The London School of Economics and Political Science

Essays on the Relation between Accounting and Employment, Risk and Valuation

Daphne Hart

A thesis submitted to the Department of Accounting of the London School of Economics and Political Science for the degree of Doctor of Philosophy

January 2019

Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorization does not, to the best of my belief, infringe the rights of any third party.

I confirm that Chapter 2 is jointly co-authored with Brian Burnett and Paige Patrick. I also confirm that Chapter 3 is jointly co-authored with Bjorn Jorgensen.

I declare that my thesis consists of 46,381 words.

Acknowledgments

I have been blessed with two exceptional supervisors. No words could fully express my appreciation and respect for my first supervisor, Bjorn Jorgensen. Thank you for your support, guidance and faith. Thank you for giving me space to ask questions and make mistakes. Above all, thank you for teaching me to always keep trying and never give up. These lessons and our long conversations will forever remain with me.

To my second supervisor, Vasiliki Athanasakou, I am deeply indebted for your coaching and care. Thank you for being an endless source of inspiration and encouragement, for always having an open door and an open heart for me. I am grateful for your advice and for all the times you asked the difficult questions. You helped me grow into myself as an academic and a person.

I have been privileged to be part of the Department of Accounting for the last four years, and I am thankful to my friends and colleagues at the London School of Economics. I am honored to have shared this unique experience with Brett Considine, Nadine de Gannes and Rani Suleman – thank you for the long coffee chats, for being a sounding board and most of all, thank you for being such good friends.

Completing this dissertation is almost the last stage of my doctoral journey. I shared this journey with many wonderful people, whose love and support carried me through. To my mentors, Asher Tishler and Iris Canor, thank you for your encouragement and for your guidance over the years. I appreciate our many long discussions about life and academia. Thank you for sharing your experience with me.

My family has been the driving force behind me. The long days that turned into long nights were fueled by their love. I knew I was never alone in this - Reuven, Michal, Udi, Itamar and Galit Pinchas, I could not have done this without you. Thank you for believing in me, for pushing forward with me and for standing by me. I am thankful to Baias Shila for looking out for me, I cherish your short yet heart-warming phone calls. Emanuel and Mia Hart, thank you for giving me courage and good advice in critical moments. I am grateful to Galia Finkelstein for her wisdom and patience and to Irit Meyer for making London feel like home.

To my sister, Miri, who always helps me to make sense of this world and can always make sense of me. You planted the seed of curiosity in my mind and taught me how to carve my own path. Thank you for your understanding and love, for making everything feel possible.

My partner and love, Gil Pinchas, who has been with me through every step of the journey. His faith in me allowed me to dream and his reassurance lifted me over all barriers and hardship. I could not have hoped for a better partner and friend to share this journey with. Thank you for being so gracious, shielding, supportive and empowering.

To my parents, Rachel and Ovadia, this thesis is inspired by your experiences. Thank you for all your hard work over the years, for providing me with every opportunity imaginable. Thank you for respecting my choices even when the causes were not clear to you (or me). You opened the world to me, thank you for helping me feel at home no matter where I was. Your love, determination and generosity travels with me. This dissertation is dedicated to you.

Abstract

The thesis is a collection of three separate papers on accounting consequences. Specifically, the papers examine the relation between accounting and employment, risk and valuation.

The first chapter (solo-authored) documents that approximately 20% of large US public firms choose to disclose employment information quarterly, at a higher frequency than mandated by the US Securities and Exchange Commission (SEC). I use these voluntary disclosures to examine whether managers modify their firms' workforces to manage earnings. Using firm-level analysis, I find that managers alter their firms' workforce in the short-run to meet financial reporting benchmarks. I separately investigate the decision to voluntary disclose employment information more frequently than mandated by the SEC. I show that providing quarterly employment disclosures is associated with managerial myopic behavior. Overall, in the first chapter I present evidence that more frequent disclosures of workforce information provide valuable insights into firm operations and managerial decisions. I demonstrate that financial measures may govern decisions regarding real resource allocations, specifically, the firm's workforce size.

