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The Misuse of Tobin's q

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The Misuse of Tobin's *q*

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In recent years, scholars have addressed the most important topics in corporate law based on a flawed assumption: that the ratio of the market value of a corporation's securities to their book value is a valid measure of the value of the corporation. The topics have included staggered boards, incorporation in Delaware, shareholder activism, dual-class share structures, share ownership, board diversity, and other significant aspects of corporate governance.

We trace the history of this flawed assumption, and document how it emerged from Tobin's q*, a concept from an unrelated area in macroeconomics. We show that scholars have misused Tobin's* q*, and we demonstrate empirically why scholarly assumptions about this ratio are flawed, particularly because*

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book value is error prone, which generates problems involving aggregated assets, omitted variables, and statistical bias.

Our message for corporate law scholars is straightforward: view with suspicion the large body of empirical law and finance scholarship that misuses Tobin's q. *We also offer a cautionary tale for researchers more broadly: the current replication crisis in the social sciences is potentially even more serious than has been imagined, and there are critical questions about not only replicability, but also about validity.*

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You keep using that word. I do not think it means what you think it means.

—Inigo Montoya, The Princess Bride[1]

INTRODUCTION

For several decades, scholars have assessed many of the key concepts in corporate law by studying empirically how they impact the value of corporations. For example, one central question in corporate law is whether widespread incorporation in Delaware is normatively desirable. Scholars have attempted to answer this question by studying the association between a firm's state of incorporation and the value of the firm's corporate securities, and their answers have significantly influenced policy.[2]

Or consider the heated debate about the use of staggered boards of directors at corporations. Both shareholder-friendly and management-friendly groups have relied on empirical studies in their advocacy either against or on behalf of companies with staggered boards.[3] These studies examine the association between the presence of a staggered board and the value of corporate securities. The articles published in this area have also been widely cited and influential.

The same basic story holds for many of the most important areas of corporate law. How should we compare different countries' corporate law regimes?[4] How should we assess corporate governance indices,

1. THE PRINCESS BRIDE (Act III Communications 1987).

2. *See* Robert Daines, *Does Delaware Law Improve Firm Value?*, 62 J. FIN. ECON. 525 (2001) (finding that Delaware firms are worth more than firms incorporated elsewhere); Guhan Subramanian, *The Disappearing Delaware Effect*, 20 J.L. ECON. & ORG. 32 (2004) (finding that firms incorporated in Delaware are worth two to three percent more than non-Delaware firms during the period 1991–1996, but not after 1996); *see also* Robert Anderson IV & Jeffrey Manns, *The Delaware Delusion*, 93 N.C. L. REV. 1049 (2015) (describing prior studies and employing a merger reincorporation event study approach).

3. *See* Yakov Amihud, Markus Schmid & Steven Davidoff Solomon, *Settling the Staggered Board Debate*, 166 U. PA. L. REV. 1475 (2018) (finding that a staggered board has no significant effect on firm value); Lucian Bebchuk & Alma Cohen, *The Costs of Entrenched Boards*, 78 J. FIN. ECON. 409 (2005) (finding that staggered boards are negatively associated with firm value); Alma Cohen & Charles C.Y. Wang, *How Do Staggered Boards Affect Shareholder Value? Evidence from a Natural Experiment*, 110 J. FIN. ECON. 627 (2013) (same); K.J. Martijn Cremers, Lubomir P. Litov & Simone M. Sepe, *Staggered Boards and Long-Term Firm Value, Revisited*, 126 J. FIN. ECON. 422 (2017) (finding that the relationship between staggered boards and firm value is heterogeneous); Emiliano M. Catan & Michael Klausner, *Board Declassification and Firm Value: Have Shareholders and Boards Really Destroyed Billions in Value?* (NYU Law & Econ. Research Paper Series, Working Paper No. 17-39, 2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2994559 [https://perma.cc/5HCD-LFTP] (same).

4. *See, e.g.*, Larry Fauver, Mingyi Hung, Xi Li & Alvaro Taboada, *Board Reforms and Firm Value: Worldwide Evidence*, 125 J. FIN. ECON. 120 (2017) (measuring the valuation of firms to test the effect of different countries' legal regimes); Rafael La Porta, Florencio Lopez-de-Salinas, Andrei

which attempt to measure the quality of corporate governance at firms, including various provisions in their charters and bylaws such as takeover defenses?[5] How should we assess the concentration of ownership among board members or shareholders?[6] Scholars have attempted to answer all of these and many other important questions in corporate law using empirical studies that assess the relationship between changes in these factors and the value of a corporation's securities.[7] This kind of empirical research in corporate law has influenced scholars and policymakers in fundamental ways.

These studies, including the most influential ones, use the econometric technique of linear regression. The basic idea is to test whether the data show a statistically significant relationship between some concept in corporate law (the independent variable) and the value of a firm's securities (the dependent variable). Of course, linear regression is a powerful statistical technique when properly used.

Unfortunately, many of these studies do not properly use the technique. Instead of simply testing the association between a corporate law concept and the value of a firm's securities, they perform a potentially dangerous mathematical operation in the context of linear regression: *division*. Specifically, they divide the key dependent variable of interest—typically the market value of a corporation's securities—by the accounting construct known as the "book value" of a firm's assets. Book value is a record of a company's assets and liabilities based on accounting rules that vary in whether an asset or liability gets recorded at historical cost, fair market value, or some other standard. For some of the most important assets owned by a firm, accountants record no book value at all. As we demonstrate below, dividing by book value of assets can be fraught with peril.

Shleifer & Robert Vishny, *Investor Protection and Corporate Valuation*, 57 J. FIN. 1147 (2002) (same).

5. *See, e.g.*, Lucian A. Bebchuk, Alma Cohen & Allen Ferrell, *What Matters in Corporate Governance?*, 22 REV. FIN. STUD. 783 (2009) (finding that increases in a six-factor entrenchment index are negatively associated with firm value); Paul A. Gompers, Joy L. Ishii & Andrew Metrick, *Corporate Governance and Equity Prices*, 118 Q.J. ECON. 107 (2003) (finding that an improvement in a corporate-governance index is associated with an increase in firm value).

6. *See, e.g.*, John J. McConnell & Henri Servaes, *Additional Evidence on Equity Ownership and Corporate Value*, 27 J. FIN. ECON. 595 (1990) (finding that firm value is positively related to the fraction of shares owned by institutional investors and curvilinearly related to insider ownership at various levels); Randall Morck, Andrei Shleifer & Robert W. Vishny, *Management Ownership and Market Valuation: An Empirical Analysis*, 20 J. FIN. ECON. 293, 294 (1988) (describing Tobin's *q* as a "proxy for market valuation of the firm's assets" and finding that *q* varies based on board equity ownership).

7. *See, e.g.*, Larry H.P. Lang & Rene M. Stulz, *Tobin's* q*, Corporate Diversification, and Firm Performance*, 102 J. POL. ECON. 1248 (1994) (finding that firm value and diversification are negatively related throughout the 1980s).

Scholars have failed to account for this fundamental error, in part because the dependent variable commonly used in the literature has been given a sophisticated-sounding name: "Tobin's *q*."[8] This variable, which has morphed over the years from a nuanced classical macroeconomic concept into the simple ratio of the market value of a firm's securities divided by the firm's book value of assets, has become pervasive in corporate law scholarship, even though it is a very poor measure of the value of corporations, the thing that scholars are purporting to study.

The story of how Tobin's *q* came to be one of the most important concepts in corporate law scholarship is untold in the literature. Yet this variable now plays a key role in assessing how various important regulatory and corporate governance provisions impact economic welfare. More than three hundred law review articles, including many of the most widely cited in corporate law, have referenced Tobin's *q* as a key measure of the value of corporations,[9] as have hundreds of articles in the most highly regarded peer-reviewed finance and economics journals.[10] The trend in citations to Tobin's *q* is markedly upward.[11] Recently, articles in leading law reviews have referenced Tobin's *q* in analyzing such important topics as how firm value has been affected by

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8. *See* James Tobin, *A General Equilibrium Approach to Monetary Theory*, 1 J. MONEY CREDIT & BANKING 15, 15, 29 (1969) (laying out "a general framework for monetary analysis" in which the variable *q* represents the "valuations of physical assets relative to their replacement costs").

9. *See* Lucian A. Bebchuk, *The Case for Increasing Shareholder Power*, 118 HARV. L. REV. 833, 900 n.150 (2005) (describing Tobin's *q* as "a standard measure used by financial economists, as a proxy for firm value"). A search for "Tobin! /2 *q*" in the Westlaw "Law Reviews & Journals" database on January 30, 2020, generated 384 results. A search for "Tobin's *q*" at the same time in the Law "elibrary" of the Social Science Research Network found 4,751 papers. As we discuss, legal scholars primarily utilize *q* as a proxy for firm value and firm performance. *See, e.g.*, Michael Klausner, *Empirical Studies of Corporate Law and Governance: Some Steps Forward and Some Steps Not*, *in* THE OXFORD HANDBOOK OF CORPORATE LAW AND GOVERNANCE 184, 198 n.59 (Jeffrey N. Gordon & Wolf-Georg Ringe eds., 2018) ("Tobin's Q is a measure of firm value."). All of the studies cited *supra* notes 2–7 expressly used Tobin's *q* as a proxy for firm value.

10. In preparing this article, we conducted a search of articles referencing Tobin's *q* in recent issues of the three most cited finance journals: volumes 25–72 of the *Journal of Finance*, volumes 83–124 of the *Journal of Financial Economics*, and volumes 20–30 of the *Review of Financial Studies*. We found that 445 articles in these volumes referenced Tobin's *q*, with 95 articles referencing Tobin's *q* as a proxy for firm value.

11. According to the Westlaw "Law Reviews & Journals" database, the average and median annual citation rate to Tobin's *q* in law reviews has been nearly ten times higher during the 2010s than it was during the 1990s, and this rate has been increasing throughout the period 1990 through 2018.

hedge fund activism,[12] fiduciary duties,[13] staggered boards,[14] and corporate governance.[15]

As originally conceived, Tobin's *q*, named for the economist James Tobin, was an important variable in macroeconomic theory; it was defined as the market value of a firm's assets divided by their replacement value.[16] However, in corporate law and related areas of scholarship, researchers have used a very different, more simplistic version of *q*, which we label "Simple *q*." Simple *q* is essentially a version of the "market-to-book" ratio: the market value of a firm's capital divided by its book value.[17] Simple *q* is a ratio and its denominator plays an important role in the story of the misuse of Tobin's *q* in modern corporate law scholarship.

Our goal here is to lay out for a law review audience the historical development of the misuse of Tobin's *q* in modern corporate law scholarship and demonstrate the basic reasons why using Simple *q* as a proxy for firm value is problematic. Our central point in this article is that the scholarly use of Simple *q* is deeply flawed.[18] As a general

12. *See* Leo E. Strine, Jr., *Who Bleeds When the Wolves Bite?: A Flesh-and-Blood Perspective on Hedge Fund Activism and Our Strange Corporate Governance System*, 126 YALE L.J. 1870 (2017) (discussing results of hedge fund activism studies based on Tobin's *q*); K.J. Martijn Cremers, Erasmo Giambona, Simone M. Sepe & Ye Wang, Hedge Fund Activism, Firm Valuation, and Stock Returns (Dec. 19, 2018) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2693231 [https://perma.cc/59QB-3XLL] (using Tobin's *q* to examine effect on firm value from hedge fund activism).

13. *See* Sean J. Griffith & Natalia Reisel, *Dead Hand Proxy Puts and Shareholder Value*, 84 U. CHI. L. REV. 1027, 1035 n.41 (2017) (referencing studies based on Tobin's *q* in the second paragraph of the main body of the article).

14. *See* Amihud et al., *supra* note 3 (using *q* to find that a staggered board has no significant effect on firm value); Cremers et al., *supra* note 3 (using *q* to find that the relationship between staggered boards and firm value is heterogeneous); Catan & Klausner, *supra* note 3 (also using *q* to find that staggered boards have minimal effect on firm value).

15. *See* Zohar Goshen & Richard Squire, *Principal Costs: A New Theory for Corporate Law and Governance*, 117 COLUM. L. REV. 767 (2017) (discussing corporate governance studies based on Tobin's *q*).

16. *See* Tobin, *supra* note 8 (setting forth the analytical approach that serves as the point of origination for Tobin's *q*); *see also* William C. Brainard & James Tobin, *Pitfalls in Financial Model-Building* 9 (Cowles Found., Discussion Paper No. 244, 1968), https://cowles.yale.edu/sites/default/files/files/pub/d02/d0244.pdf [https://perma.cc/85LR-XMBJ] ("One of the basic theoretical propositions motivating the model is that the market valuation of equities, relative to the replacement cost of the physical assets they represent, is the major determinant of new investment.").

17. More specifically, scholars have used a simplified version of *q* in which the only market value estimate is that of a firm's equity securities; the market value of other securities (e.g., debt and preferred stock) as well as the replacement value of assets are derived from book values. As we demonstrate below, this simplified version of *q* is seriously flawed, and does not provide an accurate estimate of firm value. Nevertheless, Simple *q* has become standard in the literature. We discuss the evolution of Simple *q* from Tobin's *q* in Part I. *See infra* Part I.

18. In terms of the scholarly use of Simple *q*, our critique is focused on the empirical corporate finance literature. In addition, there also is a theoretical literature addressing Simple *q* in a general equilibrium economic framework: scholars applying this framework have concluded that

matter, Tobin's *q*, in any specification, is not a good measure of the value of corporations, either in theory or in practice. James Tobin did not envision that scholars would use this measure to assess firm value, and it is not fit for that purpose, particularly in its currently used simplified form. When researchers began adopting a market-to-book estimate of *q* as the dependent variable in empirical studies of firms, some scholars warned about its inaccuracy, bias, and variability.[19] Notwithstanding these warnings, academics continued to use market-to-book estimates, often without questioning their accuracy or meaning.

We begin in Part I by tracing the history of Tobin's *q* within the corporate law and finance literature. Our historical account reveals how the use of Tobin's *q* in this literature arose from untested assertions in a handful of papers during the early 1980s, when a few scholars argued that the value of a corporation's assets might exceed their replacement value due to superior management, despite other possible explanations (e.g., monopoly power, temporary first mover advantages, intellectual property rights, etc.). Our historical critique explores how these early papers laid the foundation for the assumption that Tobin's *q* necessarily reflects firm value. Part I also explores how Tobin's *q* morphed into Simple *q*, despite clear warnings about the shortcomings of using a market-to-book proxy as an estimate for Tobin's *q*.

In Part II we explore some specific flaws in the assumption that Tobin's *q* is an appropriate measure of the value of corporations. First, we assess various interpretations of Tobin's *q* as a measure of firm value and explain several flaws associated with these interpretations. These flaws follow naturally from our historical critique.

Second, we examine some econometric problems associated with the use of Simple *q*, detailing how the use of Simple *q* as a dependent variable can produce biased coefficient estimates in linear regressions. Substituting book value for replacement costs in the denominator can generate statistical bias, both from the aggregation of assets and the omission of assets (particularly intangible assets, such as intellectual property). Simply put, firms with relatively high intangible assets

Simple *q* is a mean-reverting function associated with both the value premium and the volatility of stock returns. *See, e.g.*, Giovanni Walter Puopolo, *The Dynamics of Tobin's* q (Centre for Studies in Econ. & Fin., Working Paper No. 286, 2016), https://pdfs.semanticscholar.org/9e62/6dc7ced4b4d638d7ec1b35fe6a7f7921da24.pdf [https://perma.cc/9TAK-VY5T] (concluding that Simple *q* is mean reverting); *see also* Patrick Bolton, Hui Chen & Neng Wang, *A Unified Theory of Tobin's* q*, Corporate Investment, Financing, and Risk Management*, 66 J. FIN. 1545 (2011) (proposing a model of how external financing costs influence firm investment).

19. *See infra* text accompanying notes 109–114 (discussing Perfect & Wiles' analysis of several different proxies for Tobin's *q*, including Simple *q*).

generally will have higher measures of Simple *q*.[20] Moreover, because this measurement error affects the denominator of Simple *q*, conventional approaches to control for bias from aggregation and omission (e.g., by adding a covariate that proxies for intangible assets) will be ineffective. As we show, even when scholars acknowledge that Simple *q* may contain measurement error, they have not recognized this denominator-related statistical challenge, leading them to rely on empirical solutions that do not address the risk of bias.

Third, we discuss a fact that might surprise many researchers: Simple *q* is inversely associated with the following year's annual returns. This inverse association raises serious questions for studies that interpret an increase in Simple *q* as an increase in firm value, especially firm value over time.[21] We argue that scholars should explicitly consider the inverse relationship between Simple *q* and subsequent returns, and the connection between this puzzle and other related literatures, including financial asset pricing. Most notably, the reciprocal of Simple *q*—the ratio of book value to market value—is similar to a fundamental risk factor in the Fama-French asset pricing model and its progeny, which we discuss in detail below; this similarity and the relationship between Simple *q* and returns are not mentioned in the literature relying on Simple *q* as a proxy for firm value.[22]

In Part III, we show that our critique of Simple *q* matters. We do so by examining the results of an especially influential corporate governance study by Harvard Law School professors Lucian Bebchuk,

20. The reason is straightforward arithmetic: if the denominator is lower because it omits intangibles, the overall measure will involve division by a lower number, and therefore Simple *q* will be higher. Moreover, because firms' investments in intangibles vary, both by firm and over time, conventional statistical approaches are problematic. For example, as we show in Appendix A and discuss below, unbooked intangible assets are positively associated with Simple *q*, even holding constant industry- and firm-fixed effects. *See infra* app. A. Within the finance literature, Ryan Peters and Lucian Taylor have developed a modified version of Tobin's *q*, which they refer to as Total *q*, to attempt to address the measurement error bias that arises from the market valuing a firm's intangible assets even though intangible assets are not part of balance sheet assets and are highly serially correlated. *See* Ryan H. Peters & Lucian A. Taylor, *Intangible Capital and the Investment-*q *Relation*, 123 J. FIN. ECON. 251, 269 (2017) ("This bias is probably most severe in the standard regressions that omit intangible capital, as omitting intangible capital is an important source of measurement error, and a firm's intangible capital stock is highly serially correlated."). Total *q* includes in the denominator an estimate of a firm's intangible assets, making it potentially less problematic than Simple *q*. But Total *q* suffers from additional limitations as it is simply based on the firm's past expenditures on research and development and a thirty percent share of its prior selling, general, and administrative expenditures.

21. *See, e.g.*, Cremers et al., *supra* note 3, at 423 (finding that, among innovative firms, adoption of a staggered board is associated with an increase in firm value as proxied by *q* and concluding that "in more innovative firms . . . adopting (removing) a staggered board is associated with an increase (decrease) in long-term firm value").

22. *See, e.g.*, Eugene Fama & Kenneth French, *Common Risk Factors in the Returns on Stocks and Bonds*, 33 J. FIN. ECON. 3 (1993) (finding that book-market ratios are significantly associated with equity returns).

Alma Cohen, and Allen Ferrell.[23] Their paper relies heavily on Simple *q* and contributed to a wave of papers examining the relationship between Simple *q* and various corporate governance interventions. While we can replicate their findings using Simple *q*, our replication study demonstrates that these findings disappear when we use an alternative measure for Tobin's *q* that seeks to correct for the omission of intangible assets in Simple *q*. This alternative measure suffers from problems similar to Simple *q*'s, such as aggregating all of a firm's assets; it also imposes strict assumptions in estimating intangible assets. Accordingly, we do not endorse its use as a solution to the problems posed by Simple *q*. On the contrary, our replication study simply underscores the fragility of empirical findings relying on any *q* proxy given the simple fact that the denominator of true *q* is unobservable. Consequently, all *q* proxies measure it with error, and as we discuss, using such a mismeasured ratio as a dependent variable in linear regression makes the resulting estimates especially susceptible to bias.

Finally, we also show in Part III how the story of the use and misuse of Tobin's *q* in corporate governance research provides an important insight into the current "replication crisis" within the social sciences. Over the past several years, researchers across a range of disciplines have been unable to replicate a number of notable empirical findings due to both intentional data falsification as well as selective reporting of data and results.[24] Interventions meant to address this crisis have focused almost exclusively on methods that can enhance the likelihood that a study is replicable—a concern that, in the context of scientific reasoning, implicates a study's *reliability*. Yet these interventions are ill-equipped to address the empirical problems that arise when a measure fails to measure what it purports to measure, as is the case with Simple *q*. The latter concern implicates a study's *validity*, and, as we discuss, efforts to enhance a study's reliability can paradoxically serve to encourage reliance on an invalid measure. Our goal here is to expose Simple *q* as an invalid measure and, in the process, discourage scholars from relying on it as a proxy for firm value.[25]

23. *See* Bebchuk et al., *supra* note 5.

24. *See An Open, Large-Scale, Collaborative Effort to Estimate the Reproducibility of Psychological Science*, 7 PERSP. ON PSYCHOL. SCI. 657 (2012) [hereinafter *Effort to Estimate the Reproducibility of Psychological Science*] (describing a large-scale replication project within psychology); Caren M. Rotello, Evan Heit & Chad Dubé, W*hen More Data Steer Us Wrong: Replications with the Wrong Dependent Measure Perpetuate Erroneous Conclusions*, 22 PSYCHONOMIC BULL. & REV. 944 (2015) (discussing the problems of replication and misinterpretation plaguing psychological studies).

