std Dev	Minimum	Maximum
assets	4718	8485	22702	31.849	304594
sales	4698	8212	21174	1.857	345977
mve	4718	11880	31676	4.477	460768
logassets	4718	7.81405	1.47247	3.46101	12.62674
logsales	4698	7.81236	1.50306	0.61896	12.75413
logmve	4718	7.94546	1.64479	1.49895	13.04065

Panel B: Correlation

For any two measures of firm size, the first line reports the Pearson correlation coefficient, the second line denotes the Probability > |r| under H0: Rho=0. The third line refers to the number of observations.

	assets	sales	mve	logassets	logsales	logmve
assets	1	0.80988	0.6351	0.62978	0.56359	0.51524
		<.0001	<.0001	<.0001	<.0001	<.0001
	4718	4698	4718	4718	4698	4718
sales		1	0.67084	0.58564	0.61417	0.50087
			<.0001	<.0001	<.0001	<.0001
		4698	4698	4698	4698	4698
mve			1	0.55892	0.51373	0.63399
				<.0001	<.0001	<.0001
			4718	4718	4698	4718
logassets				1	0.92061	0.85227
					<.0001	<.0001
				4718	4698	4718
logsales					1	0.77029
						<.0001
					4698	4698
logmve						1
						4718

Table 3: Firm Performance-Tobin's Q

The explanatory variables in this table resemble those in Table 4, Panel A, Column 4 in Mehran (1995). The dependent variable is Tobin's Q. Models (1)-(3) are based on pooled OLS regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Industry FE	(5) Industry FE	(6) Industry FE
% of managers'	0.793***	0.793***	0.017	0.696***	0.663***	0.019
equity compensation	20.89	21.19	0.48	18.75	18.01	0.57
Managers' delta	0.317***	0.315***	0.082***	0.281***	0.269***	0.075***
	23.05	23.02	6.46	21.02	20.19	6.15
% of shares held by all	0.283***	0.288***	0.203***	0.345***	0.354***	0.215***
outside blockholders	5.49	5.58	4.34	6.92	7.11	4.76
% of outside directors	-0.388***	-0.400***	-0.595***	-0.360***	-0.409***	-0.518***
	-7.60	-7.82	-12.89	-6.93	-7.83	-11.04
R&D/sales	5.447***	5.544***	4.703***	4.683***	4.784***	4.107***
	33.12	33.44	31.44	26.32	26.87	25.49
(Inventory+PPE)/assets	-0.302***	-0.299***	-0.599***	-0.640***	-0.652***	-0.414***
	-6.75	-6.72	-14.82	-9.64	-9.84	-6.88
Long-term debt/assets	-0.198***	-0.196***	-0.158***	-0.210***	-0.209***	-0.151***
	-35.08	-34.95	-31.00	-36.24	-36.18	-28.57
Std of % change in	0.052*	-0.067**	0.391***	-0.092***	0.130***	0.428***
operating income	1.95	2.46	16.15	3.37	4.74	17.46
Size-Log of	0.030***			0.043***		
total assets	4.77			6.35		
Size-Log of sales		0.037***			0.076***	
		5.84			11.02	
Size-Log of market			0.370***			0.398***
value of equity			72.36			73.87
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.22	0.22	0.35	0.28	0.28	0.41
N	24,582	24,579	24,582	24,582	24,579	24,582

Table 4: Board of Directors-Board Independence

The explanatory variables in this table resemble those in Table 4, Column 2 in Linck, Netter, and Young (2008). The dependent variable is board independence, defined as the proportion of non-executive board members. Models (1)-(3) are based on pooled OLS regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Industry FE	(5) Industry FE	(6) Industry FE
Log(MVE)	0.015*** 17.03			0.017*** 18.00		
Log(Assets)		0.018*** 20.27			0.020*** 20.97	
Log(Sales)			0.019*** 21.17			0.025*** 25.91
Debt	0.016** 2.17	-0.005 -0.63	0.008 1.06	0.027*** 3.57	0.006 0.86	0.009 1.18
Log(Segments)	0.024*** 15.06	0.022*** 13.77	0.022*** 13.61	0.017*** 10.33	0.015*** 8.89	0.012*** 6.85
FirmAge	-0.007*** -9.28	-0.007*** -8.74	-0.007*** -8.20	-0.004*** -5.57	-0.004*** -5.20	-0.003*** -4.11
FirmAge^2	0.0002*** 12.01	0.0002*** 11.29	0.0002*** 10.58	0.0001*** 7.95	0.0001*** 7.39	0.0001*** 6.07
MTB	-0.012*** -12.59	-0.005*** -6.52	-0.005*** -6.13	-0.010*** -11.50	-0.004*** -4.91	-0.004*** -5.22
R&D	0.116*** 5.39	0.134*** 6.25	0.202*** 9.27	-0.054** -2.41	-0.037* -1.68	0.006 0.28
RETSTD	-0.055*** -8.31	-0.066*** -10.01	-0.067*** -10.03	-0.023*** -3.38	-0.035*** -5.20	-0.030*** -4.58
CEO_Own	-0.302*** -6.68	-0.293*** -6.52	-0.311*** -6.93	-0.211*** -4.88	-0.206*** -4.78	-0.199*** -4.64
Director_Own	0.647*** 45.64	0.663*** 46.97	0.657*** 47.20	0.644*** 46.74	0.658*** 47.95	0.670*** 49.71
FCF	0.150*** 11.05	0.153*** 11.33	0.133*** 9.77	0.125*** 9.34	0.127*** 9.56	0.098*** 7.39
Performance	-581.307*** -6.65	-702.407*** -8.02	-647.593*** -7.51	-617.460*** -7.28	-706.805** -8.33	-786.459*** -9.37

Lag(CEO_Chair)	0.054***	0.051***	0.052***	0.050***	0.047***	0.045***
	21.01	19.99	20.12	20.12	19.09	18.20
Age	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	-16.78	-16.70	-16.53	-14.29	-14.25	-14.03
Tenure	0.000	0.000	0.000	0.000	0.000	0.000
	0.70	0.60	0.63	0.35	0.20	-0.16
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.23	0.24	0.24	0.31	0.32	0.32
N	21,708	21,708	21,708	21,708	21,708	21,708