The second chapter (co-authored with Brian Burnett and Paige Patrick) investigates the effect of adopting more principles-based standards on litigation risk. A common perception is that principles-based accounting standards, such as International Financial Reporting Standards (IFRS), allow for more managerial discretion over financial reporting. This suggests that adopting principles-based standards may alter the litigation risk exposure of companies and their directors and officers. We study changes in litigation risk in Canada following IFRS adoption in 2011. Canada switched its reporting standards from Canadian Generally Accepted Accounting Principles (GAAP) to IFRS, which is considered more principles-based. We examine the effect of IFRS adoption on litigation risk using two established proxies for litigation risk: Directors' and Officers' (D&O) liability insurance, which Canadian firms are mandated to disclose, and excess cash holdings. We document that more principles-based

accounting standards reduce litigation risk and provide evidence for a benefit of adopting such standards, in the form of lower insurance premiums.

The third chapter (co-authored with Bjorn Jorgensen) develops an accounting-based valuation model for an economy with multiple firms and demonstrates the effect of cross-holdings on firms' prices. We illustrate how market values appear distorted when firms have mutual minority interest equity investments. We discuss possible empirical implications for valuation of multiple firms and articulate why corporate equity investments may distort firms' market-to-book ratios. Overall, we show how the accounting treatment for corporate equity investments may alter prices and provide theoretical predictions regarding the mechanism and magnitude of these distortions. We also model linear information dynamics in a setting with multiple firms, allowing for inter-firm information transfers for firms with and without cross-holdings. Our analysis illustrates how inter-firm accounting information shape prices. Moreover, we describe possible implications of our model for firms that exhibit variation in reporting dates or reporting frequency.

Contents

Declaration of Authorship 1

Acknowledgements 2

Abstract 4

List of Figures 10

List of Tables 11

1. Voluntary Employment Disclosures and Real Earnings Management 12

1.1 Introduction 12

1.2 Employment and Real Earnings Management 16

1.2.1 Firms' Employment Policies 16

1.2.2 Real Earnings Management and Employment 18

1.2.3 Voluntary Employment Disclosure and Myopic Behavior 20

1.3 Data and Methodology 23

1.3.1 Employment Data 23

1.3.2 Normal Employment Model 28

1.3.3 Selection of Suspect Firm-quarters 31

1.4 Empirical Analysis 32

1.4.1 Choice Model Estimation 32

1.4.2 Abnormal Employment Estimation 33

1.4.3 Real Earnings Management 34

1.4.4 Subsequent Performance 38

1.5 Voluntary Employment Disclosure and Managerial Behavior 40

1.6 Conclusion 41

1.7 Appendix 43

1.7.1 Variable Descriptions 43

1.8 Figure 45

1.8.1 Changes in Disclosure Policy (Non-Financial Firms) 45

1.9 Tables 46

1.9.1 Descriptive Statistics 46

1.9.2 Number of Firms and Disclosing Firms by Industry Division 47

1.9.3 Descriptive Statistics: Disclosure Choice Model 48

1.9.4 Regression Results: Estimation of the Disclosure Choice Model 49

1.9.5 Descriptive Statistics: Disclosing Firms 50

1.9.6 Regression Results: Estimation of the labor model 51

1.9.7 Comparison of Suspect Firm-quarters with the Rest of the Sample 52

1.9.8 Comparison of Suspect Firm-quarters with the Rest of the Sample, Full Interaction 53

1.9.9 Regression Results: Future Performance 54

1.9.10 Regression Results: Probability of Just Meeting or Beating Earnings Benchmarks 55

2. IFRS Adoption and Litigation Risk: Evidence from Directors' and Officers' Liability Insurance 56

2.1 Introduction 56

2.2 Directors' and Officers' (D&O) Liability Insurance 61

2.3 Hypothesis Development 64

2.4 Research Design 67

2.4.1 The Canadian Setting 67

2.4.2 Canadian Firms Cross-listed in the US 68

2.4.3 Specifications 69

2.4.4 Sample Selection and Data Description 74

2.5 Empirical Results 77

2.5.1 Univariate Results 77

2.5.2 Regression Analyses of D&O Insurance Policy 79

2.5.3 Regression Analyses of Excess Cash 81

2.6 Robustness Tests 82

2.7 Conclusion 84

2.8 Appendix 86

2.8.1 Variable Descriptions 86

2.9 Tables 88

2.9.1 Sample Formation 88

2.9.2 Descriptive Statistics 89

2.9.3 Univariate Tests of Changes in D&O Coverage and Premiums After IFRS Adoption 91

2.9.4 Univariate Tests of Changes in Excess Cash After IFRS Adoption for Firms That Do Not Purchase D&O Insurance 92

2.9.5 Regression of the Effect of IFRS Adoption on D&O Coverage and Premiums for Canadian Firms Not Cross-listed in the US 93