25. For scholars interested in examining how various regulatory and corporate governance provisions relate to firm value, we recommend alternative techniques that do not rely on any

In sum, we uncover the flawed assumption in many of the most important studies in corporate law: the assumption that the market-to-book ratio is an appropriate measure of the value of corporations. As we demonstrate, this ratio does not mean what many scholars seem to think it means. In our view, without more robust testing, the conclusions in corporate law that rely on market-to-book estimates for Tobin's q as a dependent variable are unsound and should not be the basis for academic inquiry or policy decisions. Instead, scholars and policymakers should approach studies based on Tobin's q with caution.

Our examination of modern corporate law scholarship connects to a broader phenomenon: the emergence of path-dependent yet haphazard ideas in intellectual history.[26] We hope to follow other scholarship that shows how some ideas gain traction in academia but later are exposed as inaccurate.[27] Our hope is that, in the future, scholars will look back on the flawed assumption in modern corporate law scholarship as an interesting historical anecdote, a surprising wrong turn, but one that has been superseded by more careful, scientifically justified analysis in empirical law and finance.

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version of Tobin's q, and instead evaluate securities returns and direct estimates of firm value. We find a promising example of the use of direct estimates of firm value in the accounting literature, where scholars have long eschewed using Tobin's q, and instead measure improvements in firm value directly by using a firm's market value of equity. *See, e.g.*, Mary E. Barth & Sanjay Kallapur, *The Effects of Cross-Sectional Scale Differences on Regression Results in Empirical Accounting Research*, 13 CONTEMP. ACCT. RES. 527 (1996) (investigating bias resulting from scale differences in regressions based on market values); Mary E. Barth & Greg Clinch, *Scale Effects in Capital Markets-Based Accounting Research*, 36 J. BUS. FIN. & ACCT. 253 (2009) (assessing simulations of the effects of firm size in regressions based on market values); James A. Ohlson & Seil Kim, *Linear Valuation Without OLS: The Theil-Sun Estimation Approach*, 20 REV. ACCT. STUD. 395 (2015) (discussing modifications of regressions based on market values to account for scale). In related work, we also explore how using the natural logarithm of Simple q solves many of the empirical challenges of using Simple q as an outcome variable in a linear regression framework. However, to avoid imposing an assumption that the elasticity of a firm's market value to its book value is exactly one, a researcher should also include the natural log of a firm's book value as a covariate in the regression specification. As we illustrate there, adopting this approach is equivalent to using the natural log of the numerator of Simple q—a direct estimate of firm value—to estimate the effect of a regressor of interest on firm value. *See* Robert Bartlett & Frank Partnoy, The Ratio Problem (Jan. 2020) (unpublished manuscript) (on file with authors).

26. The concept of supposed truths that are false and therefore should be rejected has existed for centuries, and arguably emerged into widespread parlance from the King James Bible, which included the admonition from the Apostle Paul to his young protégé, Timothy: "But refuse profane and old wives' fables, and exercise thyself rather unto godliness." 1 *Timothy* 4:7 (King James).

27. *See, e.g.*, Lawrence A. Hamermesh & Michael L. Wachter, *The Short and Puzzling Life of the "Implicit Minority Discount" in Delaware Appraisal Law*, 156 U. PA. L. REV. 1, 16–24 (2007) (describing the emergence and reliance on the implicit minority discount ("IMD") by courts conducting a corporate valuation using a comparable company analysis, despite lacking any support for the IMD within the academic finance literature).

I. A HISTORY OF TOBIN'S *Q*

This Part sets forth a history of Tobin's *q*, beginning with its original use and then turning to more recent simplified specifications, including Simple *q*. Although Simple *q* is widely used in corporate law scholarship, its evolution from the original use of Tobin's *q* in macroeconomics has not previously been described in the literature. The history of how Tobin's *q* came to be seen as a proxy for firm value and how it subsequently transformed into Simple *q* illustrates many of the drawbacks of using Simple *q* in corporate law scholarship.

A. The Classical Macroeconomic View: 1968–1976

Although the variable Tobin's *q* is typically attributed to the economist James Tobin, the theoretical construct underlying it originated from joint work between Tobin and William C. Brainard,[28] a colleague of Tobin's at Yale. In 1968, Brainard and Tobin introduced a theoretical model of an economy in which one central proposition was that "the market valuation of equities, relative to the replacement cost of the physical assets they represent, is the major determinant of investment."[29] They noted that investment in physical assets is stimulated when physical capital is more highly valued in the market than it costs to produce, and investment is discouraged when physical capital is valued in the market below its replacement cost.[30] Brainard and Tobin were focused on explaining fluctuations in investment, so they intuitively compared the market yield on equity with the real returns to physical investment. In their 1968 paper, however, they did not specify a variable with a letter to describe this concept. The concept was not yet named "*q*."

The setting in which Brainard and Tobin introduced the conceptual underpinnings of *q* obviously was quite different than the setting in which the concept is used in empirical law and finance scholarship. The authors were comparing market prices with the

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28. Although Tobin ultimately came to receive naming credit for *q*, Brainard also left a considerable, though *q*-less, legacy, including the William C. Brainard Professorship of Economics at Yale, where he served as provost from 1981 to 1986 and was chair of the economics department. *See Yale Officer: Provosts*, YALE U. LIBR., https://guides.library.yale.edu/c.php?g=296064&p=1973564 (last updated Jan. 3, 2020) [https://perma.cc/5CT8-93Z6] (listing Brainard's tenure as Yale provost). Among Brainard's Ph.D. students is David F. Swensen, the long-time Yale chief investment officer. *Chair Pays Tribute to Economist William Brainard's Leadership*, GIVING TO YALE (Dec. 19, 2008), https://giving.yale.edu/news/chair-pays-tribute-economist-william-brainards-leadership [https://perma.cc/QHZ8-386M].

29. Brainard & Tobin, *supra* note 16, at 9.

30. *Id.*

replacement cost of physical assets in order to describe fluctuations in investment that were relevant for the purposes of macroeconomic modeling. Indeed, their paper was specifically directed toward monetary economists, and the relevance of the relationship between market prices and the replacement cost of physical assets was to explain how monetary policy might affect investment in the real economy. In their words, this relationship was "the sole linkage in the model through which financial events, including monetary policies, affect the real economy."[31]

A year later, in 1969, Tobin published *A General Equilibrium Approach to Monetary Theory*. In developing the macroeconomic model in that paper, Tobin reiterated the concept of market value versus replacement costs and stated that he would "allow the value of existing capital goods, or of titles to them, to diverge from their current reproduction cost."[32] Tobin then used the letter q to describe the ratio of the market value of capital goods and their replacement costs.[33] Because Tobin allowed q to depart from a one-to-one ratio, he noted how this variation could be interpreted in then-current versions of the Investment Saving–Liquidity Preference Money Supply ("IS–LM") macroeconomic model.[34] In Tobin's formulation, if q equaled one, the standard IS–LM curves held.[35] But if q were greater than or less than one, there would be a short-run disequilibrium.[36] The long-run equilibrium would then require some form of adjustment, so that q would move in the direction of one.[37] Tobin illustrated the effects of changes in q on the IS–LM model in Figure 3 of his 1969 paper,[38] which is reproduced from the original below.

31. *Id.*

32. Tobin, *supra* note 8, at 19.

33. *Id.* at 21. We follow the literature in using the terms "physical capital" and "capital goods" interchangeably.

34. *See id.* (observing that "equation (I.5) can be interpreted as a species of the standard Keynesian *LM* curve").

35. *Id.* at 23.

36. *Id.* at 22–23.

37. *Id.* at 23.

38. *Id.* at 22 fig.3.

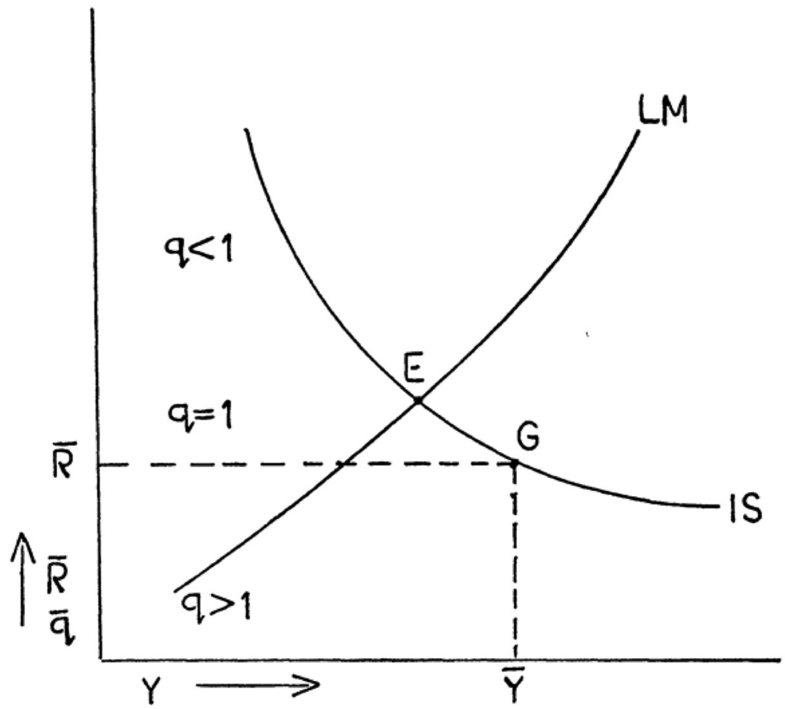

FIG. 3. *LM* Curve Plotted with *IS* Curve.

Tobin cautioned in his concluding remarks that "[t]he models discussed here were meant to be illustrative only, and to give meaning to some general observations about monetary analysis."[39] Tobin concluded that the key insight associated with the introduction of *q* related to monetary policy: the major way for monetary policy to affect aggregate demand was "by changing the valuation of physical assets relative to their replacement costs."[40] In other words, the context for the introduction of *q* was as a tool in the theory of monetary policy. Tobin's *q* was truly "Macro *q*": it had nothing to do with measuring the effects of a change in policy or a shock on relative prices; instead, it was a potential lever that might be used to change aggregate demand (the dependent variable in Tobin's model). In general terms, Tobin's *q* described how financial markets affected investment and economic activity. Put another way, Tobin's *q* began its life as a potential independent variable on the right side of financial equations, not as a dependent variable on the left.

39. *Id.* at 29.
40. *Id.*

According to Tobin, the deviation of *q* from one was an important short-term determinant of investment. Specifically, in Tobin's model, if *q* were above one, the value of physical assets would be relatively high. Firms would invest a greater amount, because they would benefit from buying assets at a lower cost than their market value. Accordingly, in Tobin's model, when *q* was greater than one, investment should increase. Conversely, when *q* was less than one, investment should decrease. In the long run, adjustments in capital investment should occur, so that a firm's actual physical capital or capital goods should approach the optimal level.[41]

Tobin's *q* remained an important concept in macroeconomic theory throughout the 1970s and it continues to play a role in that field today.[42] However, Tobin's *q* did not play any role in corporate law or corporate governance at its inception.

B. Early Interpretations from Empirical Finance: 1977–1984

Not surprisingly, the first empirical studies using Tobin's *q* focused on examining the sensitivity of investment outlays to changes in the incentive to invest.[43] Indeed, the stagflation of the 1970s made Tobin's theory particularly attractive to scholars seeking to understand how factors other than interest rates might affect corporate investment. Similar considerations motivated pioneering work on how tax policy might affect corporate investment through changes in Tobin's *q*.[44] In keeping with this macroeconomic focus, these early papers examined aggregate levels of Tobin's *q* across the entire economy, generally using federal flow of funds data to estimate Tobin's *q*.[45] Scholars did not focus on Tobin's *q* at the individual firm level.

41. Note that Tobin's model explicitly contemplated that in the short run the measure of *q* would fluctuate. Indeed, the explanatory power of Tobin's model derived in part from the fluctuations in *q*.

42. Tobin refined his macroeconomic model during the 1970s. *See* James Tobin, *Monetary Policies and the Economy: The Transmission Mechanism*, 37 S. ECON. J. 421 (1978).

43. *See e.g.*, George M. von Furstenberg, *Corporate Investment: Does Market Valuation Matter in the Aggregate?*, 1977 BROOKINGS PAPERS ON ECON. ACTIVITY 347 (empirically examining whether the *q* ratio predicts investment by nonfinancial corporations).

44. *See e.g.*, Lawrence H. Summers, *Taxation and Corporate Investment: A* q*-Theory Approach*, 1981 BROOKINGS PAPERS ON ECON. ACTIVITY 67 (examining corporate investment as a function of changes in tax-adjusted *q*).

45. *See e.g.*, Fumio Hayashi, *Tobin's Marginal* q *and Average* q*: A Neoclassical Interpretation*, 50 ECONOMETRICA 213, 214 (1982) ("[W]e calculate modified q from data on average q taking into account the actual U.S. tax system and estimate a simple linear investment function."); Summers, *supra* note 44, at 85 (noting that their "equations and diagram[s] can be interpreted as referring to the entire economy rather than an individual firm"); von Furstenberg, *supra* note 43, at 347 (describing an intention to explore the "influence on aggregate investment behavior" of "[b]alance-sheet variables and stock-market appraisals," which, at that time, remained "less clear").

During this same time, in a different area of research, scholars in empirical corporate finance, who traditionally had used accounting-based measures to assess firm profitability, began raising several objections to those measures.[46] In particular, scholars expressed concern that accounting rates of return measured only past profits and did not reflect expectations about the future.[47] Accounting measures did not reflect assessments of risk, either.[48] Moreover, they were sensitive to inflation, a major concern during the late 1970s, when inflation rates and nominal interest rates were very high.[49] At this time, financial economists first considered introducing Tobin's *q* onto new scholarly turf: to evaluate firm performance. Might Tobin's *q* be better than accounting-based measures?

A potential answer appeared in a 1981 article by Eric Lindenberg, a researcher at AT&T, and Stephen Ross, an economist at Yale (and a colleague of James Tobin).[50] Lindenberg and Ross titled their article *Tobin's* q *Ratio and Industrial Organization*, but they opened the article more modestly, by referencing the use of Tobin's *q* in macroeconomic models, not industrial organization.[51] They noted the important intuition arising from Tobin's macroeconomic model that if firms took all profitable opportunities when the value of their new capital investment exceeded its cost (in other words, when Tobin's *q* was greater than one), then the marginal value of Tobin's *q* should converge to one.[52] This reference, and the intuition backing it, had become standard in the macroeconomics literature.

But then Lindenberg and Ross said something extraordinary: "We will employ this argument peripherally below, but our focus is somewhat different. Our interest is in the cross-sectional value of *q* and

46. *See, e.g.*, Franklin M. Fisher & John J. McGowan, *On the Misuse of Accounting Rates of Return to Infer Monopoly Profits*, 73 AM. ECON. REV. 82, 84 (1983) (demonstrating that accounting rates of return are not a reliable proxy for the economic rate of return); Ezra Solomon, *Alternative Rate of Return Concepts and Their Implications for Utility Regulation*, 1 BELL J. ECON. & MGMT. SCI. 65, 80 (1970) (critiquing the prevalent mistake of assuming that book rate of return measures and discounted-cash flow ("DCF") rate of return measures are estimates of the same thing); Thomas R. Stauffer, *The Measurement of Corporate Rates of Return: A Generalized Formulation*, 2 BELL J. ECON. & MGMT. SCI. 434, 467 (1971) (demonstrating that "the accounting rate of return is generally a very poor proxy for the economic or DCF rate of return").

47. *See* Solomon, *supra* note 46, at 65 (showing that returns based on book value and returns based on discounted cash flow rarely generate similar results).

48. *See* Stauffer, *supra* note 46 (analyzing factors associated with bias in accounting returns).

49. *See* Fisher & McGowan, *supra* note 46, at 82 (noting that accounting practices do not incorporate allowances for inflation).

50. *See* Eric B. Lindenberg & Stephen A. Ross, *Tobin's* q *Ratio and Industrial Organization*, 54 J. BUS. 1 (1981).

51. *See id.* at 1–2.

52. *See id.* at 2.

its implications for industrial organization in general . . . ."[53] In other words, Lindenberg and Ross were transporting Tobin's macroeconomic *q* to a new context, where the variable might take on entirely different meanings and functions.

Instead of focusing on the effects on capital investment when *q* differed from one, as Tobin and his followers had, Lindenberg and Ross described the range of reasons why Tobin's *q* might differ from one. Their analysis of *why* the variable might differ from one included the prospect of Ricardian and monopoly rents, which presumably would lead to asset market values that were higher than their replacement values.[54] Thus, Lindenberg and Ross suggested that Tobin's *q* might be useful not only in examining levels of investment, but also in assessing firm profitability and monopoly power. The implicit conclusion that firms with a high value of Tobin's *q* were more profitable was asserted but not rigorously defended.

Most importantly, Lindenberg and Ross developed a procedure for calculating Tobin's *q*. They created a database of Tobin's *q* estimates for a large sample of firms and then used it to examine the dispersion of supercompetitive market power across different companies and industries.[55] The implication of their pathbreaking paper was that other scholars also could use Tobin's *q* to examine and assess differences among firms. In other words, they provided a template for how Tobin's *q* could be measured and evaluated for individual firms.

The new Lindenberg and Ross formulation of Tobin's *q* was catnip for empirical corporate finance researchers. During the early 1980s, researchers began advocating Tobin's *q* as a measure that was superior to the range of accounting-based measures that scholars had been using to assess firm profitability.[56] By adopting and then adapting Tobin's *q* from the theoretical macroeconomics literature, empirical researchers in corporate finance potentially had found a more accurate measure to use in assessing firm profitability.

Following Lindenberg and Ross, finance scholars began to embrace Tobin's *q*.[57] It offered several advantages compared to

53. *Id.* at 2.

54. *See id.* at 2–3 (proposing reasons why "the actual *q* value of even a competitive firm may differ from unity").

55. *See id.* at 10 tbl.1.

56. *See*, *e.g.*, Henry McFarland, *Evaluating* q *as an Alternative to the Rate of Return in Measuring Profitability*, 70 REV. ECON. & STAT. 614, 614 (1988) (citing the literature assessing firm profitability).

57. Mark Hirschey, *Market Structure and Market Value*, 58 J. BUS. 89 (1985) (reexamining the relationship between market structure and monopoly profits as proxied by Tobin's *q*); McFarland, *supra* note 56 (exploring whether accounting estimates of *q* are less erroneous than accounting rates of return); Michael A. Salinger, *Tobin's* q*, Unionization, and the Concentration-*

accounting measures. Because the numerator of Tobin's *q* included market value, it reflected expectations about the future. Market prices also reflected assessments of risk, because they were influenced by expectations about the variance of future profits. Replacement cost, the denominator of Tobin's *q*, was difficult to calculate, but Lindenberg and Ross had demonstrated it could be estimated based on contemporaneous data. Throughout the early and mid-1980s, several scholarly articles discussed the extent to which Tobin's *q* might be a viable substitute for purely accounting-based metrics. We turn next to this research.

C. The Divergence Between Macroeconomics and Empirical Finance: 1984–1992

During the 1980s, as Tobin's *q* gained traction among financial economists as a measure of firm performance, two notable trends emerged that highlighted a growing divide between the use of Tobin's *q* by macroeconomists and financial economists. The first difference was conceptual; the second was definitional.

First, consistent with the early macroeconomic literature testing Tobin's original theory, several macroeconomists explored the relationship between Tobin's *q* and corporate investment. Their papers largely reflected the original conception of Tobin's *q* (as articulated by Tobin).[58] However, an important theoretical modification was made in 1982 by Fumio Hayashi, who sought to connect formally the insights of Tobin with the neoclassical theory of investment.[59] This latter theory had generally focused on modeling a firm's investment in its physical capital as an optimization challenge in which a firm sought to maximize returns to scale while accounting for "installation costs."[60] Recognizing the theoretical importance of installation costs, Hayashi formally modified Tobin's theory to account for them: in this new "*q*-theory of investment," a firm decides the optimal rate of investment through

Profits Relationship, 15 RAND J. ECON. 159 (1984) (using Tobin's *q* to examine the link between market structure and monopoly profits); Michael Smirlock et al., *Tobin's* q *and the Structure-Performance Relationship*, 74 AM. ECON. REV. 1051 (1984) (using *q* to measure firm rents).

58. *See*, *e.g.*, Steven M. Fazzari, R. Glenn Hubbard & Bruce C. Peterson, *Financing Constraints and Corporate Investment*, 1988 BROOKINGS PAPERS ON ECON. ACTIVITY 141 (studying the impact of financing constraints on corporate investment by individual firms after controlling for *q*); Michael A. Salinger & Lawrence H. Summers, *Tax Reform and Corporate Investment: A Microeconomic Simulation Study, in* BEHAVIORAL SIMULATION METHODS IN TAX POLICY ANALYSIS 247 (Martin Feldstein ed., 1983) (developing a methodology for simulating the effects of alternative corporate tax reforms on corporate investment by individual firms).

59. *See* Hayashi, *supra* note 45.

60. *Id.* at 215.

knowledge of Tobin's *q* and the firm's installation costs.[61] Notably, given the focus on a firm's investment in physical capital and installation costs, Tobin's *q* within this literature represented the market value of the firm relative to the replacement costs of its *physical* capital.