Table 5: Board of Directors-CEO Duality

The explanatory variables in this table resemble those in Table 4, Column 3 in Linck, Netter, and Young (2008). The dependent variable is board leadership, a log-transformed dummy that equals 1 if the CEO and Chairman of the Board are combined and 0 otherwise. Models (1)-(3) are based on logistic regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Logistic	(2) Logistic	(3) Logistic	(4) Logistic Industry FE	(5) Logistic Industry FE	(6) Logistic Industry FE
Log(MVE)	0.324***			0.305***		
	520.326			390.963		
Log(Assets)		0.406***			0.396***	
		785.862			611.320	
Log(Sales)			0.365***			0.415***
			664.551			659.980
MTB	-0.230***	-0.086***	-0.091***	-0.221***	-0.095***	-0.105***
	297.455	52.101	59.008	242.113	56.232	68.293
R&D	0.130	0.822***	1.670***	-0.063	0.456	0.953***
	0.194	7.667	29.891	0.034	1.760	7.667
RETSTD	-0.664***	-0.755***	-0.742***	-0.231**	-0.323***	-0.180
	38.689	53.991	51.959	4.101	7.946	2.292
Performance	-4490.8***	-6921.2***	-5396.9***	-5628.1***	-7561.1***	-7745.6***
	17.200	-41.894	25.010	24.236	43.212	46.183
Age	-0.004***	-0.004***	-0.004***	-0.003***	-0.003***	-0.003***
	34.440	29.469	28.006	21.052	18.749	16.106
Tenure	0.000	0.000	0.000	-0.001	-0.002	-0.002
	0.002	0.002	0.030	0.249	0.481	0.606
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.09	0.11	0.10	0.15	0.16	0.16
N	23,750	23,750	23,750	23,750	23,750	23,750

Table 6: Payout Policy-Dividend Dummy

The explanatory variables in this table resemble those in Table 3, Column 1 in DeAngelo, DeAngelo, and Stulz (2006). The dependent variable equals 1 if the firm pays out dividend and 0 otherwise. Models (1)-(3) are based on logistic regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Logistic	(2) Logistic	(3) Logistic	(4) Logistic Industry FE	(5) Logistic Industry FE	(6) Logistic Industry FE
RE/TE	1.120***	1.229***	1.394***	1.045***	0.985***	1.214***
	73.831	91.419	114.726	56.581	52.267	74.823
TE/TA	-7.040***	-6.819***	-9.217***	-4.946***	-4.721***	-6.940***
	-1109.875	-1011.415	-1913.596	-452.294	-409.500	-874.909
Profitability	1.608***	1.168***	0.818***	1.320***	0.785***	0.491***
	211.333	111.596	53.953	117.566	41.197	16.069
Sales growth	-0.801***	-0.744***	-0.850***	-0.687***	-0.641***	-0.758***
	-335.184	-290.140	-375.478	-212.541	-182.770	-258.087
Log(Assets)	0.255***			0.284***		
	1086.849			987.380		
Log(Sales)		0.250***			0.320***	
		1092.687			1232.935	
Log(Market Capitalization)			0.172***			0.201***
			676.817			680.229
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.30	0.30	0.28	0.44	0.45	0.42
N	24,573	24,573	24,573	24,573	24,573	24,573

Table 7: Book Leverage

The explanatory variables in this table resemble those in Table II, Panel A, Column 3 in Lemmon, Roberts, and Zender (2008). The dependent variable is book leverage, defined as the ratio of total debt to book assets. Models (1)-(3) are based on pooled OLS regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Industry Fixed Effect	(5) Industry Fixed Effect	(6) Industry Fixed Effect
Initial book lev.	0.209***	0.264***	0.211***	0.188***	0.235***	0.192***
	36.46	65.78	36.78	32.95	57.40	33.64
Log(Assets)	0.008***			0.009***		
	11.83			12.71		
Log(Sales)		0.002***			0.007***	
		4.61			12.14	
Log(Market Value of Equity)			-0.001**			-0.002***
			-2.02			-3.18
Market-to-book	-0.014***	-0.012***	-0.012***	-0.019***	-0.015***	-0.016***
	-16.92	-20.80	-13.01	-22.99	-25.31	-18.64
Profitability	-0.122***	-0.134***	-0.135***	-0.098***	-0.134***	-0.101***
	-9.78	-18.26	-10.79	-7.86	-18.24	-8.11
Tangibility	0.040***	0.088***	0.048***	0.091***	0.120***	0.085***
	7.53	23.00	8.92	12.10	22.74	11.23
Industry median lev.	0.295***	0.325***	0.309***	0.355***	0.369***	0.342***
	28.31	39.54	29.71	9.35	14.46	8.96
Dividend payer	0.049***	0.019***	0.057***	0.040***	0.013***	0.048***
	23.21	12.32	27.13	18.41	7.97	22.49
Cash flow vol.	0.127***	-0.108***	0.047	0.191***	-0.065***	0.097***
	4.18	-7.24	1.56	6.23	-4.46	3.18
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.24	0.23	0.23	0.32	0.27	0.31
N	25,680	56,590	25,680	25,680	56,590	25,680