2.9.6 Regression of the Effect of IFRS Adoption on D&O Coverage and Premiums for Canadian Firms Cross-listed in the US 94

2.9.7 Regression of the Effect of IFRS Adoption on Excess Cash for Canadian Firms Not Cross-listed in the US That Do Not Purchase D&O Insurance 95

2.9.8 Regression of the Effect of IFRS Adoption on Excess Cash for Canadian Firms Cross-listed in the US That Do Not Purchase D&O Insurance 96

2.9.9 Descriptive Statistics for New York State Incorporated Firms 97

2.9.10 Regression of the Effect of IFRS Adoption on Premiums for Canadian Firms Cross-listed in the US Compared to Firms Incorporated in New York State 98

3. Accounting-Based Valuation for Multiple Firms: The Case of Cross Holdings 99

3.1 Introduction 99

3.2. A Valuation Model with Corporate Equity Ownership 105

3.2.1 Formal Model of Cross Holdings 105

3.2.2 Implication for Empirical Research: The Case of Cross Holdings 113

3.2.3 Price and Book Values: The Effect of Cross Holdings on Financial Ratios 120

3.3. Uncertainty and Linear Information Dynamics 121

3.3.1 Inter-Firm Information Transfers: Multiple Firms 122

3.3.2 Linear Information Dynamics and Firm Valuation: The Case of Two Firms 125

3.3.3 Linear Information Dynamics and Firm Valuation: Cross Holdings 128

3.4. Conclusion 130

3.5 Appendices 133

3.5.1 Variable Definitions 133

3.5.2 Illustration of Two Firms with Cross Holdings Using the Fair Value Method 135

3.5.3 Illustration of Two Firms with Cross Holdings Using the Equity Method 139

3.5.4 Market-to-Book and Return-on-Equity Ratios 142

3.5.5 Linear Information Dynamics 145

3.5.6 Linear Information Dynamics – Empirical Application 155

3.6 Figures 164

3.6.1 Cross Holdings and Firm Value 164

3.6.2 Circular Ownership Structure Illustration 165

3.7 Table 166
3.7.1 Two Firms - Fair Value Method 166
3.7.2 Two Firms -Equity Method 167
3.7.3 Market-to-Book Ratios 168
3.7.4 Return on Equity 169
Bibliography 170

List of Figures

1.8.1 Changes in Disclosure Policy (Non-Financial Firms) 45

3.6.1 Cross Holdings and Firm Value 164

3.6.2 Circular Ownership Structure Illustration 165

List of Tables

1.9.1 Descriptive Statistics 46

1.9.2 Number of Firms and Disclosing Firms by Industry Division 47

1.9.3 Descriptive Statistics: Disclosure Choice Model 48

1.9.4 Regression Results: Estimation of the Disclosure Choice Model 49

1.9.5 Descriptive Statistics: Disclosing Firms 50

1.9.6 Regression Results: Estimation of the labor model 51

1.9.7 Comparison of Suspect Firm-quarters with the Rest of the Sample 52

1.9.8 Comparison of Suspect Firm-quarters with the Rest of the Sample, Full Interaction 53

1.9.9 Regression Results: Future Performance 54

1.9.10 Regression Results: Probability of Just Meeting or Beating Earnings Benchmarks 55

2.9.1 Sample Formation 88

2.9.2 Descriptive Statistics 89

2.9.3 Univariate Tests of Changes in D&O Coverage and Premiums After IFRS Adoption 91

2.9.4 Univariate Tests of Changes in Excess Cash After IFRS Adoption for Firms That Do Not Purchase D&O Insurance 92

2.9.5 Regression of the Effect of IFRS Adoption on D&O Coverage and Premiums for Canadian Firms Not Cross-listed in the US 93

2.9.6 Regression of the Effect of IFRS Adoption on D&O Coverage and Premiums for Canadian Firms Cross-listed in the US 94