In contrast, within finance circles the possibility that Tobin's *q* might reflect a firm's ability to extract economic rents was increasingly conflated with the possibility that Tobin's *q* reflected firm value. An article commonly cited as pioneering the use of Tobin's *q* in this regard is Randall Morck, Andrei Shleifer, and Robert Vishny's 1988 study of the relationship between management ownership and firm value.[62] In examining a cross section of 371 firms using data from 1980, they found that Tobin's *q* rose with management ownership in firms where management held a small percentage of equity, but declined in firms where management held a larger percentage.[63] Morck, Shleifer, and Vishny assumed that high Tobin's *q* firms were associated with higher expected future profits,[64] an assumption we examine in Part II.

It is worth noting that the version of Tobin's *q* used by Morck, Shleifer, and Vishny is markedly different from the Simple *q* market-to-book ratio used today. First, they used actual estimates of replacement costs, from the 1980 Griliches R&D Master file, rather than book value, to estimate the denominator of Tobin's *q*.[65] This financial dataset was created by the National Bureau of Economic Research for a sample of firms during the late 1970s and early 1980s and provided a variety of metrics one could use to estimate actual replacement values.[66] Second, they used actual estimates of the market values of preferred stock and long-term debt rather than book value to

61. The "*q*-theory of investment" remains provocative given the informational content it attributes to Tobin's *q*. As Hayashi noted, "All the information about the demand curve for the firm's output and the production function that are relevant to the investment decision is summarized by *q*." *Id.* at 218. Additionally, in the neoclassical theory of investment, note that firms make investment decisions on the margin—that is, an optimizing firm evaluates the benefits of investing in an additional unit of capital relative to the costs of acquiring and installing an additional unit of capital. As such, in applying Tobin's work to the neoclassical framework, the relevant metric was a firm's marginal *q* (the ratio of the market value of an additional unit of capital to its replacement cost) rather than its overall, or average, *q*. While marginal *q* is an unobservable construct, Hayashi's work established conditions under which marginal and average *q* were the same, thereby opening the door to rigorous statistical testing of the *q*-theory of investment. *Id.*

62. *See* Morck et al., *supra* note 6.

63. *See id.* at 311 (summarizing the study's results).

64. *Id.* at 312 n.12.

65. *Id.* at 296.

66. Bronwyn H. Hall et al., *The R&D Master File Documentation* (NBER Technical Working Paper Series, Paper No. 72, 1988), https://www.nber.org/papers/t0072.pdf [https://perma.cc/QEA9-LVRQ].

estimate their Tobin's *q* numerators.[67] Third, they extensively discussed the potential bias associated with their Tobin's *q* estimates.[68] (Scholars later largely abandoned all of these practices and instead simply used book values for all measures except stock prices, without discussion.[69])

However, Morck, Shleifer, and Vishny did not show the same degree of care in describing their rationale for using Tobin's *q* as a measure for firm value. In explaining the choice of Tobin's *q* as the outcome variable, the authors explained that "Tobin's *Q* is high when the firm has valuable intangible assets in addition to physical capital, such as monopoly power [Lindenberg and Ross (1981)], goodwill, a stock of patents, or good managers."[70] They noted that high Tobin's *q* might arise from any of these sources of "intangible assets," and then simply asserted that Tobin's *q* reflected management performance and, therefore, firm value. The boldness of this unsubstantiated claim, published in 1988, makes it worth quoting in its entirety: "Although *Q* is undoubtedly a very noisy signal of management performance, we believe it is well-suited to our purpose. Because we are interested in the predictable effects of a firm's ownership structure on its value, it seems natural to look at the cross-sectional relationship between ownership and value."[71]

In two sentences, Tobin's *q* was thus transformed into a proxy for management's effect on firm value. Despite the uncertainty as to why the measure might be "well-suited" to Morck, Shleifer, and Vishny's purpose or "natural" for examining the relationship between ownership and "value," this notion of Tobin's *q* as reflecting firm value took root.[72] By the early 1990s, prominent papers in finance were citing, though not analyzing or critiquing, Morck, Shleifer, and Vishny (1988) and Lindenberg and Ross (1981) as the justification for using Tobin's *q* as a proxy for firm value.[73]

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67. Morck et al., *supra* note 6, at 296.

68. *See id.* at 295–307 (providing extensive discussion of the above factors).

69. *See, e.g.*, Steven N. Kaplan & Luigi Zingales, *Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?,* 112 Q. J. ECON. 169, 177 (1997):

> We measure average Tobin's *Q* as the market value of assets divided by the book value of assets (item 6) where the market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity (item 60) and balance sheet deferred taxes (item 74).

70. Morck et al., *supra* note 6, at 296.

71. *See id.*

72. *Id.*

73. *See*, *e.g.*, Henri Servaes, *Tobin's Q and the Gains from Takeovers*, 46 J. FIN. 409, 417–18 (1991) (interpreting *q* as a "measure of managerial performance"); *see also* Benjamin E. Hermalin & Michael S. Weisbach, *The Effects of Board Composition and Direct Incentives on Firm Performance*, 20 FIN. MGMT. 101, 103–05 (1991) (using *q* as a proxy for firm value for estimating

In addition to the conceptual differences in the use of Tobin's *q* in macroeconomics and finance, scholars in these two areas adopted distinct definitions of Tobin's *q*. The fault line between the two camps was generally whether one was examining the *q* theory of investment (the macroeconomic approach) or the determinants of firm value (the finance approach). Macroeconomists examining the effects of Tobin's *q* on investment behavior typically defined Tobin's *q* as the ratio of the market value of a firm's stock of tangible capital to that stock's replacement value.[74] This "Macro *q*" ratio resembles the original framework of Brainard and Tobin, who had sought to explain the incentives to invest in physical capital.[75] The macroeconomic formulation was also consistent with the idea introduced by Hayashi that installation costs might deter a high Tobin's *q* firm from investing.

In contrast, finance scholars defined Tobin's *q* as the ratio of the market value of the firm's outstanding securities to the replacement cost of *all* of the firm's assets, not only its physical capital. Although early papers that used Tobin's *q* as a proxy for firm value, such as Morck, Shleifer, and Vishny (1988), limited the denominator of Tobin's *q* to the replacement value of a firm's plant and inventories, by the early 1990s finance scholars were including all of a firm's assets in the *q* denominator—both tangible and (to the extent reported) intangible.[76] Other authors were even less specific about the extent to which their calculations included particular assets: for example, the first footnote of a prominent paper published in 1990 in the *Journal of Financial Economics* simply notes that a "variation of the Lindenberg and Ross (1981) algorithm is used to compute the market value of the firm (debt plus equity) and the replacement value of its assets. A description of the procedure to compute these values is available from the authors."[77] Overall, empirical finance scholars during this time shifted their focus

the effect of board composition on firm value); McConnell & Servaes, *supra* note 6, at 599 (using *q* as an outcome variable for estimating changes in firm value due to various measures of ownership). The Morck, Shleifer, and Vishny paper was also the primary basis for using *q* as a proxy for firm value in the important 2003 article by Paul Gompers, Joy Ishii, and Andrew Metrick, which we discuss in Part II. *See* Gompers et al., *supra* note 5, at 126 (referring to Morck, Shleifer, and Vishny's study).

74. *See*, *e.g.*, Fazzari et al., *supra* note 58, at 141 app. B (defining *Tobin's q* to be equal to (market value of equity + preferred stock debt + debt – market value of inventories) / (replacement value of property, plant, and equipment)).

75. *See* Brainard & Tobin, *supra* note 16, at 9 ("One of the basic theoretical propositions motivating the model is that the market valuation of equities, relative to the replacement cost of the physical assets they represent, is the major determinant of new investment.").

76. *See, e.g.*, Hermalin & Weisbach, *supra* note 73, at 105 ("The denominator of *q*, the replacement value of the firm's assets, has three main components: the market value of capital stock, the market value of inventories, and other assets.").

77. McConnell & Servaes, *supra* note 6, at 600 n.1.

to a firm's assets overall, a move that was in many ways predictable given the emerging assumption that Tobin's *q* reflected a firm's overall performance and value.

This broader formulation of "Finance *q*" in the literature had intuitive appeal, but it represents yet another departure from Tobin's original theory. Brainard and Tobin had noted that "[t]here are many kinds of physical capital and many markets where existing stocks are valued,"[78] implying that in an ideal world, each different type of asset should have a different Tobin's *q*. Similarly, subsequent work by Fumio Hayashi and Tohru Inoue noted that "one has to invoke a very stringent set of assumptions including the Hicks aggregation condition [that all of the firm's assets are perfect substitutes in the production process] to derive a one-to-one relation between the sum of investments and *Q* that is independent of the composition of investments."[79] The tendency to measure firm value by aggregating together assets as dissimilar as capital goods, inventories, and intangibles accordingly fails this condition.[80]

In other words, the macroeconomists' analysis of Tobin's *q*, because it was focused on investment, was circumspect about aggregating firm assets for comparison: tangibles and intangibles were apples and oranges for the purposes of assessing changes in investment and should not be lumped together. In contrast, financial economists saw their version of Tobin's *q* as a way to analyze a firm's assets in the aggregate, both tangibles and intangibles (as well as cash, investment securities, accounts receivable, and so on), and accordingly were comfortable grouping disparate categories of assets into one measure, notwithstanding the questionable theoretical basis for doing so.

D. The Adoption of Simple Q *as a Measure of the Value of Corporations: 1994–Present*

The most significant split between what we have labeled "Macro *q*" versus "Finance *q*" was the move by empirical corporate finance researchers to use a simplified calculation of Tobin's *q*. As we have noted, Simple *q* is, essentially, a market-to-book ratio: the market value of a firm's securities divided by the firm's book value of assets. Today, corporate finance scholars routinely and sanguinely use Simple *q*

78. Brainard & Tobin, *supra* note 16, at 9.

79. Fumio Hayashi & Tohru Inoue, *The Relation Between Firm Growth and* Q *with Multiple Capital Goods: Theory and Evidence from Panel Data on Japanese Firms*, 59 ECONOMETRICA 731, 732 (1991).

80. Timothy Erickson & Toni M. Whited, *On the Accuracy of Different Measures of* q, 35 FIN. MGMT. 5, 9 (2006).

largely without question, perhaps because it is wrapped up in the lore of "Tobin's *q*," which might mask the fact that it is merely "market-to-book."[81] The story of how Simple *q* became so widely accepted is surprising, given how many scholars warned, two decades ago, about the potential problems with market-to-book estimates of Tobin's *q*.

Macroeconomics scholars resisted simplistic market-to-book estimates of Tobin's *q* for theoretical reasons and because of measurement error and data unavailability, problems that the "Macro *q*" literature continues to address. In contrast, empirical corporate finance scholars eagerly swallowed Simple *q*, methodological problems and all. The recent corporate finance literature suggests that the adoption of Simple *q* was straightforward and uncontroversial. In fact, it was neither.

First, consider early versions of the "Finance *q*" numerator: the market value of a firm's securities. Although market values of the common equity of publicly traded firms could be observed during the 1990s, an accurate measure of Tobin's *q* needed to include all of a firm's capital, including preferred stock and debt. The valuations of these other slices of capital often had to be estimated, because market prices typically were not available.[82] Scholars accordingly developed a range of approaches to incorporate market-based data to estimate the numerator at the firm level, but there were serious measurement

81. The use of market-to-book ratios elsewhere in the finance literature is not consistent with their use in empirical corporate finance. For example, as we describe below, a firm's market-to-book ratio has played an important role as one of the central risk factors in the asset pricing literature. *See infra* notes 182–183 and accompanying text (discussing Fama and French's groundbreaking research on asset pricing). In particular, market-to-book ratios are inversely related to future returns. As we discuss below, this empirical fact places the use of a de facto market-to-book ratio as the proxy for *q* in tension with the notion that increasing *q* necessarily means increasing long-term firm value. *See id.* Scholars also have explored the extent to which high market-to-book ratios are associated with greater borrowing and lower financing costs. *See* Long Chen & Xinlei Zhao, *On the Relation Between the Market-to-Book Ratio, Growth Opportunity, and Leverage Ratio*, 3 FIN. RES. LETTERS 253, 254 (2006) (showing that the negative relation between market-to-book and leverage is driven by a subset of firms with high market-to-book ratios). With limited exceptions, scholars in the empirical finance literature have not addressed the extent to which the subset of firms with the highest levels of *q* might share these same empirical relationships.

82. W.G. Shepherd, *Tobin's* q *and the Structure-Performance Relationship*, 76 AM. ECON. REV. 1205, 1206 (1986); Smirlock et al., *supra* note 57, at 1058–59.

challenges.[83] Early efforts to measure "Finance *q*" included lengthy appendices that outlined particular methods, data, and assumptions.[84]

Second, consider early versions of the "Finance *q*" denominator: the replacement value of a firm's capital assets. The market value of a firm's capital assets reflects intangible assets such as customer goodwill and technical knowledge, yet readily available accounting and balance-sheet–based measures of a firm's assets do not include such values.[85] Accounting measures of asset values are also generally recorded at historical cost and then adjusted using depreciation schedules that typically do not reflect the true economic depreciation of the firm's assets.[86] Firms also have the ability to choose different depreciation schedules.

Moreover, although during the early 1980s many publicly traded firms were required to estimate replacement costs for some assets based on rules established by the Financial Accounting Standards Board, those estimates often were not based on market prices when active markets did not exist.[87] In addition, after 1984, even these firms were no longer required to provide replacement cost estimates; accordingly, the National Bureau of Economic Research was unable to augment its database for researchers to estimate replacement values for firms. Since the mid-1980s, it has been difficult, if not impossible, for researchers to calculate reliable estimates of replacement costs for the assets of publicly traded firms.[88] As a result, there were, and are, serious difficulties in estimating the Tobin's *q* denominator.

83. For example, several scholars collected the prices of long-term bonds so that their measure did not assume that the market value and book value of debt were the same. These bond prices were available then from the *Moody's Bond Record* and *Standard & Poor's Bond Guide*. *See* Kee H. Chung & Stephen W. Pruitt, *A Simple Approximation of Tobin's* q, 23 FIN. MGMT. 70, 71 n.3 (1994) (describing studies that collected long-term bond prices). In addition, researchers had information about the replacement cost of net plant, equipment, and inventories from the Financial Accounting Standards Board ("FASB") Regulation 33 Tape, edited by researchers at Columbia University. However, that dataset was available only during 1979 to 1984, and only for firms with net plant and equipment of more than $120 million. *See id.*

84. *See*, *e.g.*, Larry H.P. Lang et al., *Dividend Announcements: Cash Flow Signaling vs. Free Cash Flow Hypothesis?*, 24 J. FIN. ECON. 181, 186 (1989) (describing methodology for estimating values of preferred stock, bonds, and replacement costs for purposes of estimating a firm's Tobin's *q*); Larry H.P. Lang et al., *A Test of the Free Cash Flow Hypothesis: The Case of Bidder Returns*, 29 J. FIN ECON. 315, 319 (1991) (using the Lindenberg and Ross algorithm to estimate firms' Tobin's *q*); Lindenberg & Ross, *supra* note 50, at app. (explaining their methodology in defining replacement cost).

85. *See* McFarland, *supra* note 56, at 614–15 (discussing how the omission of intangible assets from the book value of assets can bias Tobin's *q*).

86. *Id.* at 616.

87. *Id.* at 615 n.4.

88. Lang, Stulz, and Walking describe the arduous process of obtaining replacement cost estimates, a process that contrasts so sharply with the use of Simple *q* that it is worth quoting in full:

Despite these measurement challenges, the growing interest in using Tobin's *q* in empirical corporate finance inspired scholars to search for ways to estimate Tobin's *q* to enable its use across a broader cross section of firms. These efforts only heightened the measurement error. Most notably, in 1994, Kee Chung and Stephen Pruitt set forth a simpler version of calculating Tobin's *q* based on inputs that were easily downloaded from available financial and accounting databases.[89] Chung and Pruitt defined "approximate *q*" using the following equation:

$$\text{Approximate } q = (MVE + PS + DEBT) \ / \ TA$$

where *MVE* is the product of a firm's share price and the number of common shares outstanding, *PS* is the liquidating value of any outstanding preferred stock, *DEBT* is the value of the firm's short-term liabilities net of its short-term assets plus the book value of long-term debt, and *TA* is the book value of the firm's total assets. In short, "approximate *q*" was nothing more than a slightly modified version of the firm's market-to-book ratio, with book value substituted for market value of preferred and debt securities in the numerator. Calculating the denominator of Tobin's *q* had seemed impossible; suddenly it was a snap.

> Replacement costs of net plant and equipment and inventories are obtained from the FASB regulation 33 tape edited by Columbia University that covers the period 1979–1984. Although these data are unaudited and firms are allowed considerable discretion in their estimates, the data are the best available information on replacement costs. Corporations with net plant valued in excess of $120 million were required to report replacement costs of plant and inventories to FASB from 1979 to 1984. Consequently, no replacement cost data are provided by firms before 1979 or after 1984 or by firms with net plant valued at less than 120 million dollars.
>
> When firms do not report replacement costs, we use the Lindenberg and Ross algorithm to estimate these costs. Plant and equipment are valued by setting up an acquisition schedule and adjusting for price level changes and depreciation as suggested by Lindenberg and Ross (1889) [sic]. Specifically, for firms listed on the FASB tape, we begin with the plant replacement costs closest to 1979 or 1984 as appropriate in the Lindenberg and Ross formula for that year. We then work backward or forward using the formula to obtain estimates of replacement costs before 1979 or after 1984, respectively. We follow Smirlock, Gilligan, and Marshall (1984) and assume the technological parameter to be zero.
>
> To obtain the replacement costs for smaller firms that do not report these replacement costs at all, we assume that the value of plant at the start (1967) is equal to book value. Following the work by Smirlock, Gilligan, and Marshall (1984), we reduce the value of plant and equipment by 5% each year to compensate for depreciation and then adjust it for the GNP deflator for nonresidential fixed investment. We then use the formula proposed by Lindenberg and Ross. If inventories are not reported in the FASB 33 tape, we use the Lindenberg and Ross (1981) algorithm.

Larry H.P. Lang et al., *Managerial Performance, Tobin's* Q*, and the Gains from Successful Tender Offers*, 24 J. FIN. ECON. 137, 153 (1989).

89. *See* Chung & Pruitt, *supra* note 83, at 71.

Unlike "Macro *q*," Chung and Pruitt's "approximate *q*" entirely avoided the need to calculate the replacement value of assets; rather, it assumed that the replacement values of plant, equipment, and inventories were equal to their book values. Chung and Pruitt also simplified the treatment of long-term debt and preferred stock. Instead of attempting to calculate market values of debt or preferred stock, their measure simply substituted book values for market values of a firm's sources of capital other than common equity. As they noted, this approach had a clear advantage over more nuanced estimates of *q* in that "all of these required inputs are readily obtainable from a firm's basic financial and accounting information."[90]

Chung and Pruitt justified their version of Tobin's *q*, as contrasted with the more complicated Lindenberg-Ross measure, by pointing to their measure's mean, median, and maximum deviations from it, which were 6.8 percent, 6.2 percent, and 18.0 percent, respectively.[91] Chung and Pruitt optimistically concluded that the average error of 6.8 percent was tolerable, because it "compare[d] extremely favorably with the errors typically observed in other financial estimates."[92] They asserted as a justification that "managers would gladly accept a contract stipulating a mean (maximum) 6.8 (18.0)% error in virtually all of their business decisions."[93] Chung and Pruitt also noted that the 6.8 percent error compared favorably to larger errors in capital budgeting projections and forecasts, both in the private and government sectors, and in forecasts by securities analysts.[94]

In short, instead of warning scholars about a 6.8 percent estimated error, Chung and Pruitt used the error as a marketing pitch for their simplified version of Tobin's *q*.[95] They asserted that their simplified version of Tobin's *q* would be particularly important when more "theoretically correct" estimates were unavailable.[96] They claimed that because their simplified version of Tobin's *q* used readily available balance sheet information, it therefore "should prove of significant interest to both academic researchers and financial practitioners."[97]

Chung and Pruitt noted that, although academics frequently used Tobin's *q*, their "discussions with several senior financial managers suggest little, if any, reliance upon *q* in real-world decision

90. *Id.*
91. *See id.* at 72 (describing the results of their calculations for forty randomly selected firms).
92. *Id.*
93. *Id.*
94. *See id.* at 72–73.
95. *See id.* at 74.
96. *Id.*
97. *Id.*

analysis."[98] They explained that "the availability of timely and accurate [Tobin's] *q* data [was] severely limited when compared with known sources of other important financial variables, such as beta."[99] However, given the ready availability of accounting data for firms, Chung and Pruitt imagined that "thousands of corporate financial analysts" might one day use their measure of Tobin's *q*.[100] They added, "Given the potential for Tobin's *q* to provide valuable insight into a variety of important business and financial decisions, it is plausible that approximate *q* or some variation of it may one day play an important role in financial analysis,"[101] a prediction that seems omniscient in hindsight.

Also in 1994, at the same time Chung and Pruitt were offering their simplified version of "approximate *q*," Steven Perfect and Kenneth Wiles published an analysis of how sensitive the results of empirical corporate finance studies were to different versions of Tobin's *q* for purposes of estimating firm value.[102] Perfect and Wiles compared five different constructions of Tobin's *q*.[103] One of the five estimates was q_s, which they labeled the "simple *q* ratio."[104]

Although the methodologies used to calculate the five measures were similar to each other in many respects, the methodology for q_s was the most straightforward.[105] The numerator of q_s included common stock, preferred stock, short-term debt, and long-term debt.[106] Common

98. *Id.* at 70.

99. *Id.*

100. *Id.*

101. *Id.* As of early 2019, Chung and Pruitt's article was the most cited of the approximately 30,000 articles mentioning Tobin's *q* generated by a search of "Tobin's q" on Google Scholar, with more than 2,500 citations.