Table 8: Cash holdings

The explanatory variables in this table resemble those in Table 3, Column 1 in Harford, Mansi, and Maxwell (2008). The dependent variable is the natural log of cash/sales ratio. Models (1)-(3) are based on pooled OLS regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Industry Fixed Effect	(5) Industry Fixed Effect	(6) Industry Fixed Effect
Gindex	-0.063***	-0.067***	-0.063***	-0.065***	-0.068***	-0.064***
	-17.10	-18.66	-17.15	-18.97	-19.97	-18.89
Inside Ownership	9.764***	30.057***	10.730***	3.006	18.165***	4.252*
	3.69	11.73	4.07	1.27	7.74	1.79
Pay sensitivity	0.042***	0.085***	0.044***	0.031**	0.058***	0.033**
	2.58	5.31	2.70	2.09	4.02	2.27
Institutional	0.001*	0.001	0.001*	0.001*	0.001	0.001
ownership	1.95	1.34	1.95	1.69	1.14	1.60
Log(Assets)	0.011			0.079***		
	1.20			9.00		
Log(Sales)		-0.231***			-0.129***	
		-28.35			-14.81	
Log(Market Value			-0.000			0.061***
of Equity)			-0.01			7.27
Leverage	-1.446***	-1.514***	-1.446***	-1.195***	-1.269***	-1.042***
	-23.79	-25.38	-22.27	-20.63	-21.97	-16.67
Market-to-book	0.046***	0.043***	0.046***	0.050***	0.051***	0.031***
	5.66	5.32	5.37	6.79	6.95	3.97
Cash flow	0.007	0.362***	0.013	-0.271**	-0.070	-0.279**
	0.06	2.96	0.11	-2.38	-0.61	-2.45
Working capital	-1.042***	-1.390***	-1.068***	-0.981***	-1.333***	-1.027***
	-14.82	-20.86	-15.24	-12.77	-17.67	-13.44
CF volatility	6.588***	5.012***	6.537***	4.192***	3.210***	4.111***
	22.01	16.97	21.87	14.90	11.42	14.62
R&D	9.579***	8.567***	9.566***	6.625***	6.238***	6.637***
	42.84	38.63	42.75	29.68	27.95	29.69
CapEx	-2.286***	-2.632***	-2.303***	-1.907***	-2.225***	-1.959***
	-12.55	-14.76	-12.67	-10.81	-12.69	-11.11
Acquisition	-1.986***	-2.403***	-1.996***	-2.148***	-2.303***	-2.192***
	-14.69	-18.07	-14.79	-17.49	-18.79	-17.85

Dividend indicator	-0.370***	-0.259***	-0.365***	-0.410***	-0.307***	-0.403***
	-17.97	-12.85	-17.73	-20.89	-15.57	-20.50
Bond indicator	-0.199***	0.114***	-0.185***	-0.183***	0.070***	-0.167***
	-8.36	4.94	-7.71	-8.13	3.12	-7.36
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.46	0.48	0.46	0.57	0.58	0.57
N	19,899	19,899	19,899	19,899	19,899	19,899

Table 9: Executive Pay Level

The explanatory variables in this table resemble those in Table 4, Panel A, Column 1 in Graham, Li, and Qiu (2012). The dependent variable is total executive compensation. Models (1)-(3) are based on pooled OLS regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Industry FE	(5) Industry FE	(6) Industry FE
Lag(logassets)	1.276*** 79.14			1.292*** 69.97		
Lag(logsales)		1.209*** 72.82			1.265*** 66.85	
Lag(logmve)			1.275*** 78.92			1.249*** 69.58
Lag(Q)	0.632*** 32.17	0.732*** 36.58	0.106*** 5.00	0.615*** 29.45	0.695*** 33.10	0.146*** 6.47
Stock Return	0.592*** 13.51	0.542*** 12.16	0.654*** 14.91	0.554*** 12.80	0.518*** 11.87	0.625*** 14.43
Lag(Stock Return)	0.205*** 4.65	0.133*** 2.96	0.085* 1.93	0.176** 4.02	0.134*** 3.04	0.031 0.71
ROA	-0.477 -1.16	-0.278 -0.66	-1.064*** -2.58	-0.462 -1.13	-0.590 -1.43	-0.935** -2.28
Lag(ROA)	-1.708*** -3.98	-4.549*** -10.39	-3.119*** -7.26	-1.682*** -3.95	-4.491*** -10.43	-3.194*** -7.49
Stock Return Volatility	0.063*** 8.64	0.080*** 10.60	0.031*** 4.35	0.040*** 5.26	0.036*** 4.59	0.017** 2.17
Lag(Director)	0.911*** 13.26	0.923*** 13.19	0.883*** 12.85	0.825*** 12.19	0.882*** 12.90	0.795*** 11.17
Tenure	0.017*** 5.50	0.019*** 6.04	0.013*** 4.24	0.020*** 6.61	0.021*** 6.76	0.018*** 5.83
CEO	2.958*** 37.78	2.926*** 36.70	3.008*** 38.40	3.006*** 39.06	2.955*** 38.07	3.047*** 39.54
Female	0.190* 1.91	0.067 0.66	0.194* 1.95	0.097 0.98	0.123 1.24	0.100 1.01
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.40	0.38	0.40	0.42	0.41	0.42
N	20,046	20,046	20,046	20,046	20,046	20,046

Table 10: R&D

The explanatory variables in this table resemble those in Table 3, Panel A, Column 1 in Coles, Daniel, and Naveen (2006). The dependent variable is the research and development (R&D) expenditures scaled by assets. Models (1)-(3) are based on pooled OLS regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Industry FE	(5) Industry FE	(6) Industry FE
Vega	3.737*** 11.38	5.964*** 18.54	3.669*** 11.15	2.505*** 8.35	4.176*** 13.80	2.466*** 8.22
Delta	-0.248*** -3.97	-0.330*** -5.76	-0.246*** -3.92	-0.194*** -3.41	-0.193*** -3.60	-0.191*** -3.35
Cash Compensation	-2.172*** -5.15	1.759*** 6.61	-2.591*** -6.16	-0.267 -0.68	1.772*** 7.05	-0.502 -1.28
Log(Assets)	-0.006*** -25.04			-0.006*** -23.12		
Log(Sales)		-0.016*** -86.31			-0.015*** -74.39	
Log(Mkt Value of Equity)			-0.006*** -23.22			-0.005*** -22.23
MKT-To-Book	0.004*** 14.37	0.007*** 31.74	0.006*** 21.28	0.003** 13.29	0.006*** 29.07	0.006*** 19.73
Surplus Cash	0.282*** 74.70	0.187*** 65.85	0.286*** 75.42	0.209*** 57.08	0.126*** 44.61	0.212*** 57.72
Sales Growth	-0.035*** -23.47	-0.024*** -23.12	-0.035*** -23.47	-0.031*** -22.59	-0.022*** -22.48	-0.031*** -22.51
Stock Return	-0.359*** -5.79	-0.001 -1.31	-0.288*** -4.64	-0.278*** -4.93	-0.000 -0.18	-0.205*** -3.63
Book Leverage	-0.019*** -9.29	-0.022*** -13.74	-0.027*** -12.98	-0.013*** -6.39	-0.009*** -5.24	-0.020*** -9.66
Tenure	-0.001*** -3.54	-0.001** -2.00	-0.001*** -3.14	-0.001*** -2.65	-0.001** -2.23	-0.001** -2.38
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.33	0.27	0.33	0.46	0.37	0.46
N	24,518	52,935	24,518	24,518	52,935	24,518

Table 11: Firm Risk

The explanatory variables in this table resemble those in Table 9, Column 1 in Coles, Daniel, and Naveen (2006). The dependent variable is firm risk, defined as stock return volatility. Models (1)-(3) are based on pooled OLS regressions without industry fixed effects, models (4)-(6) include industry fixed effects. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Industry FE	(5) Industry FE	(6) Industry FE
Lag(Vega)	-14.521***	-31.389***	-5.877	-16.621***	-19.674***	-10.005**
	-3.16	-9.03	-1.31	-4.06	-6.28	-2.51
Lag(Delta)	10.029***	8.551***	10.042***	6.931***	5.312***	6.993***
	11.57	13.61	11.85	8.96	9.42	9.27
Cash	-34.159***	-2.034	-15.928***	-35.654***	-3.129	-18.416***
Compensation	-6.07	-0.73	-2.91	-6.91	-1.23	-3.67
Log(Assets)	-0.136***			-0.136***		
	-40.80			-40.88		
Log(Sales)		-0.199***			-0.197***	
		-95.79			-95.43	
Log(Market Value			-0.167***			-0.167***
of Equity)			-52.93			-53.89
MKT-To-Book	-0.039***	-0.018***	0.037***	-0.018***	-0.010***	0.053***
	-12.13	-8.22	10.45	-5.96	-5.15	16.42
R&D	4.009***	2.563***	4.003***	3.528***	2.452***	3.475***
	52.49	56.75	53.80	45.48	55.13	45.97
CAPEX	0.551***	0.683***	0.618***	-0.146	0.172***	-0.105
	6.04	11.91	6.94	-1.64	3.13	-1.22
Book Leverage	-0.016	-0.066***	-0.169***	0.304***	0.211***	0.133***
	-0.59	-3.71	-6.30	11.27	12.22	5.07
Tenure	0.018***	-0.022***	-0.016***	-0.008	-0.009**	-0.006
	-3.26	-5.92	-2.94	-1.49	-2.49	-1.30
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.48	0.50	0.50	0.59	0.60	0.61
N	22,733	51,335	22,733	22,733	51,335	22,733

Table 12: Herfindahl Index

The explanatory variables in this table resemble those in Table 4, Panel A, Column 1 in Coles, Daniel, and Naveen (2006). The dependent variable is Herfindahl index, the sum of the square of segment sales divided by the square of firm sales. Models (1)-(3) are pooled OLS regressions without industry fixed effects, models (4)-(6) include industry fixed effects. All models use year fixed effects. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Pooled OLS	(2) Pooled OLS	(3) Pooled OLS	(4) Industry FE	(5) Industry FE	(6) Industry FE
Lag(Vega)	-1.607	-6.181***	-1.958	4.151**	1.720	2.949
	-0.77	-4.07	-0.94	2.22	1.23	1.56
Lag(Delta)	0.490	0.961***	0.481	-0.975***	-0.182	-1.004***
	1.29	3.57	1.26	-2.85	-0.74	-2.91
Cash	-7.562***	-4.727***	-10.721***	-7.397***	-3.308***	-12.249***
Compensation	-3.04	-4.1	-4.32	-3.22	-3.11	-5.31
Log(Assets)	-0.041***			-0.055***		
	-27.90			-37.45		
Log(Sales)		-0.040***			-0.055***	
		-45.87			-60.93	
Log(Market Value			-0.037***			-0.045***
of Equity)			-25.65			-32.38
MKT-To-Book	0.033***	0.021***	0.048***	0.043***	0.025***	0.059***
	21.46	23.06	28.52	27.83	28.50	36.92
ROA	-0.163***	0.066***	-0.121***	-0.280***	0.064***	-0.235***
	-7.45	6.09	-5.48	-13.52	6.24	-11.17
Stock Return	-0.208	-0.007***	0.407	-1.943***	-0.007***	-1.091***
	-0.56	-3.65	1.09	-5.77	-3.78	-3.23
Sales Growth	0.073***	0.040***	0.069***	0.050***	0.020***	0.045***
	8.38	8.93	7.94	6.35	4.88	5.73
Dividend Cut	-0.085***	-0.084***	-0.088***	-0.057***	-0.054***	-0.061***
	-19.94	-29.82	-20.70	-14.54	-20.28	-15.39
CEO Turnover	0.004	-0.004	0.004	0.000	-0.003	0.000
	0.78	-1.17	0.81	-0.07	-1.15	-0.09
Book Leverage	-0.035***	-0.038***	-0.088***	-0.051***	-0.040***	-0.117***
	-2.85	-5.57	-7.40	-4.28	-5.93	-9.91
Tenure	0.001**	0.000	0.001***	0.001***	0.000	0.001***
	2.26	0.38	2.63	2.60	1.57	2.93
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.12	0.14	0.12	0.31	0.29	0.30
N	21,966	48,381	21,966	21,966	48,381	21,966

Table 13: Acquisition Target Dummy

The explanatory variables in this table resemble those in Table 3, Column 1 in Comment and Schwert (1995). The dependent variable is equal to 1 if a firm is a target of a successful M&A deal in a certain year and 0 otherwise. Models (1)-(3) are based on Probit regressions without industry fixed effects, models (4)-(6) include industry fixed effects in Probit regressions. We include year fixed effects in all models. The data are for fiscal years 1993-2006. ***, **, * denote significance at 1%, 5%, and 10% level respectively.