102. *See* Stephen B. Perfect & Kenneth W. Wiles, *Alternative Constructions of Tobin's* q*: An Empirical Comparison*, 1 J. EMPIRICAL FIN. 313 (1994).

103. *Id.* at 314. They noted that *q* had become an increasingly popular measure of firm performance in academic research because it provided an estimate of the value of a firm's intangible assets, including monopoly power, goodwill, high quality managers, and growth opportunities. *Id.* at 313–14. Perfect and Wiles did not determine that those techniques actually resulted in estimates that reflected market values; instead, they were simply comparing five different approaches. *See id.* at 314 ("We do not, however, determine which estimator most closely approximates the firm's true value.").

104. *Id.* at 315.

105. *See id.* at 315–16, 335 (describing the procedures used to estimate *q* ratios for each of the sample firms and noting that q_s "is relatively simple to construct"). All of the other measures used market prices for common stock and various estimating techniques for the market value of preferred stock and debt. *See id.* at 317–24. Some of the estimating techniques were quite complicated: for example, calculating estimates of the market value of debt involved both estimates of changes in yields and a recursive methodology to calculate the maturity structure of a firm's debt. *See id.* at 317–18.

106. *See id.* at 315–16 (presenting and explaining the variables represented in the equation for q_s).

stock was based on year-end prices, preferred stock was estimated, and debt was based on book values.[107] The denominator of q_s was simply the book value of a firm's assets.[108]

Perfect and Wiles conceded that the assumptions associated with q_s introduced inevitable and problematic aspects of measurement error.[109] Speaking of the denominator, for instance, they noted, "While these data are easily obtainable, they do not reflect the effects of inflation or technological innovation."[110] Their concerns were consistent with emerging research in the macroeconomics literature that had been grappling expressly with the estimation errors created by using an inaccurate measure of Tobin's *q*. For example, some empirical studies in the "Macro *q*" literature warned that the relationship between Tobin's *q* and investment behavior was weak or insignificant,[111] which led macroeconomists to confront the possibility that these null results were a product of measurement error in Tobin's *q*.[112]

107. In each of the five models, the value of preferred stock was estimated, because of its infrequency of trading. *Id.* at 316–17. The estimation techniques involved both using reported prices in Compustat and capitalizing the total preferred dividends based on the Standard and Poor's preferred stock yield index; these two techniques arrived at comparable estimates. *See id.* at 317–18 (explaining the differences between the two approaches and presenting descriptive statistics for the preferred stocks used).

108. *See id.* at 315–16 (listing SRC, "the firm's year-end book value of total assets," as the denominator of the q_s equation).

109. *See id.* at 329, 338 (recognizing that using the book value of a firm's total assets to estimate replacement costs can lead to underestimating replacement costs).

110. *Id*.

111. *See, e.g.*, Andrew B. Abel & Olivier J. Blanchard, *The Present Value of Profits and Cyclical Movements in Investment*, 54 ECONOMETRICA 249, 249–50 (1986) (noting that empirical studies regressing investment on *q* show that *q* fails to explain variations in investment); Richard Blundell, Stephen Bond, Michael Devereux & Fabio Schiantarelli, *Investment and Tobin's* Q*: Evidence from Company Panel Data*, 51 J. ECONOMETRICS 233, 247, 251–52 (1992) (analyzing a number of different estimations of *q* and finding that strong assumptions were required to derive a relationship between investment and average *q*); Jason G. Cummins, Kevin A. Hassett & Glenn R. Hubbard, *A Reconsideration of Investment Behavior Using Tax Reforms As Natural Experiments*, 1994 BROOKINGS PAPERS ECON. ACTIVITY 1, 4, 53–54 (arguing that *q* explains investment poorly); Takeo Hoshi & Anil K. Kashyap, *Evidence on* q *and Investment for Japanese Firms*, 4 J. JAPANESE & INT'L ECON. 371, 388–90 (1990) (performing an empirical analysis of Tobin's *q* and finding that the relationship between investment and *q* is not stable and did not accurately explain Japanese investment during the economic boom from 1983–88).

112. *See* Timothy Erickson & Toni M. Whited, *Measurement Error and the Relationship Between Investment and* q, 108 J. POL. ECON. 1027 (2000) [hereinafter Erickson & Whited, *Measurement*] (examining whether the failure of *q* to predict investment in empirical research is due to error in measuring Tobin's *q*); *see also* Timothy Erickson & Toni W. Whited, *Treating Measurement Error in Tobin's* q, 25 REV. FIN. STUD. 1286 (2012) [hereinafter Erickson & Whited, *Treating*] (examining estimators that help remedy measurement error in *q*). Much of the careful analysis of measurement error in Tobin's *q* has been in the macroeconomic context, which as we have noted uses Tobin's *q* as an independent variable to explain corporate investment rather than as a dependent variable. It is well known that measurement error in an independent variable can result in biased regression estimates, which no doubt helps explain the focus on measurement error in the Macro *q* context. Interestingly, this analysis does not seem to have migrated to the

The greater sensitivity to measurement error in the macroeconomic literature was also due in part to the econometric challenges associated with using Tobin's *q* as an independent variable associated with investment behavior, as had been typical in that literature.[113] These concerns regarding measurement error in proxies for *q* also led the macroeconomics literature to focus on the problems that Perfect and Wiles raised regarding estimates of intangible assets.[114]

One might imagine that finance scholars, like macroeconomics scholars, would see Perfect and Wiles's findings as a warning, a yellow light for market-to-book estimates of *q*, if not a red one. Perfect and Wiles certainly saw their findings as cautionary, and anyone who read the first sentence of their abstract was warned: "Although Tobin's *q* is an attractive theoretical firm performance measure, its empirical construction is subject to considerable measurement error."[115] The abstract further put a reader on notice that market-to-book estimates of *q* were especially problematic: "The simple-to-construct estimator produces empirical results that differ significantly from the alternative estimators."[116] Readers who made it past the abstract would receive, page after page, the unmistakable message that if they chose to use a market-to-book estimate for *q*, they would do so at their peril.

Yet finance scholars cited Perfect and Wiles, not as a source of concern, but as a justification for using a simplistic version of Tobin's

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empirical corporate finance literature, though as we explain below the potential bias from measurement error in Tobin's *q* is seriously problematic even when Tobin's *q* is used as an outcome variable.

113. *See* Erickson & Whited, *Measurement*, *supra* note 112, at 1030:

> Mismeasurement of marginal *q* can generate all the pathologies afflicting empirical *q* models. In the classical errors-in-variables model, for example, the ordinary least squares (OLS) R^2 is a downward-biased estimate of the true model's coefficient of determination, and the OLS coefficient estimate for the mismeasured regressor is biased toward zero. Irrelevant variables may appear significant since coefficient estimates for perfectly measured regressors can be biased *away* from zero. This bias can differ greatly between two subsamples, even if the rate of measurement error is the same in both.

114. For example, writing in the "Macro *q*" tradition, Ryan Peters and Lucian Taylor have developed an alternative estimate for Tobin's *q* called "Total *q*" that includes in its denominator an estimate of the replacement cost of a firm's intangible assets, along with the book value of a firm's property, plant, and equipment. *See* Peters & Taylor, *supra* note 20, at 256 (describing the calculation method for Total *q*); *infra* notes 174–176 (same); *see also Peters and Taylor Total Q*, WHARTON RES. DATA SERVS. (July 19, 2016), http://www.whartonwrds.com/datasets/included/luke-taylors-total-q/ [https://perma.cc/NB43-PUHE] (presenting a Total *q* dataset).

115. Perfect & Wiles, *supra* note 102, at 313.

116. *Id.*

q.[117] In an extraordinary reinterpretation, Perfect and Wiles became a green light for market-to-book estimates, including Simple *q*.

One reason researchers were sanguine about a market-to-book estimate of *q* was its appearance on the left side of regressions, rather than the right side. In contrast to the macroeconomists' use of Tobin's *q* as an independent variable, where measurement error was known to be likely to create biased regression estimates, the financial economists' use of Tobin's *q* as a dependent variable (e.g., in the estimation of whether governance provisions were associated with firm value) did not generate similar concerns. Instead, the assumption was that measurement error in Tobin's *q* as an outcome variable should not bias any coefficients in the regression so long as the measurement error is random (although it might cause standard errors to be larger than they would be in the absence of measurement error). In a separate paper, we show that this assumption is correct for the mismeasurement of the numerator of Tobin's *q*, but is wrong when mismeasurement affects the denominator.[118]

For scholars using Tobin's *q* as an outcome variable, the assumption that random measurement error in *q* only affected a regression model's standard errors made a simple market-to-book estimate seem even more attractive. In particular, the use of simplified versions of Tobin's *q* appeared to be a conservative means to avoid Type I error (i.e., false positives) in estimating the determinants of firm value. If scholars found a result when using a market-to-book estimate such as Simple *q*, this argument went, the finding was both unbiased and unlikely to be the result of chance.

For example, in studying the relationship between incorporation in Delaware and firm value, Robert Daines used a market-to-book version of Tobin's *q* and made this very point for justifying its use: "While more complex estimates of Tobin's *Q* are possible, this simple measure produces coefficient estimates whose signs are unbiased and conservative in that they are less likely to produce significant results (Perfect and Wiles, 1994)."[119] In this fashion, the problems associated

117. *See* Daines, *supra* note 2, at 531 (citing Perfect & Wiles, *supra* note 102, at 339); Kaplan & Zingales, *supra* note 69, at 177 n.4 (citing Perfect & Wiles, *supra* note 102, generally for the conclusion that improvements to Simple *q* obtained by using alternative measures were fairly limited); *see also* Paul Gompers, Joy Ishii & Andrew Metrick, *Extreme Governance: An Analysis of Dual-Class Firms in the United States*, 23 REV. FIN. STUD. 1052, 1067 (2010) (noting that, in estimating Tobin's *q*, they use the method employed in Kaplan & Zingales, *supra* note 69).

118. *See* Bartlett & Partnoy, *supra* note 25.

119. Daines, *supra* note 2, at 531; *see also* Gompers et al., *supra* note 117, at 1068 (noting that measurement error in the book value denominator of their estimate of *q* "does inflate the residuals and standard errors, making inference more difficult" but that "measurement error in the dependent variable does not cause bias").

with simple market-to-book estimates of Tobin's q documented by Perfect and Wiles had been transformed into a feature rather than a bug. Unfortunately, this sanguine conclusion does not hold when the dependent variable is a ratio such as Simple q, where the denominator is measured with error, as we discuss below and in the Appendix.[120]

Following the publication of Chung and Pruitt and Perfect and Wiles, scholars continued to use a simplified market-to-book estimate for Tobin's q, occasionally making refinements to its precise calculation.[121] Surprisingly, they often cited Perfect and Wiles as support for continuing to rely on a simplified market-to-book estimate for Tobin's q, even though the gist of Perfect and Wiles was that q_s had serious methodological flaws.

Especially notable in this regard was Steven Kaplan and Luigi Zingales's 1997 article, *Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?* Published in the prestigious *Quarterly Journal of Economics*, the study sits squarely in the "Macro q" literature in that it investigated and questioned previous findings regarding the investment–cash flow sensitivities of firms.[122] These previous findings were based on a version of Tobin's q derived from estimates of replacement costs, following Brainard and Tobin's original formulation.

Yet Kaplan and Zingales instead used a simplified version of Tobin's q, grounding it in the market-to-book ratio examined in Perfect and Wiles's study. The precise definition, which would shape the course of corporate governance research for the next two decades, was as follows:

$$q = \frac{AT + MVE - BVE - DT}{AT}$$

where *AT* is the book value of assets, *MVE* is the market value of common stock, *BVE* is the book value of common equity, and *DT* are balance sheet deferred taxes.[123] They justified their choice in a footnote, noting that: "[Fazarri, Hubbard, and Peterson] compute Q based on replacement costs, while we simply use a market-to-book ratio. The results in Perfect and Wiles [1994] indicate that the improvements obtained from the more involved computation of Q are fairly limited,

120. *See also* Bartlett & Partnoy, *supra* note 25.

121. *See* Gompers et al., *supra* note 5, at 126; Kaplan & Zingales, *supra* note 69, at 170, 211–12.

122. *See* Kaplan & Zingales, *supra* note 69, at 170, 211–12. The findings examined by Kaplan and Zingales were originally published in Fazzari, Hubbard & Peterson, *supra* note 58.

123. *See* Kaplan & Zingales, *supra* note 69, at 177.

particularly when regressions are estimated with firm fixed effects."[124] This formulation is the one we label Simple q.[125]

Note that the 1997 formulation by Kaplan and Zingales appears to be consistent with Macro q because the denominator seems focused on the value of assets and the left side of the balance sheet. In fact, however, this formulation is equivalent to a simplistic version of Tobin's q in which the numerator and denominator are both derived on the right side of the balance sheet. The reason stems from the fundamental equation of accounting, which is that assets equal liabilities plus equity. Specifically, $AT = BVE + BVD$, where BVD is the book value of debt, defined as all liabilities. Given this equality, simple algebra yields the following equivalent equation for Tobin's q:

$$q = \frac{MVE + BVD - DT}{BVE + BVD}$$

The above equation is based exclusively on measures of a firm's outstanding securities: market value of equity and book values of equity and debt. Some formulations of the above version of Simple q do not include DT, balance sheet deferred taxes, and others add preferred securities in addition to debt, but this formulation is analytically the same. The key point here is that Simple q is not based on the market value of assets divided by their replacement costs, but instead is based on a simplified version of the market value of firm's securities divided by their book value.

Another historical strand in our story of Tobin's q merits exploration. While financial economists were adopting Simple q, accounting academics were carefully studying the econometric challenges that arose from "scale differences" in regressions when the main dependent variable was the market value of firms' capital. This accounting literature was not specifically focused on Tobin's q, but rather considered the more general question of how to account properly for the fact that firms vary in size. Just as one should not reach conclusions about crime rates simply by comparing the number of murders in New York to those in, say, Lawrence, Kansas, one should adjust for the size of firms in any econometric tests with the market value of firms' capital as the dependent variable. Simple q was, in a

124. *Id.* at 177 n.4.

125. As discussed below, academic studies occasionally use this calculation of Tobin's q but do not deduct deferred taxes from the numerator. *See infra* notes 131–132 and accompanying text (citing several representative examples of Simple q calculations from recent academic literature). Given the modest effect of deferred taxes on the overall calculation of Simple q, we include these studies as among those that use Simple q.

way, a crude attempt to make such adjustments, by scaling the market value of firms' capital by their book value. But the accounting literature undertook a more comprehensive and nuanced approach.

Specifically, one year before the publication of Kaplan and Zingales's paper, Mary Barth and Sanjay Kallapur published an important study of the effects of the bias that resulted from scale differences in regressions using the market values of firms' equity as a dependent variable.[126] Barth and Kallapur did not limit their analysis to the use of book value as a potential scaling factor in the way that the finance literature did with market-to-book estimates of *q*; in fact, their article did not even mention Tobin's *q*. Instead, their focus was on how, generally, regressions with the market value of firms' equity as the dependent variable should take into account differences in scale.[127]

During the following two decades, the accounting literature has continued to develop and refine this general approach to scale adjustments.[128] Interestingly, the concept of Tobin's *q* does not appear to have arisen in this literature, perhaps because accounting scholars were not part of the historical devolution of Tobin's *q* into Simple *q* and accordingly did not consider whether one might study Tobin's *q* as a dependent variable instead of studying market values directly (and *then* addressing challenges related to scale adjustments). The accounting literature implicitly rejected, or at least ignored, Tobin's *q* as a method of scaling the market value of firms' capital and instead studied other, less problematic approaches.

Apparently, neither corporate law scholars nor empirical finance scholars noticed these developments in the accounting literature. Instead of considering the accounting literature's new empirical techniques, during the two decades after the publication of Kaplan and Zingales's study, law and finance scholars have simply used Simple *q*. Indeed, the use of Simple *q* in corporate governance scholarship became de rigueur after the publication of Paul Gompers, Joy Ishii, and Andrew Metrick's widely cited 2003 article in the *Quarterly Journal of Economics*, entitled *Corporate Governance and Equity Prices*. Notably,

126. *See* Barth & Kallapur, *supra* note 25 (concluding that "the most effective remedy" for scale differences "is to include a scale proxy as an independent variable and report inferences based on White standard errors").

127. *See id.* at 528 ("We seek to provide evidence on the extent of scale-related econometric problems in accounting research contexts and the effectiveness of available remedies.").

128. *See*, *e.g.*, Barth & Clinch, *supra* note 25, at 253–54 (assessing simulations of the effects of firm size in regressions based on market values); Ohlson & Kim, *supra* note 25, at 398–99 (discussing modifications of market-value-based regressions to account for scale).

Gompers, Ishii, and Metrick's sole source of authority for using Simple *q* was Kaplan and Zingales's 1997 paper.[129]

During recent years, articles in which Simple *q* is the dependent variable have continued to appear in the academic literature. We conclude this Part with a few representative examples. For instance, Sreedhar T. Bharath, Sudarshan Jayaraman, and Venky Nagar begin their definitions discussion with the following straightforward paragraph: "Our measure of firm value is Tobin's *Q* (*Q*). We define *Q* as the ratio of the market value of assets divided by the book value of assets, both computed at the end of each fiscal year."[130] Their precise calculation of Tobin's *q* tracks the version used by Kaplan and Zingales, based on market and book values of securities, except that their numerator does not include a deduction for balance sheet deferred taxes. Likewise, Martijn Cremers and Allen Ferrell write in a footnote: "We interpret a higher average *Q*, measured as the ratio of book value of firm assets to market capitalization, as evidence that the firm uses its resources more productively and efficiently, in line with the literature."[131] Merritt Fox, Ronald Gilson, and Darius Palia call Simple *q* "the typical measure of a firm's success at creating value."[132] In adopting this definition, they include a footnote discussing the potential problems that its use creates; nevertheless, they conclude: "Tobin's *Q* is still, however, a reasonable way of looking for a historical period of time to see which firms on average did better at creating value and which did worse."[133] As these statements suggest, many of the most important recent questions in corporate law have been addressed by studies that rely on Simple *q*.

That brings our story up to date. Today, Simple *q* has become the accepted and central dependent variable in corporate law and

129. *See* Gompers et al., *supra* note 5, at 126 (citing Kaplan & Zingales, *supra* note 69, as the basis for using Simple *q*).

130. Sreedhar T. Bharath, Sudarshan Jayaraman & Venky Nagar, *Exit as Governance: An Empirical Analysis*, 68 J. FIN. 2515, 2524 (2013); *see also id.* at app. (defining *Q*).

131. Martijn Cremers & Allen Ferrell, *Thirty Years of Shareholder Rights and Firm Value*, 69 J. FIN. 1167, 1168 n.2 (2014). Cremers and Ferrell calculate *q* using the formula set forth in Kaplan and Zingales, *supra* note 69, at 177. *See* Cremers & Ferrell, *supra*, at 1173 n.9 (describing their formula for calculating *q*). One additional data question is whether the market price of a firm's stock is determined as of the end of a firm's fiscal year or the end of the calendar year.

132. Merritt B. Fox, Ronald J. Gilson & Darius Palia, *Corporate Governance Changes as a Signal: Contextualizing the Performance Link* 3 (European Corp. Governance Inst., Law Working Paper No. 323 & Stanford Law and Econ., Olin Working Paper No. 496, 2016), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2807926 [https://perma.cc/T7R4-UYKS]. Similar to Bharath, Jayaraman & Nagar, *supra* note 130, Fox, Gilson, and Palia define Tobin's *q* using the same formula as Kaplan and Zingales, *supra* note 69, but omit any deduction in the numerator for deferred taxes. *See* Fox et al., *supra*, at 10 n.24 (describing the method used to calculate Tobin's *q*).

133. Fox et al., *supra* note 132, at 11 n.25.

related scholarship. Notwithstanding some criticism,[134] it has become standard practice for scholars to assert, without further explanation, not only that Simple *q* is an acceptable measure of Tobin's *q* but also that it is an appropriate measure of firm value.[135]

II. THE CASE AGAINST USING SIMPLE *Q*

For some readers, the peculiar intellectual journey of Tobin's *q* will be reason enough to question its reliability as a proxy for firm value in the literature. But we also want to present a more specific case against using any version of Tobin's *q*—and particularly Simple *q*—as such a proxy.

First, we pause to ask whether it makes theoretical sense to assume that Tobin's *q*, in any formulation, measures the value of corporations. Our basic answer is no. The problem is that a high value of Tobin's *q* does not necessarily mean that a corporation is more valuable in any meaningful way.

Second, we focus on the problem of measurement error with respect to Simple *q*. Although the literature frequently ignores the measurement error problems associated with using simple market-to-book estimates for Tobin's *q*, many of the problems have been scrutinized in the macroeconomics literature. We explore why measurement errors are likely to create biased estimates in regressions with Simple *q* as a dependent variable.

Third, we examine recent advances in the asset pricing literature that raise questions about the very meaning of Simple *q*. Specifically, the book-to-market ratio (similar to the reciprocal of Simple *q*, except that it is calculated as a firm's book value divided by the market value of equity, instead of the full capital structure) has been a risk factor in prominent asset pricing models. As we illustrate below, firms that have a high level of Simple *q* (and therefore typically a low book-to-market ratio) are likely to experience relatively low future

134. *See, e.g.*, Ing-Haw Cheng, Harrison Hong & José A. Scheinkman, *Yesterday's Heroes: Compensation and Risk at Financial Firms*, 70 J. FIN. 839, 870 (2015) (citing the "substantial empirical debate about whether traditional measures such as market-to-book or Tobin's *q* adequately capture growth options").