	(1) Probit (Without Industry FE)	(2) Probit (Without Industry FE)	(3) Probit (Without Industry FE)	(4) Probit (Industry FE)	(5) Probit (Industry FE)	(6) Probit (Industry FE)
Poison Pill	0.098**	0.099***	0.105**	0.1937***	0.140***	0.203***
	4.391	7.234	4.984	13.116	12.539	14.212
Control share law	-0.200***	-0.304***	-0.196***	-0.240***	-0.316***	-0.236***
	-11.709	-39.660	-11.168	-12.764	-35.759	-12.263
Business	0.084	-0.058	0.087	0.138	-0.099	0.144
Combination law	0.501	-0.609	0.545	1.041	-1.559	1.124
Abnormal return	0.074*	0.028	0.065	0.058	0.035	0.049
	3.515	0.653	2.527	1.593	0.873	1.127
Sales growth	-0.197*	0.031	-0.203*	-0.250**	-0.035	-0.261**
	-3.589	0.128	-3.780	-5.480	-0.152	-5.875
Noncash working	0.139	0.103	0.156	0.519**	0.475***	0.511**
capital	0.597	0.624	0.739	4.823	8.182	4.667
Leverage	0.341**	0.119	0.457***	0.281*	0.091	0.391**
	5.350	1.120	9.721	3.208	0.051	6.106
Market-to-book	-0.031*	-0.042***	-0.089***	-0.027	-0.051***	-0.068***
	-2.804	-6.809	-17.834	-1.603	-8.392	-8.554
Price-to-earnings	0.001	0.001	0.002	0.002**	0.002*	0.002**
	1.120	0.323	1.874	4.272	3.565	5.125
Size(Assets)	0.115***			0.088***		
	44.355			18.953		
Size(Sales)		0.079***			0.081***	
		38.007			28.372	
Size(MVE)			0.123***			0.097***
			53.545			24.980
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.08	0.06	0.08	0.18	0.13	0.18
N	22,012	37,198	22,012	22,012	37,198	22,012

Table 14: Simulation of Measurement Error

Panel A: Average frequency of sign change

This table shows the average frequency of changes in sign for fitted coefficients among 1000 simulations of each regression model with the selected firm size infused by Gaussian noises generated with standard deviation 5%, 10%, 20%, and 40% respectively.

Firm Size	Total assets				Sales				Market value of equity			
Error Rate	5%	10%	20%	40%	5%	10%	20%	40%	5%	10%	20%	40%
Q	0.00%	0.02%	0.48%	2.24%	0.00%	0.00%	0.24%	1.54%	0.00%	0.00%	0.00%	0.00%
ROA	0.00%	0.00%	0.62%	2.16%	0.00%	0.00%	0.00%	0.58%	0.00%	9.77%	21.63%	22.22%
board size	0.00%	0.00%	0.00%	0.50%	0.00%	0.01%	9.09%	10.00%	9.91%	10.00%	18.84%	20.00%
board independence	0.00%	0.00%	0.00%	0.03%	0.03%	5.87%	6.67%	6.68%	0.00%	0.00%	0.00%	0.00%
board leadership	0.04%	0.00%	14.29%	14.29%	13.27%	14.29%	27.33%	28.57%	0.00%	0.00%	14.13%	14.29%
dividend	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
book leverage	0.00%	0.00%	0.00%	0.16%	0.00%	0.00%	0.34%	2.18%	0.05%	0.94%	2.83%	4.31%
market leverage	0.00%	0.00%	0.01%	0.35%	1.34%	12.45%	12.50%	12.50%	0.00%	0.00%	0.00%	0.00%
cash holding	0.95%	2.25%	2.79%	3.21%	0.00%	2.53%	6.67%	6.69%	3.44%	3.70%	3.65%	3.38%
Vega	0.00%	0.00%	0.03%	21.43%	0.00%	2.38%	12.49%	23.01%	0.00%	0.00%	0.00%	15.49%
Delta	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TDC1	0.00%	0.08%	9.53%	9.25%	0.01%	0.45%	9.88%	9.35%	0.00%	1.64%	9.15%	9.15%
RANDD	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.02%	10.00%	0.00%	0.00%	0.00%	0.00%
CAPEX	0.00%	0.00%	1.14%	8.00%	0.00%	0.00%	0.13%	1.18%	0.00%	0.00%	0.31%	4.84%
hindex	0.04%	5.31%	8.35%	8.34%	0.00%	0.04%	8.69%	8.77%	0.00%	0.00%	0.01%	0.01%
business segments	0.00%	0.93%	8.25%	8.33%	2.62%	1.91%	9.54%	8.48%	0.00%	0.00%	0.00%	0.00%
firm risk	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	11.11%	11.11%
bidder	0.01%	11.25%	16.91%	24.11%	7.33%	9.28%	11.35%	12.29%	11.55%	12.50%	12.54%	23.40%
target	0.12%	5.44%	16.47%	19.85%	0.58%	4.92%	9.36%	14.86%	0.03%	4.03%	15.28%	19.41%
poison pill	0.00%	2.64%	9.95%	10.24%	0.11%	5.92%	9.97%	10.16%	0.00%	0.72%	9.82%	10.13%

Panel B: Average frequency of significance change

This table shows the average frequency of changes in significance for fitted coefficients among 1000 simulations of each regression model with the selected firm size infused by Gaussian noises generated with standard deviation 5%, 10%, 20%, and 40% respectively.

Firm Size	Total assets				Sales				Market value of equity			
Error Rate	5%	10%	20%	40%	5%	10%	20%	40%	5%	10%	20%	40%
Q	4.22%	10.04%	16.48%	19.70%	1.14%	5.72%	15.19%	18.84%	10.91%	11.12%	11.11%	17.91%
ROA	1.38%	4.56%	7.50%	8.94%	0.00%	0.00%	1.11%	5.26%	16.67%	22.42%	33.33%	22.22%
board size	7.94%	10.00%	10.00%	20.00%	12.53%	19.97%	20.00%	19.94%	3.76%	19.44%	20.00%	19.97%
board independence	0.15%	1.63%	12.29%	20.07%	0.00%	0.00%	5.85%	16.26%	0.00%	0.15%	9.27%	19.44%
board leadership	7.61%	14.29%	14.29%	8.09%	6.89%	22.07%	28.57%	25.26%	0.06%	14.20%	28.44%	23.47%
dividend	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
book leverage	0.00%	1.10%	12.15%	15.70%	0.44%	3.14%	6.95%	9.56%	12.16%	16.76%	20.29%	22.38%
market leverage	0.06%	0.00%	0.50%	4.35%	0.00%	0.10%	12.48%	12.65%	0.00%	0.00%	0.00%	0.01%
cash holding	5.31%	6.34%	6.37%	5.67%	7.07%	15.81%	12.31%	19.59%	1.48%	4.37%	5.99%	5.23%
Vega	7.39%	24.76%	44.15%	47.53%	0.83%	3.68%	20.05%	24.35%	0.00%	0.11%	13.61%	31.03%
Delta	0.00%	0.98%	10.62%	14.71%	0.00%	2.86%	10.97%	14.12%	0.80%	0.18%	0.03%	4.30%
TDC1	3.69%	8.58%	23.35%	17.09%	2.09%	5.53%	17.43%	9.24%	23.18%	29.44%	22.97%	24.10%
RANDD	0.17%	8.37%	10.00%	10.00%	3.20%	14.10%	5.22%	3.21%	0.00%	0.01%	2.87%	9.77%
CAPEX	6.03%	9.50%	16.74%	24.71%	2.00%	11.15%	25.36%	34.79%	4.49%	16.10%	22.80%	31.93%
hindex	14.75%	31.74%	33.33%	33.35%	0.34%	17.04%	19.53%	14.08%	0.28%	8.34%	13.50%	17.44%
business segments	14.40%	23.82%	28.52%	33.64%	2.13%	2.78%	19.09%	9.56%	0.32%	9.13%	23.28%	28.63%
firm risk	11.89%	22.91%	32.19%	33.33%	11.01%	11.11%	11.11%	11.11%	22.47%	29.77%	33.66%	33.33%
bidder	15.26%	15.60%	19.75%	28.34%	5.43%	17.29%	30.28%	29.39%	12.48%	33.51%	52.40%	51.58%
target	7.09%	16.96%	28.36%	36.42%	1.64%	7.68%	17.15%	28.52%	12.70%	23.80%	44.32%	58.03%
poison pill	0.45%	5.43%	10.49%	20.71%	0.00%	0.00%	1.22%	11.84%	1.09%	6.51%	9.87%	19.13%

Table 15: Summary of Results

This table summarizes all the regression results to show the changes in sign, significance, R-squared, and standard error, based on the different choice of firm size measures.

Panel A: Sensitivity of Firm Size Coefficient Based on OLS

measures / field	Sign			Significance			R^2		
	Assets	Sales	Mkt Cap	Assets	Sales	Mkt Cap	Assets	Sales	Mkt Cap
Tobin's Q	+	+	+	<1%	<1%	<1%	0.22	0.22	0.35
ROA	+	+	+	<1%	<1%	<1%	0.17	0.17	0.23
Board Size	+	+	+	<1%	<1%	<1%	0.40	0.40	0.39
Board Independence	+	+	+	<1%	<1%	<1%	0.24	0.24	0.23
Board Leadership	+	+	+	<1%	<1%	<1%	0.11	0.10	0.09
Dividend Payout	+	+	+	<1%	<1%	<1%	0.30	0.30	0.28
Book Leverage	+	+	-	<1%	<1%	<5%	0.24	0.23	0.23
Market Leverage	+	+	-	<1%	<1%	<1%	0.39	0.38	0.40
Cash Holdings	+	-	-	>10%	<1%	>10%	0.46	0.48	0.46
Vega	+	+	+	<1%	<1%	<1%	0.41	0.40	0.41
Delta	+	+	+	<1%	<1%	<1%	0.33	0.33	0.33
Executive Pay Level	+	+	+	<1%	<1%	<1%	0.40	0.38	0.40
R & D	-	-	-	<1%	<1%	<1%	0.33	0.27	0.33
Capital Expenditure	+	+	+	<1%	<1%	<1%	0.09	0.08	0.09
Herfindahl Index	-	-	-	<1%	<1%	<1%	0.12	0.14	0.12
Business Segments	+	+	+	<1%	<1%	<1%	0.18	0.20	0.18
Firm Risk	-	-	-	<1%	<1%	<1%	0.48	0.50	0.50
Bidder	+	+	+	<1%	<1%	<1%	0.10	0.09	0.10
Target	+	+	+	<1%	<1%	<1%	0.08	0.06	0.08
Poison Pill	-	-	-	<1%	<1%	<1%	0.05	0.06	0.06

Panel B: Sensitivity of Firm Size Coefficient Based on Industry Fixed Effect

measures / field	Sign			Significance			R^2		
	Assets	Sales	MktCap	Assets	Sales	MktCap	Assets	Sales	Mkt Cap
Tobin's Q	+	+	+	<1%	<1%	<1%	0.28	0.28	0.41
ROA	+	+	+	>10%	<1%	<1%	0.25	0.26	0.32
Board Size	+	+	+	<1%	<1%	<1%	0.45	0.46	0.45
Board Independence	+	+	+	<1%	<1%	<1%	0.32	0.32	0.31
Board Leadership	+	+	+	<1%	<1%	<1%	0.16	0.16	0.15
Dividend Payout	+	+	+	<1%	<1%	<1%	0.44	0.45	0.42
Book Leverage	+	+	-	<1%	<1%	<1%	0.32	0.27	0.31
Market Leverage	+	+	-	<1%	<1%	<1%	0.45	0.42	0.46
Cash Holdings	+	-	+	<1%	<1%	<1%	0.57	0.58	0.57
Vega	+	+	+	<1%	<1%	<1%	0.43	0.42	0.43
Delta	+	+	+	<1%	<1%	<1%	0.34	0.34	0.34
Executive Pay Level	+	+	+	<1%	<1%	<1%	0.42	0.41	0.42
R & D	-	-	-	<1%	<1%	<1%	0.46	0.37	0.46
Capital Expenditure	+	+	+	<1%	<1%	>10%	0.38	0.29	0.38
Herfindahl Index	-	-	-	<1%	<1%	<1%	0.31	0.29	0.30
Business Segments	+	+	+	<1%	<1%	<1%	0.35	0.33	0.34
Firm Risk	-	-	-	<1%	<1%	<1%	0.59	0.60	0.61
Bidder	+	+	+	<1%	<1%	<1%	0.16	0.16	0.18
Target	+	+	+	<1%	<1%	<1%	0.18	0.13	0.18
Poison Pill	-	-	-	<1%	<1%	<1%	0.19	0.16	0.19