135. *See, e.g.*, Ran Duchin, Amir Goldberg & Denis Sosyura, *Spillovers Inside Conglomerates: Incentives and Capital*, 30 REV. FIN. STUD. 1696 (2017) (using Simple *q* to assess the impact of pay changes within divisions of firms); T. Clifton Green & Russell Jame, *Company Name Fluency, Investor Recognition, and Firm Value*, 109 J. FIN. ECON. 813 (2013) (concluding that "firms with more fluent names have significantly higher Tobin's *q* and market-to-book ratios"); Byoung-Hyoun Hwang & Hugh Hoikwang Kim, *It Pays to Write Well*, 124 J. FIN. ECON. 373 (2017) (using Simple *q* to conclude that easier-to-read disclosure documents are associated with higher firm valuation); Antoinette Schoar & Luo Zuo, *Shaped by Booms and Busts: How the Economy Impacts CEO Careers and Management Styles*, 30 REV. FIN. STUD. 1425 (2017) (using Simple *q* to assess CEOs).

returns, and vice versa. This finding suggests that scholars should be more careful in reaching conclusions about firms with higher measures of Simple *q*.

To be clear, our claim here is not that Tobin's *q* can *never* be an acceptable proxy for firm value. Rather, our goal is to establish why scholars who make assertions about the value of corporations based on a positive relationship between Simple *q* and a variable of interest bear a heavy burden of persuasion, a burden we believe they have not met.

A. Interpretive Error

First, it is worth taking a moment to ask what the original formulation of Tobin's *q* measures. According to Tobin, when *q* is high, the market value of an asset—call it a widget—held by a firm is greater than its replacement cost. In other words, the perception among market participants is that this asset is more valuable than the cost of replacing it. If this perception is accurate, and a firm can increase the scale of its operations, it follows that the firm should invest in widgets, and continue to invest, until the market value of widgets is equal to their replacement cost—that is, until *q* is equal to one.

However, it does not follow from this analysis that firms with relatively high Tobin's *q* have relatively high value or that they will even retain a high level of Tobin's *q*. To the contrary, according to the original macroeconomic theory, the Tobin's *q* of any given firm should revert to one in the future.[136] Additionally, to the extent the market value of a firm's assets is greater than their replacement value, high Tobin's *q* firms could face declining profit opportunities. (Widgets might become more expensive due to increased demand, or competitors might recognize the profit opportunities associated with widgets.) Alternatively, under the *q* theory of investment, Tobin's *q* might exceed one for a sustained period of time because of high adjustment costs. Indeed, these adjustment costs could vary systematically with the type of assets owned by a firm. For instance, Ryan Peters and Lucian Taylor find that intangible assets have convex adjustment costs that are roughly twice as high as those for physical assets, suggesting that firms

136. Moreover, the disconnect between the market value of a firm's assets and their replacement value might be due to short-term market opportunities or to behavioral effects on market prices. High *q* can also be consistent with lower expected returns (i.e., a lower cost of capital). We explore the relationship between *q* and equity returns in Section II.C.

with large amounts of intangible assets may take longer to respond to investment opportunities implied by a high Tobin's *q*.[137]

In theory, a high Tobin's *q* firm could even reflect *poor* management. Indeed, as Philip Dybvig and Mitch Warachka note, a high Tobin's *q* could result from inefficient underinvestment (and accordingly a failure to maximize firm value) given that additional investment should drive *q* towards one.[138] Dybvig and Warachka's critique of Tobin's *q* is more narrowly circumscribed than ours: they focus on developing a theoretical critique of Tobin's *q* and assessing measures of operating efficiency as a potential substitute.[139] Nevertheless, it is striking that Dybvig and Warachka's paper has not only remained unpublished since it was posted online in 2010, but also has been mostly ignored within the law and finance literature.[140]

137. *See* Peters & Taylor, *supra* note 20, at 253. As Peters and Taylor note, one possible explanation for the higher adjustment costs associated with intangible assets could reflect the fact that adjusting intangible capital often requires replacing specialized employees. *Id.*

138. *See* Philip H. Dybvig & Mitch Warachka, Tobin's q Does Not Measure Firm Performance: Theory, Empirics, and Alternatives (Mar. 2015) (unpublished manuscript), https://ssrn.com/abstract=1562444 [https://perma.cc/QT7T-DBDR] (performing an empirical analysis demonstrating that Tobin's *q* is not a proxy for firm performance). As a simple example, Dybvig and Warachka posit a firm with a market value of $15 based on $10 of investment, yielding a *q* of 1.5. *See id.* at 2. If expanding the firm's scale through a $20 investment increased its market value by $24, the firm's *q* would decline to 1.3 but its market value would increase by $4. *Id*.

139. *See id.* at 2–3 (deriving a theoretical framework to demonstrate the conflicting implications of better performance on Tobin's *q* and developing two new operating efficiency measures focusing on scale efficiency and cost discipline).

140. For instance, while nearly 400 papers discuss Tobin's *q* within Westlaw, see supra note 9, only four papers within Westlaw could be located that cite Dybvig and Warachka's paper. To determine these figures, we conducted a search in the Westlaw "Law Reviews & Journals" database for "Dybvig /4 Warachka." Dybvig and Warachka's paper was cited twice in 2018 in conjunction with an unpublished version of this paper to point out that there are critiques of Tobin's *q*. *See* Amihud et al., *supra* note 3, at 1483 n.24 (citing Dybvig and Warachka as "a critique of the use of Tobin's Q as a measure of firm value"); Andrew William Winden, *Sunrise, Sunset: An Empirical and Theoretical Assessment of Dual-Class Stock Structures*, 2018 COLUM. BUS. L. REV. 852, 895 n.115 ("Tobin's Q has, in any event, been seriously questioned as a means of measuring the effect of corporate governance changes on firm performance in both the financial and legal literature."). But of the two papers before 2018, one paper dismisses the study in a footnote as "an unpublished paper," *see* Lucian A. Bebchuk, Alon Brav & Wei Jiang, *The Long-Term Effects of Hedge Fund Activism*, 115 COLUM. L. REV. 1085, 1102 n.53 (2015), and the other cites it once for the proposition that the use of *q* as a measure of company performance "has been subject to criticism," *see* Leo E. Strine, Jr., *Can We Do Better By Ordinary Investors? A Pragmatic Reaction to the Dueling Ideological Mythologists of Corporate Law*, 114 COLUM. L. REV. 449, 462 n.39 (2014). In addition, we are aware of one paper within the corporate governance literature that also cites Dybvig and Warachka. *See* Klausner, *supra* note 9, at 18 (citing Dybvig and Warachka for the proposition that *q* "is considered by some economists to be an unreliable measure of value").

Finally, the theoretical interpretation of Tobin's q as a measure of the value of corporations is misplaced for econometric reasons as well. The standard "q regression" generally takes the following form:

$$SimpleQ_i = \beta_0 + \beta_1 X_i + \epsilon_i$$

where β_0 is an estimated intercept, X represents a regressor of interest, β_1 represents the regression coefficient that estimates the association of the regressor with Simple q, and ϵ_i is the error term. (A typical q regression also includes a vector of control variables, which we omit without loss of generality.) Now consider the two primary statistical justifications for using a ratio such as Tobin's q as an outcome variable of interest.[141]

In the first instance, the variable of interest is a specific measure such as firm value, but a researcher may be concerned about scale effects, as has been studied in the accounting literature.[142] As is well known within statistics,[143] the researcher could control for scale effects by dividing *every* variable in the regression equation (i.e., both left-side and right-side variables, including the intercept) by a scaling factor. In the context of estimating the market value of a firm, for instance, a researcher would divide every variable by a scale factor such as book value, thus resulting in Simple q as the outcome variable. However, we are unaware of a single paper in empirical corporate finance that justifies its reliance on either Tobin's q or Simple q in this fashion or that divides every variable in the regression equation by the scaling factor. Rather, researchers uniformly apply the specification noted above, which omits estimating a coefficient for the ratio *1/(Book Value)* and typically includes only nonratio regressors (i.e., X is not divided by book value).[144]

In the second instance, the variable of interest to the researcher is supposed to be the ratio itself, which is believed to be of independent

141. *See* Robert Wiseman, *On the Use and Misuse of Ratios in Strategic Management Research, in* 5 RESEARCH METHODOLOGY IN STRATEGY AND MANAGEMENT 75 (Donald D. Bergh & David J. Ketchen eds., 2009). Wiseman notes that there are three rationales for using a ratio as an outcome variable: deflating a variable of interest to be a rate, deflating a variable of interest to be a proportion, and examining a ratio that is of independent theoretical interest. *Id.* at 76–80. Given that the first two rationales reflect the same concern about scale effects, this leaves two principle reasons researchers utilize ratios as outcome variables.

142. *See supra* notes 126–128 and accompanying text (discussing the accounting literature's focus on accounting for differences in scale amongst firms when examining the predictors of a firm's market value of equity).

143. *See* Richard Kronmal, *Spurious Correlation and the Fallacy of the Ratio Standard Revisited*, 156 J. ROYAL STAT. SOC'Y 379, 381 (1993) (outlining the process of controlling for a deflator: dividing both the dependent and independent variables by a common factor).

144. We discuss these challenges in greater detail in Bartlett & Partnoy, *supra* note 25.

theoretical interest (e.g., Tobin's q is purported to be a proxy for monopoly power, firm performance, or some other construct). The researcher therefore chooses to estimate the relationship between a particular predictor of interest and the ratio. In so doing, however, the researcher is effectively examining whether the effect of the predictor on the *numerator* of the ratio is moderated by the ratio's *denominator*. Imagine, for instance, a researcher who seeks to examine the effect of a staggered board on Simple q using the specification noted in the equation above. In such a scenario, the regression will estimate the effect on Simple q's numerator (an estimate of the market value of the firm) from the interaction of the staggered board variable and the denominator of Simple q (the book value of assets). The reasons arise from basic principles of linear regression, yet this interpretative challenge, as well as other assumptions this estimation approach entails, are not even mentioned in papers that use some version of Tobin's q as a proxy for firm value.[145]

B. Measurement Error in Simple Q

We now turn to some aspects of measurement error that are problematic for studies that rely on Simple q to assess the relationship between corporate law and the value of corporations. We begin this critique by revisiting the Perfect and Wiles study of five different formulations of Tobin's q. Recall that scholars have cited Perfect and Wiles as justifying the use of market-to-book estimates of q, such as Simple q. That reliance on Perfect and Wiles has been based on two generally unstated assumptions: that alternative measures of Tobin's q would not significantly improve measurement accuracy and that the measurement errors associated with market-to-book estimates are not problematic. As we demonstrate, both of these assumptions are incorrect.

1. Evidence of Measurement Error

As we note above, Perfect and Wiles compared a market-to-book estimate of q, labeled q_s, to four other estimates of Tobin's q. They calculated these four other estimates using more detailed techniques than simply dividing the market value of a firm by its book value, including more accurate estimates of replacement value that capture changes in prices, depreciation, and technology, as well as first-in, first-

145. *See id.*

out ("FIFO") versus last-in, first-out ("LIFO") inventory methods.[146] For instance, some of these other estimates of Tobin's *q* took advantage of a Securities and Exchange Commission requirement, effective from 1976–1979, that large firms report annual estimates of the replacement costs of plant, equipment, and inventories, as well as depreciation and cost of goods sold, and a similar requirement, effective from 1980–1985, arising from Financial Accounting Standard No. 33.[147]

Perfect and Wiles found that although their estimates of Tobin's *q* generally were highly correlated with one another,[148] the estimate for q_s had a significantly larger mean and median, and generated significantly different values for particular firms than estimates for the other four.[149] For example, they tested how similar the five Tobin's *q* estimates were in grouping a sample of 558 firms into two categories: Tobin's *q* greater than one versus Tobin's *q* less than one.[150] The simple estimate of q_s agreed with the other estimates in only 79.4 percent to 82.8 percent of cases.[151] In other words, for roughly one in five firms, the simple estimate of q_s was not even precise enough to correspond with other measures in categorizing a firm's *q* as above or below one. Perfect and Wiles concluded: "Thus, although q_s is relatively simple to construct, it does not produce sorting results that are comparable to the other four estimators."[152] To repeat, Perfect and Wiles concluded that a market-to-book estimate of Tobin's *q* did not produce comparable results to four alternative formulations of Tobin's *q*. That is not the ringing endorsement of their market-to-book estimate that many scholars have assumed.

The literature's citation to Perfect and Wiles as justifying the use of market-to-book estimates of *q* is all the more puzzling in light of additional studies documenting that, of all the estimates of Tobin's *q*, market-to-book estimates perform among the worst. In their comprehensive empirical estimation of measurement error in Tobin's *q*, Timothy Erickson and Toni Whited note that different approaches to

146. *See* Perfect & Wiles, *supra* note 102, at 324–32 (detailing the derivation of the different proxies for *q*).

147. *See id.* at 326 (discussing the rationale for choosing the Securities and Exchange Commission and Financial Accounting Standards Board standards as estimates of asset replacement cost). Interestingly, firms generally included disclaimers along with these reported estimates, indicating that the managers believed the replacement value data were "of limited value because of the subjective judgments necessarily involved in making these estimates." *Id.* at 326 n.13.

148. Pairwise Pearson correlation coefficients for the measures ranged from 0.9045 to 0.9856. *Id.* at 334. Correlations among changes in *q* were lower, in the range of 0.8503 to 0.9404. *Id.*

149. *See id.* at 332–34 (describing the various *q* ratio estimates).

150. *Id.* at 335 tbl.7.

151. *Id.*

152. *Id.* at 335.

calculating Tobin's *q* yield nearly two hundred different estimates of "Macro *q*" and two hundred different estimates of "Finance *q*."[153] (Recall that macroeconomists have been using a version of Tobin's *q* that more closely resembles Brainard and Tobin's original conception, whereas financial economists have adapted Tobin's *q* in ways that make it easier to calculate.)

In a series of studies, Erickson and Whited have demonstrated several serious drawbacks to a market-to-book estimate, including biases that result from measurement error. Following Hayashi and Inoue, they question whether the basic assumption of perfect substitutability holds for such a simplified estimate of *q*, which aggregates all of a firm's assets.[154]

Erickson and Whited do not mince words: they find that "the most common proxy used in the finance literature, the market to book ratio, only explains about forty percent of the variation in average *q*."[155] They conclude that the ratio's "measurement error problem must therefore stem more from issues such as aggregation and unobservable assets."[156] Later studies have confirmed Erickson and Whited's findings; for example, Ryan Peters and Lucian Taylor similarly find that "market-to-book-assets ratios are especially poor proxies" for the true theoretical Tobin's *q*.[157]

These problems with market-to-book proxies are also evidenced by the extent to which datasets including market-to-book ratios have extreme outliers, both high and low. Although scholars commonly exclude these outliers, even a cursory review of them suggests a number of puzzling findings. For example, in his study of Delaware law and firm value, Robert Daines eliminated the top and bottom one percent of firm-level measurements of a market-to-book estimate of Tobin's *q*, claiming that the effect of Delaware corporate law was unlikely to explain high or low Tobin's *q* values.[158]

However, using Simple *q* to estimate *q*, Guhan Subramanian found that the one percent lower and upper ranges in a sample of firms resembling Daine's were 0.38 and 70.49, respectively, for the relevant periods.[159] Such levels of Tobin's *q* are extreme: it would be interesting

153. *See* Erickson & Whited, *supra* note 80, at 12.

154. *See* Erickson & Whited, *Treating*, *supra* note 112, at 1325.

155. Timothy Erickson & Toni M. Whited, On the Information Content of Different Measures of *Q* 22 (August 2, 2001) (unpublished manuscript) (on file with authors).

156. *Id.* at 23.

157. *See* Peters & Taylor, *supra* note 20, at 252 (referencing similar findings to Erickson and Whited).

158. *See* Daines, *supra* note 2, at 530.

159. *See* Subramanian, *supra* note 2, at 39.

to know why a firm with a Tobin's *q* of 0.38 had not been liquidated, or why a firm with a Tobin's *q* of 70.49 had such a measure (and what it meant), perhaps because it was small or idiosyncratic in some way. Subramanian's analysis suggests that the distribution of Simple *q* includes a significant number of extreme, outlier values, particularly in samples that include small firms. (As Subramanian notes, Enron's Simple *q* at the height of its stock market valuation was 6.8.[160]) Unfortunately, the literature generally does not focus on the analysis or impact of Simple *q* outliers.

Simple *q* generates such extreme outliers in part because of questionable assumptions with regard to both the numerator and the denominator utilized in estimating Simple *q*. With respect to the numerator, Simple *q* requires an estimate of the market value of a firm's assets. However, Simple *q* seeks to estimate these values based on the market values of all of a firm's outstanding securities, and these values are often not observable aside from a company's outstanding common stock (assuming it is publicly traded). Market values for a firm's other securities, such as outstanding debt and preferred stock, are instead typically estimated from book values, which can diverge from their fair value. As a result, the Simple *q* numerator is not based on an assessment of individual assets, or even categories of assets, on the left-hand side of the balance sheet; instead, it simply reflects the book values of capital on the right-hand side.

More problematic still is the calculation of the denominator, which originally reflected the replacement value of a firm's assets. Simple *q* substitutes basic accounting measures in its denominator. In particular, it uses a company's book value of equity and debt as a proxy for the replacement value of assets. The use of book values virtually guarantees that the denominator will depart from the replacement cost of assets theorized by Tobin and Brainard. In a 1997 study examining measurement error in proxies for Tobin's *q*, Wilbur Lewellen and S.G. Badrinath demonstrated that various conceptions of *q* differed significantly by using cases in which asset replacement costs, the original Tobin's *q* denominator, were known.[161] They found that revised *q* ratios based on actual replacement costs varied from book-value-based estimates in the literature by ten percent to twenty percent.[162] The methodologies Lewellen and Badrinath used require considerable information, attention, and work, and they require data that are not

160. *Id.*

161. *See* Wilbur G. Lewellen & S.G. Badrinath, *On the Measurement of Tobin's* q, 44 J. FIN. ECON. 77 (1997).

162. *See id.* at 121.

typically accessible to researchers. Obviously, it is much easier to calculate Simple *q* based on available Compustat data, and scholars have preferred the easier route. Measurement errors are an inevitable result.

Book values have become especially subject to measurement error given the importance of intangible assets and financial engineering. Even assets as simple as a firm's property, plant, and equipment ("PPE") are recorded at historical cost less depreciation, which will vary depending on the depreciation schedule adopted by a firm and inevitably will diverge from market values. The value of inventory generally will reflect the lower of historical cost or fair value, and the inventory balance similarly will depend on whether sales of inventory are treated under FIFO or LIFO accounting. More complex assets are not part of book value at all. For example, unbooked intangible assets are increasingly important to firm value but are not reflected on balance sheets. Likewise, financial derivatives and unconsolidated subsidiaries can be important to the market value of a firm's securities but are not included in book value.

Given these measurement problems, Erickson and Whited's finding that market-to-book measures of Tobin's *q* perform poorly is not surprising. For the same reasons, Simple *q* inevitably is subject to significant measurement error due to the problems of asset aggregation and unobservability.

2. Measurement Error and Bias

In their study of Tobin's *q*, Perfect and Wiles used each of the five estimates of Tobin's *q* as an outcome variable and regressed each one on a variety of firm characteristics, much as empirical finance scholars do today in corporate governance research.[163] Perfect and Wiles found that the regression coefficients for the simple version, q_s, differed significantly from those obtained using other measures of *q*.[164] Although scholars have subsequently cited Perfect and Wiles to support their use of Simple *q* insofar that it resembles q_s, Perfect and Wiles warned that q_s could lead to biased estimates: "In summary, the results indicate that using q_s produces regression estimates that often differ from those found using the other four *q* ratio estimates, while q_{B}, q_{LR}, q_{PW}, and q_{QH} produce comparable regression estimates."[165] Their message was clear: beware of using Simple *q* as a dependent variable.

163. *See* Perfect & Wiles, *supra* note 102, at 314.

164. *See id.* at 336.

165. *Id.* at 338. Perfect and Wiles suggested a more optimistic view of q_s in one paragraph near the end of their article, though they also make it clear that there were limitations associated with

Notwithstanding these warnings, there might have been some reasons for scholars not to worry. The fact that Simple *q* is measured with error might pose only a minor inconvenience if classical measurement error assumptions held. Under the classical errors-in-variables model, errors in the variable of interest are assumed to be independent of the true measure of the variable. To the extent this assumption holds, measurement errors in a dependent variable do not lead to biased estimates of regression coefficients; the only consequence of the presence of measurement errors in the dependent variable is that they inflate the standard errors of these coefficient estimates.[166] As noted above, this approach to measurement error has led some scholars to view Simple *q* regressions as conservative because measurement error reduces the risk of Type I error (i.e., false positives).[167]

The question remains, however, whether the assumptions of the classical errors-in-variables model hold. There are two technical reasons why they might not: problems with aggregation and problems with omitted variables. There is also one more general, fundamental, and unavoidable reason why the classical assumptions are unlikely to hold: Tobin's *q* is a ratio. We discuss each of these issues in turn.

First, the aggregation of assets can result in nonclassical measurement error. Consider, for instance, a simple firm that has only two types of assets: current assets and capital assets (i.e., property, plant and equipment). Under U.S. accounting rules, the book value of current assets is generally their fair value, meaning that the market value of current assets roughly equals their book value, so that the market-to-book ratio for current assets is typically close to one.