Panel C: Sensitivity of Regressor (Other than Firm Size) Coefficient

methods	OLS Regressions				Industry Fixed Effect Regressions			
sensitivity / field	Sign Sensitivity		Significance sensitivity		Sign Sensitivity		Significance sensitivity	
	Sign changes	# of var.	Sig. Changes	# of var.	Sign changes	# of var.	Sig. Changes	# of var.
Tobin's Q	Yes	1	Yes	2	Yes	1	Yes	1
ROA	Yes	2	Yes	1	Yes	2	Yes	1
Board Size	Yes	1	Yes	1	Yes	1	Yes	3
Board Independence	Yes	1	Yes	1	Yes	1	Yes	2
Board Leadership	No	0	Yes	1	Yes	1	Yes	2
Dividend Payout	No	0	No	0	No	0	No	0
Book Leverage	Yes	1	Yes	1	Yes	1	No	0
Market Leverage	Yes	1	Yes	1	Yes	1	Yes	1
Cash Holdings	No	0	Yes	2	No	0	Yes	4
Vega	Yes	2	Yes	1	Yes	1	Yes	2
Delta	No	0	No	0	No	0	No	0
Executive Pay Level	No	0	Yes	3	Yes	0	Yes	3
R & D	Yes	1	Yes	2	Yes	1	Yes	4
Capital Expenditure	Yes	1	Yes	4	Yes	1	Yes	4
Herfindahl Index	Yes	3	Yes	5	Yes	2	Yes	3
Business Segments	Yes	4	Yes	2	Yes	3	Yes	3
Firm Risk	Yes	2	Yes	3	Yes	2	Yes	4
Bidder	Yes	2	Yes	4	Yes	2	Yes	3
Target	Yes	2	Yes	5	Yes	2	Yes	5
Poison Pill	Yes	2	Yes	2	Yes	1	Yes	2

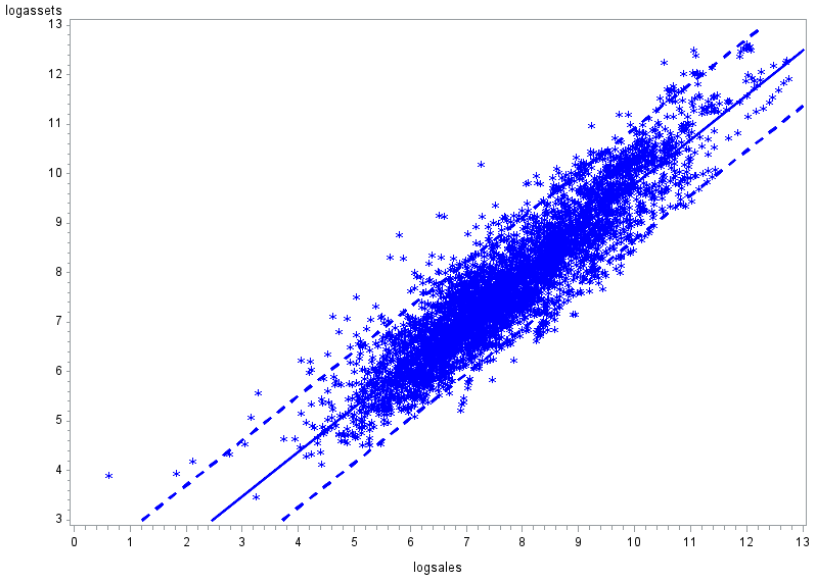
Panel D: Sensitivity of Firm Size Coefficient

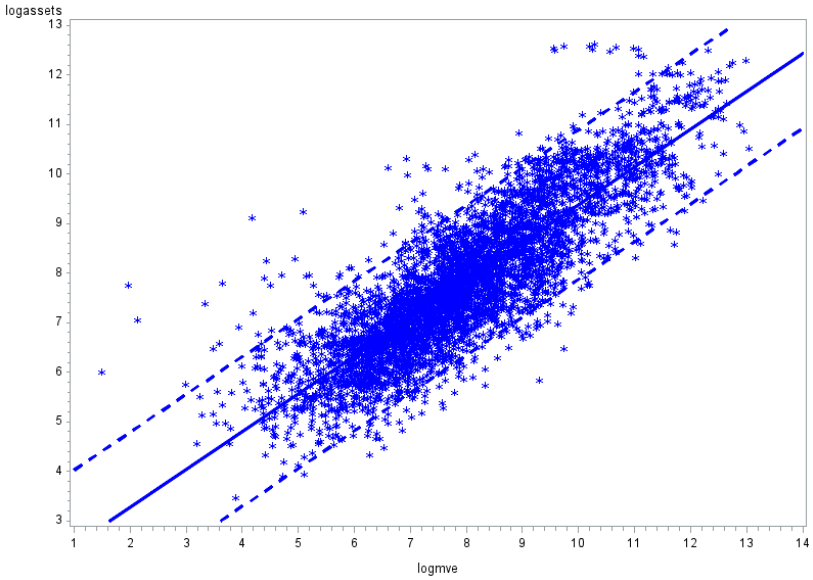
This table presents the sensitivity of firm size coefficient, particularly for sign changes, significance changes, and the maximum percentage changes of standard errors when different firm size measures are employed in the same regression.