In contrast, the book value of capital assets is their cost less depreciation. As a result, the market value of capital assets frequently

this conclusion, which related to an additional estimation of the regression models using changes in *q*. *See id.* at 338–39. They cautioned that the similarity of the regression coefficients in such a specification was not surprising given that changes in common stock values should drive the changes in the *q* estimates, but concluded nevertheless that

> [i]f, however, *changes* in the *q* estimates are used, then the empirical results do not, in general, reveal significant differences among the estimators. An implication of this result is, of course, that q_s, due to its ease of construction, may be an attractive estimator when changes in a firm's *q* ratio are of interest.

Id. at 339.

166. To illustrate, assume that we seek to understand whether x predicts y in a standard regression framework. The true measure, y_i^*, is related to the regressor x_i as $y_i^* = \beta_0 + \beta_1 x_i + \epsilon_i$. However, the outcome variable is measured with random error v_i. Thus, $y_i = y_i^* + v_i$, where v_i represents random measurement error that is uncorrelated with y_i^* and x_i. Under these conditions, measurement error in the dependent variable does not lead to biased estimates of the regression coefficient β_1, as can be seen by rewriting the model in y_i: $y_i = \beta_0 + \beta_1 x_i + \epsilon_i + v_i$. Because both ϵ_i and v_i are assumed to be independent of x_i, measurement error affects only the standard errors of the regression coefficient estimate, β_1.

167. *See* discussion *supra* note 119 and accompanying text.

will differ from their book value, depending on whether the assets decline in value by more or less than their depreciation schedule. In some cases, the market-to-book ratio might be greater than one; in other cases it will be less than one.

Moreover, the market might place a higher value on current assets than on capital assets, because current assets can be deployed more quickly. In short, there are any number of reasons why the expected market-to-book ratios for these two classes of assets might differ, regardless of how well a firm is managed. Moreover, firms are likely to differ systematically in the extent to which their assets are comprised of current assets. For these reasons, aggregating assets can cause Simple q to be biased in nonrandom ways, and failure to account for this fact might lead to biased estimates of the predictors of Simple q.

In Appendix A, Table A.1, we show that this concern is not merely theoretical.[168] We estimate the extent to which a firm's level of current assets is associated with its measure of Simple q. We find that it is: a firm's level of current assets is positively associated with a firm's Simple q even after controlling for industry- and firm-fixed effects. In other words, the market attributes a higher Simple q-ratio to firms with larger amounts of current assets.

The implications of this finding are troubling to the extent one is interested in understanding the determinants of Simple q. Because Simple q aggregates all assets (including current assets) it will be upwardly biased to the extent a firm has current assets. Moreover, the fact that this finding persists despite industry- and firm-fixed effects illustrates how this bias can vary within industries and firms. To the extent this variation is correlated with other firm characteristics, it can create biased estimates of the association of these characteristics with Simple q. A researcher might think they have spotted a relationship between some aspect of corporate law and firm value, but in fact the relationship between Simple q and the corporate law variable could be due, at least in part, to the correlation between the corporate law variable and a firm's holding of current assets.

Second, the omission of variables can result in nonclassical measurement error. Consider intangible assets. A firm's expenditures to develop knowledge, intellectual property, or software are typically recorded on a company's income statement as a research and development expense rather than capitalized on a company's balance

168. *See infra* app. A, tbl. A.1.

sheet as an asset.[169] In contrast, when a firm purchases an intangible asset, such as by acquiring another company or a patent, the firm generally capitalizes the asset on the balance sheet at the purchase price as part of a line entry for "Intangible Assets."[170] To the extent such intangibles are separately identifiable (e.g., particular patents, noncompetition agreements, etc.), they are separately recorded as "Other Intangible Assets," with the residual balance of the purchase price being booked to "Goodwill," which can be subsequently written down if these values are deemed "impaired" by management.

In other words, two firms can have radically different book values based on the extent to which they "build" rather than "buy" their intangible assets, as well as the extent to which they reflect a manufacturing firm (where PPE is likely to be large) relative to a service firm (where PPE is likely to be small and intangibles more important). Moreover, these systematic accounting differences among service firms have become more important over time as the U.S. economy has shifted toward service- and technology-based industries, which has made intangible assets such as human capital, innovative products, brands, patents, software, customer relationships, databases, and distribution systems increasingly important.[171] In their 2010 study, Carol Corrado and Charles Hulten estimate that intangible capital makes up thirty-four percent of firms' total capital in recent years.[172]

Simple *q* can be skewed upward given that it substitutes book value of capital for the replacement cost of assets, including intangible assets. Indeed, Simple *q* is by definition biased upward by research and development, brand management, and human capital, which are reflected in the market value of a firm's capital, but not its book value. As Morck, Shleifer, and Vishny recognized: "Tobin's *Q* is high when the firm has valuable intangible assets in addition to physical capital, such as monopoly power [Lindenberg and Ross (1981)], goodwill, a stock of patents, or good managers."[173]

The measurement error arising from the omission of intangibles also can lead to biased regression estimates. In Appendix A, Table A.2, we test this bias formally using an empirical estimate of a firm's

169. When Do Intangible Assets Appear on the Balance Sheet?, ACCOUNTINGTOOLS (Oct. 8, 2019), https://www.accountingtools.com/articles/when-do-intangible-assets-appear-on-the-balance-sheet.html [https://perma.cc/FVF6-WPQ7] ("[I]f a company conducts expensive research for many years and eventually creates a valuable patent from this research, all of the associated cost is charged to expense as incurred - no intangible asset can be capitalized.").

170. *Id.*

171. *See* Carol A. Corrado & Charles R. Hulten, *How Do You Measure a "Technological Revolution"?*, 100 AM. ECON. REV. 99, 99 (2010).

172. *See id.* at 102 tbl.1.

173. Morck et al., *supra* note 6, at 296.

intangible capital that Ryan Peters and Lucian Taylor have developed based on the firm's prior expenditures on research and development plus prior selling, general, and administrative expenditures.[174] With this estimate, Peters and Taylor calculated a modified version of Tobin's q for all firms in the Compustat database from 1950 through 2015, which they refer to as Total q.[175] Writing in the "Macro q" tradition, they find that Total q is associated with total investment (i.e., investment in both physical and intangible capital).[176]

Importantly, the Peters and Taylor dataset includes their estimate of the replacement value of intangible capital that is *not* reflected on a firm's balance sheet.[177] Using these data, we estimate the extent to which the omission of intangible property from a firm's reported book value of assets creates bias in Simple q. As with current assets, we find in Appendix A, Table A.2 that a firm's level of intangible assets is positively associated with a firm's Simple q even after controlling for industry- and firm-fixed effects.

Put simply, the failure of book value to capture a firm's investment in intangible property results in the systematic upward bias of Simple q for firms that make larger intangible property investments. This result has intuitive support: markets likely place *some* value on a firm's intangible capital (thus increasing the numerator used in Simple q), yet Simple q fails to account for the replacement costs of these assets (thus biasing downward the denominator for Simple q). To provide a concrete example: in 2010, Microsoft had a Simple q of 3.27 but a Total

174. *See infra* app. A, tbl. A.2; *see also* Peters & Taylor, *supra* note 20, at 252:

> We interpret research and development (R&D) spending as an investment in knowledge capital, and we apply the perpetual-inventory method to a firm's past R&D to measure the replacement cost of its knowledge capital. We similarly interpret a fraction of past selling, general, and administrative (SG&A) spending as an investment in organization capital, which includes human capital, brand, customer relationships, and distribution systems.

175. Formally, Peters and Taylor calculate Total q as the following:

$$q_{it}^{tot} = \frac{V_{it}}{K_{it}^{phy} + K_{it}^{int}}$$

where q_{it}^{tot} is their measure for Total q for each firm i as of the end of fiscal year t, V_{it} is the market value of outstanding equity plus the book value of debt less the firm's current assets in year t, K_{it}^{phy} is the book value of the firm's PPE in year t, and K_{it}^{int} is their estimate for the replacement cost of the firm's intangible capital in year t. *Id.* at 252.

176. *See id.* at 260 ("[T]otal q explains intangible investment slightly better than physical investment in our full sample, and it explains total investment even better.").

177. *See id.* at 256–57 (explaining the methodology for measuring the replacement value of intangible assets).

q of 1.77, largely due to the fact that its book value of $86 billion did not reflect an estimated $54 billion of intangible assets.[178]

As with current assets, the coefficient bias that arises because intangible assets are excluded from Simple q can affect the results of empirical studies. A researcher might think they have spotted a relationship between some aspect of corporate law and firm value, but in fact the relationship between Simple q and the corporate law variable could be due, at least in part, to the correlation between the corporate law variable and the level of a firm's intangible assets.

Finally, the fact that Simple q is a ratio rules out conventional approaches to addressing the bias created by either aggregation of assets or the omission of assets from book value. For instance, in many contexts where a dependent variable is measured with error, simply adding as a regressor a control variable that proxies for the mismeasurement error can diminish any possible bias. However, this approach is not possible when the outcome variable is a ratio with a mismeasured denominator. The intuition can be seen by comparing the following two equations:

$$y_i^* + \mu_i = \alpha_i + \beta_1 X_i + \epsilon_i \qquad \text{(A)}$$

$$\frac{y_i^*}{\theta_i + \mu_i} = \alpha_i + \beta_1 X_i + \epsilon_i \qquad \text{(B)}$$

If μ_i represents measurement error, "controlling" for it in a regression framework effectively means moving it from the left-hand side of the equation to the right-hand side. In equation (A), we can do so by subtracting μ_i from both sides of the equation (in a regression setting, this is accomplished by adding a control variable to proxy for it), leaving the other variables ($\alpha_i + \beta_1 X_i + \epsilon_i$) unaffected. In contrast, equation (B) requires us to *multiply* both sides of the equation by

$$\frac{\theta_i + \mu_i}{\theta_i}$$

This would transform all right-side variables by the same ratio, creating a host of econometric problems in the process. In related work, we explore this empirical challenge in more detail and provide a method to address the problem of measurement error in the denominator of a

178. We calculate Microsoft's Simple q using Compustat data for Microsoft's 2010 fiscal year; we obtain Microsoft's 2010 Total q from the Peters and Taylor dataset available at WHARTON RES. DATA SERVS., https://wrds-www.wharton.upenn.edu (last visited Feb. 24, 2020) [https://perma.cc/FNA9-APVT].

ratio such as Simple q.[179] The bottom line is that simply adding a control for μ_i will not control for the bias arising from mismeasurement of the denominator in equation (B). Remarkably, this basic arithmetical problem with addressing measurement error in Simple q has gone unnoticed in both the finance and legal literatures.

In short, scholars who rely on Simple q face a serious problem of measurement error bias. They cannot find solace in the argument that although any measurement error in the outcome variable (e.g., Simple q) might create large standard errors when estimating treatment effects, it does not otherwise create biased estimates of these treatment effects. As noted, that argument assumes the measurement error in Simple q conforms to the classical errors-in-variable model—an assumption that is inappropriate when measurement error is nonrandom and when it affects a ratio that is an outcome variable.

C. Q *and Equity Returns*

We conclude this Part by pointing out an interesting puzzle: firms with high Simple q have lower future equity returns, and vice versa. This empirical relationship is robust, as we demonstrate below. We hope researchers who draw conclusions about corporate law and corporate governance based on Tobin's q will take notice of this point and engage with the puzzle. We expect that scholars will interpret our results in a variety of ways; we do not want to dictate their response. Our goal here is simply to set forth the empirical relationship between q and returns and provide some potential interpretations; it is not to resolve the puzzle definitively.

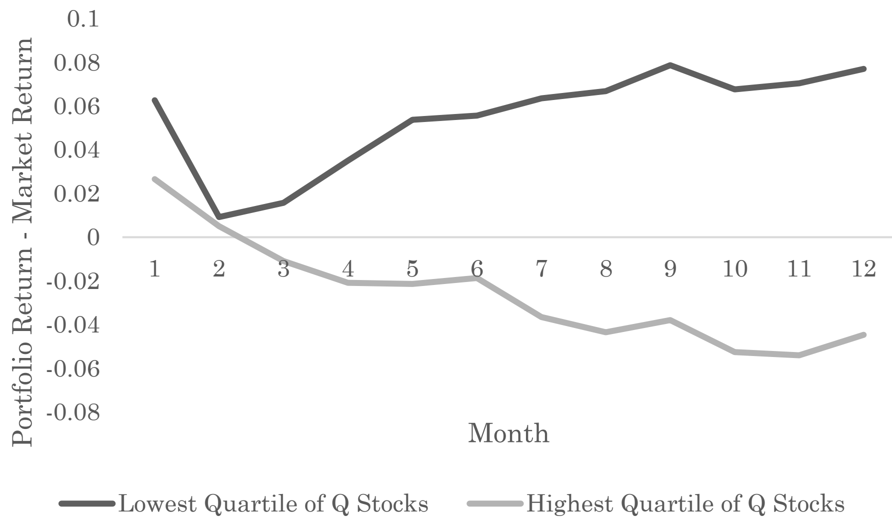
To conduct our empirical analysis, we used historical stock price data from the Center for Research in Security Prices ("CRSP") to construct two equally weighted stock portfolios for each January from 1980 through 2009, and we evaluated these portfolios for the following twelve months. In the first portfolio, we selected the stocks of all firms with a fiscal year ending on December 31 whose Simple q fell within the lowest quartile of Simple q for these firms as of December 31 for the prior year. In the second, we constructed an identical portfolio except that we selected the stocks of all firms whose Simple q fell within the highest quartile of Simple q as of December 31 for the prior year.[180] (For instance, when forming the January 1, 1989 portfolio, we selected stocks based on their Simple q for December 31, 1988.) We then

179. *See* Bartlett & Partnoy, *supra* note 25.

180. On average, each annual portfolio had approximately nine hundred securities assigned to it.

compared how these two annual portfolios fared over the ensuing twelve months relative to an investor who simply invested in an S&P 500 index fund on January 1. Figure 1 presents the average cumulative monthly return differentials between each portfolio and the S&P 500.

FIGURE 1: CUMULATIVE MONTHLY PORTFOLIO RETURNS RELATIVE TO MARKET PORTFOLIO



Clearly, an investor who formed these annual portfolios would have done significantly better by focusing on firms that fell within the lowest quartile of Simple *q* during the prior December. On average, the "low *q*" portfolio outperformed the S&P 500 by approximately seven percent by the end of each twelve-month period. In contrast, an investor who assumed that firms with high Simple *q* created stockholder value within a one-year time horizon would have been sorely disappointed. Indeed, this investor would have consistently underperformed an investment in the S&P 500.

In Appendix B, we present a more formal analysis utilizing risk-adjusted returns and controlling for year- and firm-fixed effects; the results are consistent with Figure 1.[181] In unreported results, we also find that the inverse relationship between Tobin's *q* and returns persists whether we define Tobin's *q* using Simple *q* or Total *q*.

181. *See infra* app. B.

If these questions, and the above findings, sound familiar to scholars in law and finance, it is because they are: the finance literature has demonstrated a robust relationship between a risk factor that resembles Simple *q* and future equity returns. Indeed, our results above are consistent with a widely cited literature in asset pricing, originating with the pioneering work of Eugene Fama and Kenneth French.[182] To our knowledge, the connection between this literature and Simple *q* has not previously been made by researchers who use Simple *q* as a proxy for firm value.

In a series of papers, Fama and French showed that by adding several "risk factors" to the Capital Asset Pricing Model, they could explain expected returns of U.S. common stocks better than that widely used model. Most notably for our purposes, they examined the excess returns of "value" stocks, which they identified as those with a high book-to-market ratio.[183] The Fama and French "HML" (high minus low) risk factor resembles the reciprocal of Simple *q*, except that it uses only the market and book value of equity, not the full capital structure. In other words, Tobin's *q* and HML capture similar phenomena.

More recently within asset pricing, a robust debate has emerged regarding the reason for this empirical relationship. As is often the case in asset pricing, the debate generally hinges on the extent to which one believes markets are subject to behavioral biases. Fama and French, for instance, initially theorized that if markets are efficient in pricing stocks, the higher expected returns for "value" stocks indicate that investors must demand more compensation for investing in these securities because these securities are more risky (i.e., investors expect that returns from investing in value stocks will have high volatility).[184] Other scholars, however, have theorized that whether a firm is a "value" stock may reflect market inefficiencies that can affect managers' investment decisions, which might explain the link between future returns and HML (and Simple *q*). For instance, in an influential paper, Christopher Polk and Paola Sapienza suggest that a firm's stock price might be overvalued due to mispricing by equity markets, which encourages managers to overinvest.[185] Empirically, they advance this

182. *See, e.g.*, Fama & French, *supra* note 22.

183. *See id.* at 35–40 (finding that stock portfolios formed on the basis of firms' book-to-market ratios are systematically related to returns in excess of those predicted by the Capital Asset Pricing Model).

184. *See* Eugene Fama & Kenneth French, *The Cross-Section of Expected Stock Returns*, 47 J. FIN. 427, 428 (1992) (speculating that "[f]irms that the market judges to have poor prospects, signaled here by low stock prices and high ratios of book-to-market equity, have higher expected stock returns (they are penalized with higher costs of capital) than firms with strong prospects").

185. Christopher Polk & Paola Sapienza, *The Stock Market and Corporate Investment: A Test of Catering Theory*, 22 REV. FIN. STUD. 187 (2009).

argument by constructing a mispricing metric and find that it is positively related to investment.[186] They also find an inverse relation between capital investment and future equity returns.[187] In combination, they argue that this evidence suggests that overpriced firms tend to overinvest and underpriced firms tend to underinvest,[188] which could also account for the inverse association between q and equity returns shown in Figure 1.

More recently, Lu Zhang has advanced an alternative explanation that endogenizes a firm's investment and its returns.[189] According to this "Investment CAPM" theory, the findings documented by Polk and Sapienza (among others) are entirely consistent with Tobin's original theory, and the relatively low expected returns for high-q, high-investment firms are what one would expect to see if managers are in fact optimizing as postulated by Tobin. To understand why, consider two firms, A and B, that each expect a $1 investment in capital (net of adjustment costs) to produce $1.20 of future cash flows. If we observe that only firm A makes the $1 investment, the Investment CAPM posits that the discount rate for firm A (and therefore, its expected returns) must be lower than the discount rate for firm B.[190] Moreover, if markets are efficient, this will also mean that firm A will have a higher marginal q than firm B.[191] In this fashion, firm A's higher investment levels, higher q, and lower expected returns are all endogenously determined.

To be sure, the Investment CAPM also predicts that high-investment firms could also be firms that have a high marginal product of capital because they are simply more efficient. For instance, we would also observe that firm A invests $1 when firm B does not invest if firm A and firm B have the *same* discount rate (i.e., they have the same cost of capital), but firm A expects to generate greater future cash flows from an investment of $1 than firm B does. Note, however, that the Investment CAPM is agnostic as to whether firm A's greater investment

186. *Id.* at 190–200.

187. *Id.* at 204–09.

188. *Id.* at 212–13.

189. Lu Zhang, *The Investment CAPM*, 23 EUR. FIN. MGMT. 545, 593 (2017) ("In general equilibrium, risks, expected returns and characteristics are all endogenously determined simultaneously.").

190. For example, the present value of $1.20 received in one year at a discount rate of 20% is $1.00 (i.e., 1.20 / 1.20); however, using a discount rate of 15% would produce a present value of approximately $1.04 (i.e., 1.20 / 1.15).

191. Marginal q is simply the ratio of the present value of the marginal benefits of investment to the marginal cost of investment (net of adjustment costs). Thus, if the present value of the marginal benefit of a $1 investment by firm A was $1.04 and only $1.00 for firm B, the marginal q for firm A would be 1.04, while the marginal q of firm B would be 1.00.

is a function of its marginal productivity of capital or its cost of capital. Nor does Investment CAPM place any interpretation on what it means for a firm to have either a low or high cost of capital; in contrast to the Fama and French model, it does not assume that a firm's cost of capital must reflect risk.[192]

Yuhang Xing further explores empirically the possibility that a firm's high q can reflect either a high marginal productivity of capital or a low cost of capital.[193] Xing finds that portfolios of firms with low investment growth have significantly higher average returns than portfolios of firms with high investment growth, even after controlling for the marginal productivity of capital. As Xing summarizes, these findings indicate that "higher Q and investment are more likely to result from lower expected returns in the future, rather than from a high marginal product of capital."[194] Xing further notes that the evidence suggests that firm-level capital investment is more likely to be driven by variation in future discount rates than by variation in the future productivity of its capital.

We are not advocating any particular view: the debate about the relationship between q, investment, and expected returns is ongoing in the asset pricing literature, and we will follow it with interest. Our main contribution here is to show researchers this link between empirical corporate finance and asset pricing and to highlight the challenge that this literature poses for scholars who use q as a proxy for firm value. Put simply, researchers in empirical corporate finance have been using a proxy for firm value that researchers in asset pricing have been using, in similar form, for different purposes and with different interpretations. For some of these researchers, increases in q reflect market mispricing, which is followed by low returns to equity as the mispricing dissipates and management overinvests. For others, increases in q reflect a decrease in the expected volatility of a company's stock returns. And for still others, increases in q may very well reflect stochastic reductions in a firm's discount rate, not enhanced profitability. Under all of these theories, stockholders of high-q firms can be expected to earn low future returns.