Methods	Firm Size Coefficients in OLS Regressions			Firm Size Coefficients in Industry Fixed Effects Regressions		
Changes / Field	Sign Changes	Significance Changes	Std. error changes (%)	Sign Changes	Significance Changes	Std. error changes (%)
Tobin's Q	No	No	23.71	No	No	27.89
ROA	No	No	16.70	No	Yes	20.46
Board Size	No	No	0.44	No	No	4.31
Board Independence	No	No	1.50	No	No	4.55
Board Leadership	No	No	2.25	No	No	4.65
Dividend Payout	No	No	16.67	No	No	18.33
Book Leverage	Yes	No	33.84	Yes	No	33.53
Market Leverage	Yes	No	39.71	Yes	No	39.43
Cash Holdings	Yes	Yes	9.00	Yes	No	4.05
Vega	No	No	3.20	No	No	6.33
Delta	No	No	1.75	No	No	4.30
Executive Pay Level	No	No	3.01	No	No	5.42
R & D	No	No	30.94	No	No	26.53
Capital Expenditure	No	No	59.82	No	Yes	44.80
Herfindahl Index	No	No	67.67	No	No	62.64
Business Segments	No	No	67.60	No	No	61.97
Firm Risk	No	No	60.11	No	No	61.67
Bidder	No	No	60.57	No	No	53.03
Target	No	No	35.02	No	No	33.30
Poison Pill	No	No	44.71	No	No	39.87

Figure 1: Bivariate Scattergrams of Alternative Firm Size Measures for Firm Performance

This figure depicts bivariate scattergrams of alternative firm size measures for firm performance data. The solid line represents the regression line; the dotted line represents 95% confidence limits for individual predicted values.





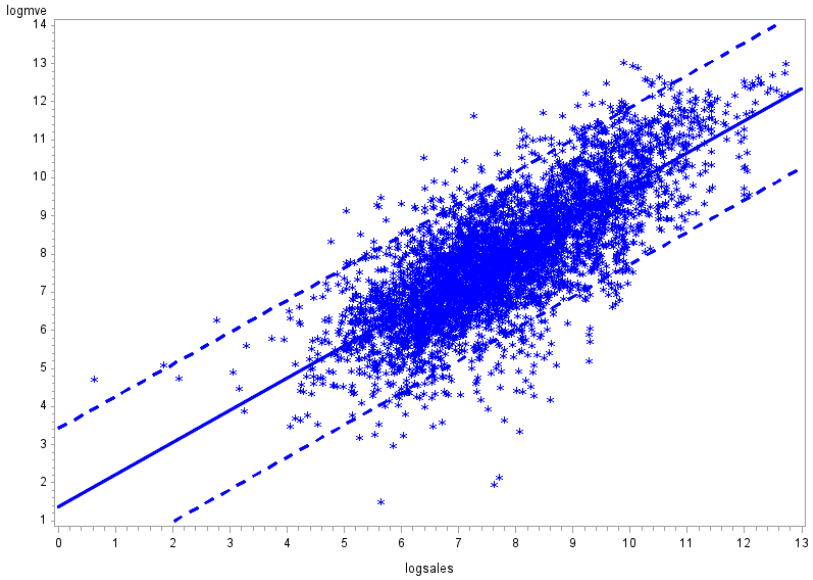

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Figure 2: Time Series of Alternative Firm Size Measures

Figure 2 provides the time series of the average firm size measures for all the firms in the data sample for firm performance. Figure 2A shows trends in logarithm form, and Figure 2B shows trends in original form (in 2006 dollars).

Figure 2A: The Trends of Firm Size Measures (in Logarithm Terms)

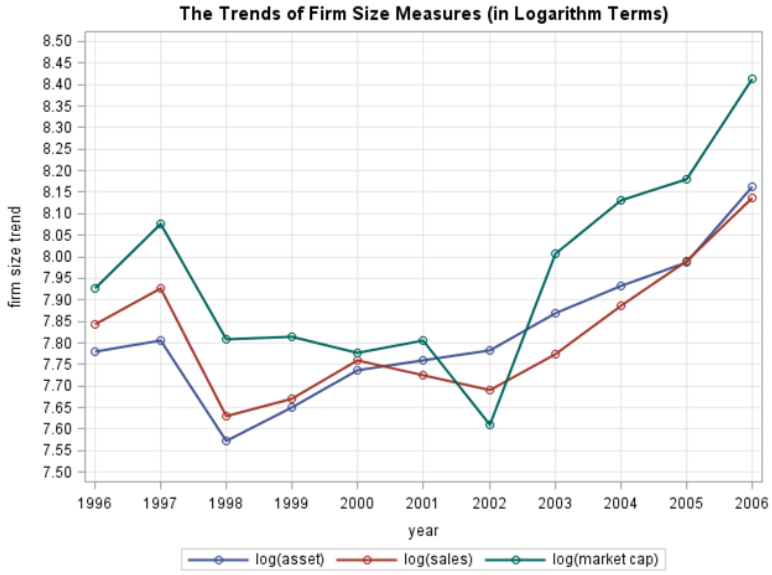

Figure 2B: The Trends of Firm Size Measures (in Original Terms)

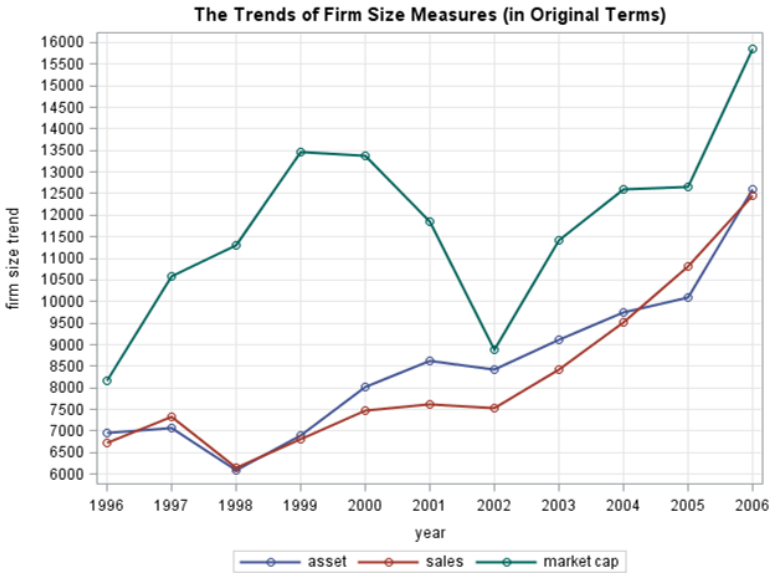

Figure 3: Maximum Change of R Squared for Alternative Firm Size Measures

Figure 3 depicts the maximum change of goodness of fit when we employ different measures of firm size in the regressions for 20 sub-fields in corporate finance.