It is a puzzle for scholars who sanguinely conclude that a corporate law change is normatively desirable because it is associated

192. *See, e.g.*, Zhang, *supra* note 189, at 593 ("I interpret the q-factor model as a parsimonious description of the cross section of expected returns, not necessarily a risk factor model, and the q-factor loadings as regression slopes, not necessarily measures of some inexplicable sources of risk.").

193. Yuhang Xing, *Interpreting the Value Effect Through the Q-Theory: An Empirical Investigation*, 21 REV. FIN. STUD. 1767 (2008).

194. *Id.* at 1783.

with a higher measure of Simple *q*. At minimum, they should engage with the asset pricing literature's findings that the book-to-market ratio is associated with relatively lower returns. We look forward to seeing how these scholars attempt to resolve this puzzle.

III. IMPLICATIONS FOR CORPORATE GOVERNANCE AND SOCIAL SCIENCE RESEARCH

In the preceding pages we have sought to convince readers that the common use of Simple *q* as a proxy for firm value is fundamentally flawed as a matter of intellectual history, as a matter of logic, and as a matter of empirics. Here, we conclude by taking stock of the widespread reliance on this flawed proxy for firm value with respect to both the state of corporate governance research and, more generally, the current "replication crisis" in social science.

First and most obviously, the growing use and reliance on Simple *q* as a proxy for firm value raises troubling questions about the large body of empirical scholarship that examines how corporate governance affects firm value. Indeed, in Appendix C, we conduct a replication study to examine empirically how the flaws in Simple *q* can produce inaccurate empirical findings that have subsequently been used to draw conclusions about what constitutes "good" versus "bad" corporate governance. Our findings confirm that the flaws we document in Simple *q* can, in fact, lead to inaccurate empirical conclusions.

In our replication study, we focus on reexamining the results of Lucian Bebchuk, Alma Cohen, and Allen Ferrell's seminal paper, *What Matters in Corporate Governance?*[195] Published in 2008 in the *Review of Financial Studies*, the article has been cited over 915 times according to Web of Science[196] and has been downloaded over thirty thousand times on the Social Science Research Network.[197] In their paper, Professors Bebchuk, Cohen, and Ferrell ("BCF") hypothesize that governance provisions that "entrench[ ]" management can have negative implications for firm value.[198] To test this hypothesis, BCF construct an Entrenchment Index—or E-Index—based on four provisions that materially constrain shareholder influence (staggered boards, limits to shareholder bylaw amendments, supermajority

195. *See* Bebchuk et al., *supra* note 5.

196. *What Matters in Corporate Governance?*, WEB SCI., http://apps.webofknowledge.com/full_record.do?product=WOS&search_mode=AuthorFinder&qid=21&SID=5DRzNduOmAxJoKHMr3p&page=1&doc=3 (last visited Feb. 24, 2020) [https://perma.cc/V8X7-TYZD].

197. *What Matters in Corporate Governance*, SSRN, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=593423 (last visited Feb. 24, 2020) [https://perma.cc/4YJH-9WSZ].

198. *See* Bebchuk et al., *supra* note 5, at 784.

requirements for mergers, and supermajority requirements for charter amendments) and two that interfere with the market for corporate control (poison pills and golden parachutes).[199] Consistent with their hypothesis, BCF find that increases in the level of the E-Index are monotonically associated with economically significant reductions in firm value as measured by Simple *q*.[200] Moreover, BCF find that, upon controlling for the presence of entrenching governance provisions, other governance provisions that had previously been shown to affect Simple *q* no longer have any effect.[201]

In Appendix C, we replicate BCF's core findings using Simple *q,* finding (as did BCF) an inverse relationship between management entrenchment—as measured by the E-Index—and Simple *q*. Yet we also find that if we use the Peters and Taylor Total *q* as our proxy for firm value instead of Simple *q*, the results in BCF disappear: the reduction in statistical significance is dramatic.[202]

As noted previously, Total *q* is an alternative estimate for "true" Tobin's *q* and attempts to include in the denominator of Total *q* a firm's level of intangible property. Peters and Taylor designed this estimate of Tobin's *q* because intangibles are typically omitted from a firm's book value of assets, which creates the likelihood that a firm's Simple *q* will be biased upward if it makes large investments in intangibles. The availability of the Total *q* dataset therefore allows us to answer a critical question implicated by BCF's decision to use Simple *q* as a proxy for firm value: if firms with low levels of the E-Index have high levels of intangibles, could this mean that the BCF finding was simply an artifact of bias in Simple *q*?

As we show in Appendix C, our replication of the BCF study confirms that this is in fact the case for BCF's central, causal finding. Firms having high levels of unbooked intangibles (as estimated in the Peters and Taylor dataset) have low levels of the E-Index. Moreover, simply substituting Total *q* for Simple *q* in the fixed-effects regression framework used by BCF shows that Total *q* has *no* statistically meaningful relationship with a firm's level of the E-Index.

By itself, our replication analysis has considerable implications for the current state of corporate governance research. For one, BCF's empirical finding of a negative association between the E-Index and firm value has significantly informed how institutional investors decide what constitutes "good" and "bad" corporate governance in voting at

199. *See id.* at 784–85.

200. *Id.*

201. *See id.* at 821–23.

202. *See supra* notes 174–175 and accompanying text (discussing the modified calculations of Peters and Taylor).

shareholder elections.[203] For another, the governance index developed in the paper—the Entrenchment Index—is today a standard regressor in corporate governance research with over three hundred studies utilizing it.[204] Yet, as with shareholders citing BCF when forming governance voting polices, the primary rationale for relying on the BCF paper stems from its empirical findings that the E-Index can affect firm value—a finding that turns out to be highly dependent on the particular proxy that they use for Tobin's q.

Additionally, BCF's paper helped usher in a wave of studies adopting the same methodology to investigate the relationship between Simple q and various corporate governance characteristics. Today the BCF empirical framework of regressing Simple q on a governance provision of interest is the standard empirical framework for examining how any number of corporate characteristics can affect firm value. This is true both with respect to studies examining U.S. firms, as well as with respect to international studies designed to inform policy. Most notably, these studies have been especially influential in shaping how scholars and policymakers evaluate the relative merits of various corporate governance regimes, particularly within emerging markets. Many explicitly adopt the framework utilized by BCF insofar that they examine how various governance and firm characteristics predict levels of Simple q.[205] In light of our replication study of BCF, we can only

203. For instance, two of the largest public pension funds—CalSTERS and CalPERS—have expressly cited the study as the basis for multiple declassification proposals submitted to publicly traded companies. *See, e.g.*, Titan International, Inc., Notice of Exempt Solicitation (Form PX14A6G) (May 18, 2015), https://www.sec.gov/Archives/edgar/data/1081019/000092189515001407/px14a6g00322tii_05182015.htm [https://perma.cc/QW3J-VLDN] ("A staggered board has been found to be one of six entrenching mechanisms that are negatively correlated with company performance, see "What Matters in Corporate Governance?" Lucian Bebchuk, Alma Cohen & Allen Ferrell, Harvard Law School, Discussion Paper No. 491 (09/2004, revised 04/2009)"); Letter from Charles E. Baker, Vice President & General Counsel, Ball Corp., to Office of Chief Counsel, Sec. & Exch. Comm'n Ex. A (Dec. 21, 2009), https://www.sec.gov/divisions/corpfin/cf-noaction/14a-8/2010/calpers012510-14a8.pdf [https://perma.cc/2SQE-8Q64] (shareholder proposal submitted by CalPERS citing the same). Companies have likewise cited the study in their own proposals for board declassification. *See, e.g.*, Rofin-Sinar Technologies, Inc., Proxy Statement Pursuant to Section 14(a) of the Securities Exchange Act of 1934, at 16 (Schedule 14A) (Feb. 23, 2016) https://www.sec.gov/Archives/edgar/data/1019361/000156761916001859/s001156x10_defn14a.htm [https://perma.cc/EW7Z-JXMX] (citing BCF as support for an advisory vote to declassify the company's board of directors).

204. *See Entrenchment Index of Bebchuk, Cohen and Ferrell Applied by More Than 300 Research Papers*, HARV. L. TODAY, (June 11, 2015), https://today.law.harvard.edu/more-than-300-research-papers-have-applied-the-entrenchment-index-of-bebchuk-cohen-and-ferrell/ [https://perma.cc/7CUW-QWTR] (remarking on the paper's circulation and influence).

205. *See, e.g.*, Marcus V. Braga-Alves & Kuldeep Shastri, *Corporate Governance, Valuation, and Performance: Evidence from a Voluntary Market Reform in Brazil*, 40 FIN. MGMT. 139 (2011) (analyzing whether corporate governance efforts were significantly related to firm value and operating performance using Simple q); Yan-Leung Cheung et al., *Does Corporate Governance*

suspect that the many studies that follow BCF in using Simple *q* as a proxy for firm value likewise suffer from the bias arising from using Simple *q* as an outcome variable.

Finally, our critique of BCF, combined with the history of Tobin's *q* described in Part II, contributes to the "replication crisis" debate in social science generally. Over the past several years, researchers across a range of disciplines have been unable to replicate a number of notable empirical findings due to both intentional data falsification as well as selective reporting of data and statistical tests.[206] The crisis has been especially prominent in the field of psychology where data from a large ongoing replication project has revealed a surprisingly high percentage of prior studies that cannot be replicated.[207] Related efforts have sought to ensure the replicability of future findings by, among other things, requiring the preregistration of research hypotheses and modifying the procedures for determining statistical significance.[208]

We add two important new elements to the broader academic debate about replication. First, we demonstrate the importance of close historical analysis, beyond a simple literature review, particularly to ensure that scholars understand how the constructs they are examining have changed over time. By the 1990s, the original story of Tobin's *q* played little role in scholars' decisions to adopt Simple *q* as a proxy for

Predict Future Performance? Evidence from Hong Kong, 40 FIN. MGMT. 159 (2011) (examining the relation between changes in the quality of corporate governance practices and subsequent market valuation among large listed companies in Hong Kong using Simple *q*); Beverley Jackling & Shireenjit Johl, *Board Structure and Firm Performance: Evidence from India's Top Companies*, 17 CORP. GOVERNANCE 492 (2009) (analyzing the relationship between internal governance structures and financial performance using Simple *q*); Jonchi Shyu, *Family Ownership and Firm Performance: Evidence from Taiwanese Firms*, 7 INT'L J. MANAGERIAL FIN. 397 (2011) (using Simple *q* as a valuation indicator to analyze the effect of family ownership on firm performance); Kun Wang & Xing Xiao, *Ultimate Government Control Structure and Fair Value: Evidence from Chinese Listed Companies*, 2 CHINA J. ACCT. RES. 13 (2009) (examining the impact of government control structures on firm value of Chinese companies using Simple *q*); Lijun Xia, *Founder Control, Ownership Structure and Firm Value: Evidence from Entrepreneurial Listed Firms in China*, 1 CHINA J. ACCT. RES. 31 (2009) (investigating the effect of the deviation between the controlling shareholders' voting rights and their cash flow rights on firm value using Simple *q*).

206. For a summary, see Rotello et al., *supra* note 24.

207. *See id.* (discussing the problems of replication and misinterpretation plaguing psychological studies); *see also Effort to Estimate the Reproducibility of Psychological Science*, *supra* note 24 (describing a large-scale replication project within psychology).

208. *See* Joseph P. Simmons, Leif D. Nelson & Uri Simonsohn, *False-Positive Psychology: Undisclosed Flexibility in Data Collection and Analysis Allows Presenting Anything as Significant*, 22 PSYCHOL. SCI. 1359 (2011) (providing four guidelines for researchers in psychology to reduce the risk of false-positive findings); Joseph E. Gonzales & Corbin A. Cunningham, *The Promise of Pre-Registration in Psychological Research,* PSYCHOL. SCI. AGENDA (Aug. 2015), https://www.apa.org/science/about/psa/2015/08/pre-registration [https://perma.cc/647S-YJXM] (describing journals where researchers either have the option or are required to submit their research rationale, hypotheses, design and analytic strategy to the journal for peer review before beginning the study).

Tobin's *q*. Scholars who do not focus on the historical origin of the constructs they are testing risk repeating the kinds of errors associated with Simple *q*. We caution academics to be especially wary of constructs that have acquired technical labels, including the names of prominent scholars, but whose meaning has strayed from the original concept.

Second, we show that it is important not only to replicate past studies, but to validate them. Our replication of BCF's study highlights how the inability to replicate a study is just one way in which empirical analysis can fail. We were able to replicate BCF's findings. However, we also showed that the statistical significance of BCF's replicated findings disappears when we use an alternative dependent variable that arguably corrects some (but not all) of the flaws in BCF's dependent variable. In other words, the replication problem we have identified in corporate governance scholarship goes beyond the *reliability* problem that has been demonstrated in the social sciences: we raise questions about the *validity* of studies that use Simple *q*.

Validity and reliability are core principles of the scientific method, and both are required in evaluating the accuracy of an empirical test.[209] In general, the validity of a scientific test is the extent to which "it measures what it purports to measure."[210] Reliability, on the other hand, is a term used to describe the consistency or stability of test results. As an illustration of these concepts, consider a scale that consistently mismeasures the weight of an individual by subtracting ten pounds from the individual's true weight. Such a scale would be *reliable* insofar that repeated attempts to weigh the same group of individuals would result in similar findings. But the scale itself would lack *validity* as a measure for these individuals' true weight.

Moreover, knowledge of the scale's history could be crucial. Suppose the scale became progressively less accurate each year (just as a financial variable that omitted intangible assets might become progressively less accurate over time, as intangible assets increase). A person who observes a declining value on the scale over the course of a decade might incorrectly assume they have lost weight, just as a scholar might make incorrect assumptions about changes in Simple *q*.

Identifying the story of Tobin's *q* as an issue of validity rather than reliability helps explain the persistent use of Simple *q* while highlighting how current efforts to address the "replication crisis" are

209. Indeed, these concepts are central to evaluating the admissibility of expert testimony. *See* David Medoff, *The Scientific Basis of Psychological Testing: Considerations Following* Daubert*,* Kumho*, and* Joiner, 41 FAM. CT. REV. 199 (2003) (explaining the principles of validity and reliability, particularly as applied to the forensic use of psychological evaluation, and discussing recent precedent expounding these precepts).

210. MARY J. ALLEN & WENDY M. YEN, INTRODUCTION TO MEASUREMENT THEORY 113 (2001).

largely ill-equipped to address empirical problems arising from the use of invalid measures.[211] Most notably, efforts designed to ensure greater empirical reliability—e.g., publicly sharing datasets, preregistering hypotheses, adjusting significance tests—do little to dislodge the use of invalid measures, such as Simple *q*. On the contrary, as more and more researchers adopt an invalid measure either to replicate results or reinterpret prior results, the very emphasis on reliability can have the pernicious effect of entrenching the use of the measure. Indeed, within psychology, Caren Rotello, Evan Heit, and Chad Dubé note that the problem of using invalid measures may be more troubling than the problem of failing to replicate empirical findings based on those measures. As they note,

> This problem—of dramatically and consistently "getting it wrong"—is potentially a bigger problem for psychologists than the replication crisis, because the errors can easily go undetected for long periods of time. The probability of self-correction is low, even if ever larger numbers of researchers work on these same (and similar) problems . . . Nor is peer review likely to provide a solution: Once an effect is "established," it may become challenging to persuade reviewers that the data should be analyzed differently.[212]

As this paper shows, a similar conclusion can also be drawn about the use of Simple *q*.

In the absence of clear statistical solutions to the problem of invalid measures, Rotello, Heit, and Dubé conclude that addressing the problem ultimately requires "scientific discipline."[213] As they elaborate, "It requires careful attention to the details of [dependent variables], thorough awareness of their assumptions, and deliberate testing of their validity."[214] Drawing on both intellectual history and empirical methods, the approach we have taken aims to provide precisely this type of analysis of Simple *q*, revealing it to underperform on all fronts. At the same time, we hope our critique will encourage scholars to explore using more direct measures of firm value rather than an invalid measure such as Simple *q*.

Of course, only time will tell whether our critique will be sufficient to alter the current state of corporate governance research. Meanwhile, we hope to instill among law and finance scholars a healthy skepticism about relying on the prevailing methodological orthodoxy.

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211. *See* Rotello et al., *supra* note 24, at 944.
212. *Id.* at 950–51.
213. *Id.* at 951.
214. *Id.*

CONCLUSION

Many of the most important findings in corporate law scholarship are based on studies that rely on a modified version of a firm's market-to-book ratio. Although these studies call this ratio "Tobin's *q*," the difference between it—what we call "Simple *q*"—and Tobin's *q* as originally defined are significant. Because Simple *q* is a ratio based on a firm's book value of assets, studies that use Simple *q* are likely to produce biased estimates due to both omitted assets (e.g., intangibles) and firm-specific details that can systematically alter Simple *q* (e.g., the level of current assets, depreciation, and so on). As a result, scholars should view with suspicion any assertions about corporate law or corporate characteristics that are based on Simple *q*.

Given the importance of understanding how corporate law and governance can affect the value of a corporation's securities, we hope to inspire a broader conversation about the challenge of measuring firm value. Until scholars find a more reliable way to assess the relationship between corporate governance and firm value, they should stop relying on Simple *q*, or market-to-book, a measure that masquerades as Tobin's *q*, but is not.

APPENDIX A: CURRENT ASSETS AND INTANGIBLES

Table A.1 presents our test of the relationship between current assets and Simple *q*. We calculate Simple *q* for all nonfinancial Compustat firms between 1990 and 2010 as of the end of each firm's fiscal year.[215] For each firm, we also determine the fraction of the firm's total book value of assets that consists of current assets for that fiscal year. We present the results of two regressions in which we regress a firm's Simple *q* on this ratio (*% Current Assets*) for the same year. We also include as a covariate the inverse of a firm's book value to avoid the risk of spurious correlation on account of the presence of book value in both the denominator of Simple *q* and *% Current Assets*.[216] In Column 1, we conduct the regression controlling for industry- and year-fixed effects (with robust standard errors clustered by firm); in Column 2, we control for firm- and year-fixed effects.[217]

TABLE A.1: CURRENT ASSETS AND SIMPLE *Q*

	(1)	(2)
% Current Assets	2.617***	2.748***
	[0.393]	[0.236]
1 / (Book Value)	0.508***	0.278***
	[0.181]	[0.016]
Industry FE	Y	N
Firm FE	N	Y
Year FE	Y	Y
N	106,856	106,856

Robust standard errors (clustered by firm) in brackets.
*** p<0.01, ** p<0.05, * p<0.1.

As shown in both columns, a firm's level of current assets is positively associated with a firm's Simple *q* even after controlling for industry- and firm-fixed effects. Overall, these regression estimates are consistent with the market attributing a higher *q*-ratio to current assets.

Table A.2 illustrates the association between a firm's intangible assets and Simple *q*. As in Table A.1, we calculate Simple *q* for all

215. We exclude firms having a Standard Industrial Classification ("SIC") code between 6,000 and 7,000.

216. The necessity for including this covariate is discussed in Bartlett & Partnoy, *supra* note 25; and Kronmal, *supra* note 143, at 381–84.

217. We use 2-digit SIC codes to control for industry fixed effects.

nonfinancial Compustat firms between 1990 and 2010 as of the end of each firm's fiscal year.[218] For each firm *i*, we calculate the percentage of a company's assets *(% Intangibles*$_{i,t}$*)* in fiscal year *t* that consists of intangible assets that are unrecorded in book value.[219] As in Table A.1, we present the results of two regressions in which we regress a firm's Simple *q* on this ratio (*% Intangibles*) for the same year, along with the inverse of a firm's book value. In Column 1, we conduct the regression controlling for industry- and year-fixed effects (with robust standard errors clustered by firm); in Column 2, we control for firm- and year-fixed effects.

TABLE A.2: INTANGIBLE ASSETS AND SIMPLE *Q*

	(1)	(2)
% Intangibles	3.982***	4.430**
	[0.673]	[2.185]
1 / (Book Value)	0.506***	0.277***
	[0.182]	[0.020]
Industry FE	Y	N
Firm FE	N	Y
Year FE	Y	Y
N	133,745	133,745

Robust standard errors (clustered by firm) in brackets.
*** p<0.01, ** p<0.05, * p<0.1.

Column 1 shows that firms with large unbooked intangible assets have larger estimates of Simple *q*. Column 2 confirms this result even after controlling for firm-fixed effects.

218. As above, we exclude firms having an SIC code between 6,000 and 7,000; we similarly use two-digit SIC codes when controlling for industry-fixed effects.

219. Estimates of unbooked intangibles for individual firms are obtained from the Total *q* dataset created by Peters and Taylor. *See* Peters & Taylor, *supra* note 20, at 258 tbl.1 (providing summary statistics). The dataset is available through WHARTON RES. DATA SERVS., *supra* note 178.

APPENDIX B: SIMPLE *Q* AND CUMULATIVE ANNUAL RETURNS

In Table B.1, we present several empirical analyses of the relationship between shareholder returns and Simple *q*. In all analyses we use the monthly stock file at CRSP to estimate the cumulative one-year return for every security in CRSP between 1980 and 2010 as a function of the security's Simple *q* as of the beginning of each calendar year. As in Appendix A, we exclude firms having Standard Industrial Classification ("SIC") codes between 6,000 and 7,000. In Columns 1 and 2, we estimate this relationship using a security's gross cumulative annual return over year *t*. Our outcome variable of interest is the one-year buy-and-hold return from investing in each security *i* at the beginning of year *t*, as a function of the firm's Simple *q* as of the beginning of year *t*. We then conduct two regressions. In the first (Column 1), we regress this return on the natural log of the security's measure for Simple *q* as of the beginning of year *t*. In the second (Column 2), we regress this annual return on whether the security's Simple *q* fell within the first, second, third, or fourth quartile of all estimates of Simple *q* as of the beginning of year *t*. In both cases, we also control for year- and firm-fixed effects.

As shown in Columns 1 and 2, a security's Simple *q* is inversely related to the security's subsequent returns in both models. In Columns 3 and 4, we conduct the same analysis but rather than using a security's gross annual return, we use as our dependent variable the security's risk-adjusted cumulative annual return for the same time period. We calculate this last measure using the Fama-French-Carhart four-factor model, in which we estimate factor coefficients for each security *i* for year *t* using the security's monthly return data for the twenty-four-month period prior to and including December of year *t-1*. Using monthly returns for year *t,* we calculate monthly risk-adjusted returns as a security's actual return less the return predicted from the four-factor model, which we use to construct the cumulative risk-adjusted return over year *t*. Regardless of whether we examine gross returns or risk-adjusted returns, Simple *q* remains inversely associated with a security's subsequent annual returns.[220]

220. The results of Table B.1 remain unchanged if we estimate these regressions using the Fama-MacBeth procedure rather than firm- and time-fixed effects. *See* Eugene F. Fama and James D. MacBeth, *Risk, Return and Equilibrium: Empirical Tests*, 81 J. POL. ECON. 607 (1973) (using the two-parameter portfolio model to evaluate the connection between average return and risk of NYSE common stocks).

TABLE B.1: RETURNS AND SIMPLE *Q*

	(1)	(2)	(3)	(4)
	Annual Gross Return	Annual Gross Return	Risk-Adjusted Return	Risk-Adjusted Return
Ln(q)	-0.323***		-0.633***	
	[.0432]		[.0551]	
Second Quartile of *q*		-0.172***		-0.246***
		[0.0286]		[0.0167]
Third Quartile of *q*		-0.290***		- 0.480***
		[0.0413]		[0.0269]
Fourth Quartile of *q*		-0.458***		-0.898***
		[0.0679]		[0.0502]
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
N	177,191	177,191	177,191	177,191

Robust standard errors (clustered by year) in brackets.
*** p<0.01, ** p<0.05, * p<0.1.

APPENDIX C: BCF REPLICATION STUDY

We present in this Appendix our replication study of *What Matters in Corporate Governance?*, a widely cited paper by Lucian Bebchuk, Alma Cohen, and Allen Ferrell ("BCF"),[221] which was published in 2009 in the *Review of Financial Studies*. In addition to being highly influential within both the academy and industry, this paper was an ideal choice for two primary reasons. First, because BCF publicly provide much of their core dataset on Lucian Bebchuk's website, it is possible for us to replicate their study. Unfortunately, a large number of papers in empirical finance use hand-collected datasets that are not available to other researchers. Second, because BCF use Simple *q* as a proxy for Tobin's *q*, it is straightforward to compare their results with results that arise when one uses a different proxy for Tobin's *q*. Most notably, we focus on the measure of Total *q* developed by Peters and Taylor and discussed in the main text. As noted previously, this alternative measure of *q* attempts to address specifically the measurement error in Simple *q* arising from the omission of intangibles in book value. Accordingly, we can use Total *q* to examine how this well-known aspect of measurement error in Simple *q* might have biased prior findings.

BCF built on a seminal study published in 2003 by Paul Gompers, Joy Ishii, and Andrew Metrick ("GIM"), entitled *Corporate Governance and Equity Prices*.[222] In their study, GIM constructed a "Governance Index" based on twenty-four governance provisions tracked by the Investor Responsibility Research Center ("IRRC") to proxy for the level of shareholder rights at 1,500 large firms during the 1990s.[223] GIM investigated returns from investing in "good governance," an investment strategy that bought firms in the lowest decile of the index (strong shareholder rights) and sold firms in the highest decile of the index (weak shareholder rights).[224] Remarkably, the study reported that this strategy would have earned abnormal returns of 8.5 percent per year from 1990 through 1999.[225]

BCF hypothesized that only a subset of these provisions truly matter to investors, with those that "entrench" management being the most significant.[226] Accordingly, they constructed an Entrenchment Index—or E-Index—based on four IRRC provisions that materially

221. *See* Bebchuk et al., *supra* note 5.

222. *See* Gompers et al., *supra* note 5.

223. *See id.* at 114–19 (describing the Governance Index).

224. *See id.* at 144–45 (describing the study's conclusions).

225. *Id.* at 144.

226. Bebchuk et al., *supra* note 5, at 785.

constrain shareholder influence (staggered boards, limits to shareholder bylaw amendments, supermajority requirements for mergers, and supermajority requirements for charter amendments) and two that interfere with the market for corporate control (poison pills and golden parachutes).[227]

BCF found that increases in the level of the E-Index were monotonically associated with economically significant reductions in firm value as measured by Simple *q*.[228] Using the same framework as GIM, they also found that pursuing the same long-short investment strategy but focusing on buying firms with the lowest E-Index and shorting firms with the highest E-Index would have produced abnormal monthly returns of 116 basis points per month during the 1990s.[229] In contrast, the other eighteen IRRC provisions not in the entrenchment index were uncorrelated with either Simple *q* or abnormal returns.[230] BCF's finding that the results from GIM were driven primarily by the six entrenchment provisions made the paper highly influential in the corporate governance literature.[231]

To the extent BCF sought to advance the more ambitious claim that high entrenchment actually results in lower firm value or abnormal returns, BCF were more cautious given the largely correlational nature of their analyses. The paper concluded by noting: "We present some evidence that is consistent with the possibility that, in the aggregate, the entrenching provisions bring about or help maintain lower firm valuation. But this evidence does not establish causality and much more work needs to be done."[232]

The evidence that BCF found with respect to a possible causal relationship focused primarily on the fact that many of the firms within their sample altered their E-Index over time.[233] Accordingly, by exploiting the panel structure of the data, they examined how variation in the E-Index was associated with changes in Simple *q*, which revealed a negative relationship.[234] Describing this finding as "consistent" with a causal relationship, they tentatively noted: "[T]o the extent that the identified correlation between the provisions in our E index and firm

227. *See id.*

228. *See id.*

229. *See id.* at 815.

230. *See id.* at 816 tbl.10 (showcasing the monthly abnormal returns for the different E-Index portfolios).

231. *See supra* notes 203–205 and accompanying text.

232. *Id.* at 823.

233. *See id.* at 803 ("[T]here was meaningful variation in the incidence of some entrenching provisions over the 1990–2003 period, such as golden parachutes and limits on shareholders' ability to amend bylaws, that would result in changes in firms' entrenchment scores.").

234. *See id.*

value at least partly reflects a causal relation going from entrenchment to firm value, these provisions are ones that deserve the attention of private and public decision makers seeking to improve corporate governance."[235] Despite this qualified approach, the paper's widely cited findings nevertheless helped usher in a wave of studies examining the relationship between q and various corporate governance characteristics.

We begin our analysis by first investigating the extent to which the E-Index is correlated with measurement error in Simple q, or q^s. Because we are interested in examining the consequences of measurement error in Tobin's q, we make the strong (and unrealistic) assumption that Total q (q^{Total}) represents the "true" value of q. To the extent this were actually the case, Simple q would therefore contain multiplicative measurement error, φ_i, as follows:[236]

$$q_i^{Total} = q_i^s \varphi_i$$

We test empirically whether this measurement error in Simple q is correlated with the E-Index. All analyses are conducted on the same sample of firms used by BCF, which we obtain from Lucian Bebchuk's website.[237] For each firm, the file lists by year its corresponding E-Index value, and we calculate φ_{it} for each observation as q_{it}^{Total}/q_{it}^s. In Column 1 of Table C.1, we present coefficient estimates of a simple regression of the natural log of φ_{it} on *E-index*$_{it}$, including industry- and year-fixed effects.

235. *Id.* at 785, 787.

236. As noted in Part II, both the numerator of Simple q (denoted here as MV^*) and its denominator (denoted here as BV^*) mismeasure the true numerator and denominator of Tobin's q. *See supra* notes 146–162 (discussing evidence of measurement error in q calculations). If these true values are denoted *MV* and *RV*, respectively, we can express the relationship between "true" q and Simple q as follows:

$$True\ q = \frac{MV^*}{BV^*} x \frac{(BV^*)(MV)}{(MV^*)(RV)}$$

Thus, measurement error in Simple q is multiplicative, as reflected by the need to multiply Simple q by $\frac{(BV^*)(MV)}{(MV^*)(RV)}$ to transform Simple q into True q. We represent $\frac{(BV^*)(MV)}{(MV^*)(RV)}$ by the variable φ_i.

237. The dataset can be downloaded at the following link. *Data*, HARV. L., http://www.law.harvard.edu/faculty/bebchuk/data.shtml (last updated Feb. 2020) [https://perma.cc/5GLR-V73P].

TABLE C.1: MEASUREMENT ERROR AND THE E-INDEX

	(1)	(s)
DV→	Ln(φ_{it})	*Intangibles$_{it}$*
E-Index	-0.063***	-129.268***
	(0.015)	(49.083)
Book Value		0.019**
		(0.008)
Constant	-0.587***	273.304***
	(0.034)	(96.433)
Year-Fixed Effects	Y	Y
Industry-Fixed Effects	Y	Y
N	14,658	17,823
R-squared	0.265	0.169

Robust standard errors (clustered by industry) in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Column 1 of Table C.1 presents the coefficient estimate. As shown in the table, the coefficient of -0.063 has a standard error of 0.015, indicating a negative association between φ_i and the E-Index. In Column 2, we examine whether the E-Index is associated with different levels of unbooked intangibles. For each firm *i*, we obtain *Intangibles$_{i,t}$*, defined as the level of unbooked intangibles reported in the Peters and Taylor dataset at Wharton Research Data Services ("WRDS"), for each firm year and similarly regress it on *E-Index$_{it}$*, including industry- and year-fixed effects as well as a control for a firm's book value in year *t*. The coefficient of -141.658 is statistically significant. These latter results suggest that the negative correlation of φ_i and the E-Index is driven in part by the fact that firms having lower E-Index scores have a greater percentage of their assets in the form of unbooked intangibles.

Next, we replicate BCF's core finding regarding entrenchment and Tobin's *q*, which they estimate by using Simple *q*. As reflected in Table C.1, all analyses are conducted on the same sample of firms used by BCF. We present the results of this replication in the first two columns of Table C.2.

TABLE C.2:
REPLICATION OF BCF USING SIMPLE *Q* AND TOTAL *Q*—
POOLED REGRESSIONS

	(1)	(2)	(3)	(4)
E-Index	-0.118***		-0.225***	
	[0.00814]		[0.0258]	
E-Index 1		-0.278***		-0.362**
		[0.0520]		[0.158]
E-Index 2		-0.350***		-0.597***
		[0.0488]		[0.148]
E-Index 3		-0.452***		-0.714***
		[0.0485]		[0.146]
E-Index 4		-0.555***		-1.110***
		[0.0486]		[0.148]
E-Index 5-6		-0.687***		-1.014***
		[0.0556]		[0.198]
O-Index	0.00908*	0.00949*	0.00996	0.0103
	[0.00508]	[0.00510]	[0.0153]	[0.0154]
Log[Assets]	-0.0261***	-0.0286***	0.346***	0.344***
	[0.00869]	[0.00878]	[0.0327]	[0.0326]
Log[Age]	-0.128***	-0.128***	-0.777***	-0.773***
	[0.0156]	[0.0156]	[0.0523]	[0.0523]
Delaware Incorporation	0.00599	0.00694	-0.205***	-0.210***
	[0.0214]	[0.0214]	[0.0679]	[0.0680]
Insider Ownership	0.438	0.377	5.965***	5.855***
	[0.337]	[0.338]	[1.024]	[1.028]
Insider Ownership Squared	-1.125	-1.03	-9.770***	-9.603***
	[0.731]	[0.734]	[1.869]	[1.874]
ROA	1.686***	1.687***	2.832***	2.831***
	[0.220]	[0.219]	[0.328]	[0.326]
CAPX/Assets	1.637***	1.653***	-8.941***	-8.946***
	[0.203]	[0.203]	[0.633]	[0.634]
Leverage	-0.712***	-0.719***	-1.475***	-1.483***
	[0.0935]	[0.0936]	[0.271]	[0.272]
R&D per Sales	0.0208***	0.0209***	0.0291***	0.0291***
	[0.00632]	[0.00637]	[0.00688]	[0.00697]
Year-Fixed Effects	Y	Y	Y	Y
Firm-Fixed Effects	N	N	N	N
Number of Observations	11,336	11,336	11,336	11,336
R-squared	0.138	0.139	0.098	0.098

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

As in the BCF study, Column 1 presents the results of a pooled OLS regression for their sample firms for the 1992–2002 period. Following their original specification, we regress the industry-adjusted

Simple q for firm i in year t on the firm's E-index score for that year, holding constant a variety of variables. Consistent with BCF, we define a firm's industry-adjusted Simple q as a firm's Simple q minus the median Simple q in the firm's industry in the observation year (using two-digit SIC codes). Due to the existence of outliers, we winsorize this measure at one percent. We note that this differs slightly from the approach of BCF, who use as their dependent variable the log of a firm's industry-adjusted Simple q. We use winsorized, nontransformed industry-adjusted Simple q for two reasons. First, industry-adjusted Simple q can yield negative values, and BCF do not describe how they conducted their log transformation given the presence of these negative measures. Second, BCF report obtaining the same results using nontransformed industry-adjusted Simple q.

In all regressions in Table C.2, including the regression in Column 1, we include the same controls used in BCF, which include the assets of the firm (in logs), the age of the firm (in logs), whether the firm is incorporated in Delaware (0/1), the level of insider ownership (and its squared value), return on assets, capital expenditures (scaled by total assets), research and development ("R&D") expenditures (scaled by sales), and leverage. In keeping with BCF's approach, we also include as a control a firm's "O Index," which they define as a firm's IRRC provisions (reported by Gompers, Ishii, and Metrick)[238] minus its E-Index value. BCF include this latter variable to estimate how well the E-Index predicts firm outcomes relative to the other governance provisions tracked by IRRC. Finally, we include year-fixed effects and a dummy variable for missing R&D expenditures, also consistent with BCF.[239] As with BCF, we use robust standard errors to account for potential heteroskedasticity.

In Column 1, the coefficient on the E-Index is significantly negative, consistent with the findings of BCF. In Column 2, we further confirm the findings of BCF when we regress industry-adjusted Simple q on dummy variables that represent the different levels that the E-Index can take. As noted by BCF, this latter specification avoids the imposition of linearity on the E-Index's relationship with industry-adjusted Simple q. The results in Column 2 track those of BCF closely, with each level of the E-Index having an increasingly negative association with industry-adjusted Simple q. Moreover, across all six levels of the index, the results are significant at the one percent level.

238. *See* Gompers et al., *supra* note 5.

239. BCF appear to use a dummy for missing variables for R&D given the large number of observations for which R&D expenditures are missing. BCF do not specify how they implement this dummy variable substitution; therefore, we do so by substituting the median value of observed R&D values for missing R&D values and dummy code these observations as "missing R&D."

Similar to BCF, the coefficient on the O-Index is positive and significant in both columns, though only at the ten percent level.

In the third and fourth columns, we re-run each of these specifications using industry-adjusted Total *q* rather than industry-adjusted Simple *q*. As with calculating industry-adjusted Simple *q*, we define a firm's industry-adjusted Total *q* as a firm's Total *q* (as reported in the Peters and Taylor dataset) minus the median Total *q* in the firm's industry in the observation year (using two-digit SIC codes). As with industry-adjusted Simple *q*, we winsorize the measure at one percent. As shown in Columns 3 and 4, the results are strikingly similar to those obtained in Columns 1 and 2. The primary exception is that the negative coefficient on E-Index 5-6 is slightly less negative than the coefficient on E-Index 4. The positive coefficient on the O-Index is also no longer statistically significant at conventional levels.

Overall, Table C.2 suggests that BCF's original finding that firms with high E-Index values are associated with lower Tobin's *q* persists regardless of whether we define Tobin's *q* using Simple *q* or Total *q*. However, as emphasized by BCF, these cross-sectional regressions do not speak to their more provocative suggestion that changes in a firm's E-Index can cause changes in firm value. To get at this latter issue, BCF ran an additional set of specifications using firm-fixed effects to control for unobserved firm heterogeneity that remains constant over their sample period.[240] By holding constant firm-fixed effects, these regressions put them on a firmer footing for examining how changes in the E-Index over time at a firm might affect its industry-adjusted Simple *q*. As they note, "The fixed effects regressions . . . examine the effect on firm value of changes that firms made, during the 1990–2003 period, in the number of entrenching provisions (whether to increase or decrease the number of entrenching provisions)."[241]

In Table C.3, we use both BCF's measure of industry-adjusted Simple *q* and industry-adjusted Total *q* as our outcome variables. The first two columns use industry-adjusted Simple *q* and replicate the results obtained by BCF. Specifically, in Column 1, the coefficient on the E-Index is negative and significant at the one percent level, and the coefficient on the O-Index is now insignificant. Overall, these results are virtually the same as those obtained by BCF.

240. *See* Bebchuk et al., *supra* note 5, at 803.
241. *Id.*

TABLE C.3:
REPLICATION OF BCF USING SIMPLE *Q* AND TOTAL *Q*—
CONTROLLING FOR FIRM-FIXED EFFECTS

	(1)	(2)	(3)	(4)
E-Index	-0.0450***		-0.0479	
	[0.0148]		[0.0454]	
E-Index 1		-0.0872*		-0.136
		[0.0494]		[0.119]
E-Index 2		-0.0846		-0.0569
		[0.0537]		[0.132]
E-Index 3		-0.164***		-0.109
		[0.0589]		[0.151]
E-Index 4		-0.211***		-0.256
		[0.0647]		[0.183]
E-Index 5-6		-0.203***		-0.255
		[0.0724]		[0.356]
O-Index	0.00604	0.00599	0.0388***	0.0390***
	[0.00439]	[0.00439]	[0.0115]	[0.0115]
Log[Assets]	-0.319***	-0.318***	0.00333	0.005
	[0.0327]	[0.0327]	[0.0998]	[0.0997]
Log[Age]	-0.177**	-0.178***	-1.300***	-1.309***
	[0.0694]	[0.0692]	[0.185]	[0.186]
Delaware Incorporation	-	-	-	-
Insider Ownership	1.370***	1.374***	1.453	1.463
	[0.418]	[0.420]	[1.200]	[1.208]
Insider Ownership Squared	-1.409**	-1.412**	-1.072	-1.076
	[0.708]	[0.708]	[1.706]	[1.714]
ROA	1.118***	1.117***	2.278***	2.275***
	[0.179]	[0.179]	[0.318]	[0.318]
CAPX / Assets	1.697***	1.699***	0.274	0.275
	[0.270]	[0.270]	[0.536]	[0.537]
Leverage	-0.407***	-0.409***	0.061	0.0536
	[0.138]	[0.138]	[0.295]	[0.295]
R&D per Sales	0.00622	0.00623	0.0121***	0.0121***
	[0.00493]	[0.00493]	[0.00264]	[0.00266]
Year-Fixed Effects	Y	Y	Y	Y
Firm-Fixed Effects	Y	Y	Y	Y
Observations	11,336	11,336	11,336	11,336
R-squared	0.734	0.734	0.772	0.772

Robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1.

In Column 2, we further follow BCF in exploring whether higher values of the E-Index are more predictive of declining values of industry-adjusted Simple *q*, holding constant firm-fixed effects. Consistent with BCF, the coefficients grow increasingly negative between E-Index 1 through E-Index 5-6, although only the last three levels of the E-Index achieve the same level of statistical significance as in the BCF paper. Overall, however, one could draw a similar conclusion as BCF in interpreting these findings as suggesting that higher levels of entrenchment cause a decline in industry-adjusted Simple *q*. Moreover, the absence of any significant coefficient on the O-Index suggests that the mechanism by which corporate governance might affect Simple *q* would be through the E-Index as opposed to the G-Index.

In contrast, as shown in Columns 3 and 4, the same cannot be said of the relationship between the E-Index and industry-adjusted Total *q*. In both Columns 3 and 4, the coefficients on the E-Index have lost all statistical significance. More importantly, the coefficient on the O-Index is positive and significant at the one percent level. In other words, BCF's main results do not hold if we simply substitute Total *q* for Simple *q*.

These results underscore how failure to account for measurement error in a ratio that is used as an outcome variable can lead to biased regression estimates. Additionally, note that BCF included R&D as a control variable, but the addition of this variable was insufficient to control for the fact that Simple *q* omitted a firm's investment in intangible assets.

Of course, Total *q* is not necessarily an appropriate substitute for Tobin's *q* generally, or even a defensible substitute for Simple *q*. Among other things, for instance, it continues to rely on the book values of PPE, which are recorded at cost and subject to depreciation. Total *q* also reflects the capitalization of R&D as well as a fixed thirty percent measure of selling, general, and administrative expenses, both of which are unlikely to be associated with actual replacement costs. The ratio of the denominator of Total *q* to replacement costs is unlikely to be straightforward. But our point is not to advocate on behalf of Total *q*; rather it is to illustrate that there are good reasons to believe measurement error in a ratio that is an outcome variable can easily bias results, even when a researcher includes proxies for this measurement error as a covariate.