2.9.7 Regression of the Effect of IFRS Adoption on Excess Cash for Canadian Firms Not Cross-listed in the US That Do Not Purchase D&O Insurance 95

2.9.8 Regression of the Effect of IFRS Adoption on Excess Cash for Canadian Firms Cross-listed in the US That Do Not Purchase D&O Insurance 96

2.9.9 Descriptive Statistics for New York State Incorporated Firms 97

2.9.10 Regression of the Effect of IFRS Adoption on Premiums for Canadian Firms Cross-listed in the US Compared to Firms Incorporated in New York State 98

3.7.1 Two Firms - Fair Value Method 166

3.7.2 Two Firms -Equity Method 167

3.7.3 Market-to-Book Ratios 168

3.7.4 Return on Equity 169

Chapter 1

Voluntary Employment Disclosures and Real Earnings Management

Daphne Hart

1.1 Introduction

This chapter studies the employment policies of public firms. While the US Securities and Exchange Commission (SEC) mandates annual disclosures of a public firm's number of employees, approximately 20% of large US firms voluntarily disclose employment quarterly. Using these voluntary quarterly disclosures, I study whether managers modify their firms' workforce to meet earnings benchmarks and whether the decision to disclose is associated with myopic managerial behavior.

In the past decade, technological advances fueled rapid growth in service industries, reducing the share of capital-intensive industries in the economy (Lee and Wolpin 2006). Many public firms rely on human capital for their operations and state they view their employees as an important asset. Nonetheless, the information available to investors and other stakeholders about the way firms manage their workforces is limited.

I thank Vasiliki Athanasakou, Bjorn Jorgensen, and Wim Van der Stede for their guidance and support. I also thank Jan Bouwens, Maria Correia, Thomas Gilliam, Katherine Gunny, Ana Simpson and workshop participants at Bocconi University, Cambridge University, Cass Business School, Hebrew University, IESE Business School, London School of Economics and Political Science, Oxford University, Pompeu Fabra University, Tilburg University, University of Illinois at Chicago and University of Warwick for their comments and suggestions.

The SEC requires public firms to disclose their number of employees annually. The Business and Financial Disclosure required by Regulation S–K includes a narrative description of a registrant's business. Under Regulation S-K, firms must disclose their number of employees in their annual financial statements.[1] Firms are not required to disclose any information about their workforce in their quarterly financial statements. Nonetheless, some firms choose to provide this information voluntarily, with quarterly frequency.[2]

Using a hand collected sample of the largest 500 firms listed on NYSE and NASDAQ from 2006 until 2016 (44 quarters),[3] I document that 20.5% of them provided information about the size of their workforce in interim financial reports. The choice to provide quarterly employment information appears relatively sticky over time.[4,5] I use these voluntary disclosures in two ways. First, I examine whether managers appear to alter the workforce to manage earnings. Second, I investigate the relation between providing voluntary employment information at higher frequencies and managerial short-termism.

A firm's economic activity can be represented in price terms (costs, wages, and interest) or in volume (labor and capital). The literature uses labor costs to estimate managers' asymmetric responses to changes in operations and to detect managerial opportunism (Dierynck, Landsman, and Renders 2012, Hall 2016). Annual net changes in the number of employees (net hiring) are also used to proxy for investment in labor. Pinnuck and Lillis (2007) examine whether reporting negative earnings influences investments in employees and find a discontinuity in a histogram of net hiring around zero earnings. Jung, Lee, and Weber (2014)

[1] 17 CFR 229.101 - Description of business, Item 101(c)(1)(xiii).
[2] Interestingly, Beatty and Liao (2017) document that around 20% of US multinationals' 10-K filings voluntarily disclose domestic and foreign headcount separately. Their analysis suggests that voluntary geographic headcount disclosure choice with annual frequency, depends on both political pressure and employee backlash.
[3] I limit the sample to the largest 500 firms listed on NYSE and NASDAQ in the sample period that report under US Generally Accepted Accounting Principles (GAAP). Out of 749 firms for which data is available, 154 provide information about their workforces in their interim reports and 143 firms have consecutive disclosures that permit constructing quarterly time series.
[4] In each period, a firm may choose to initiate or cease disclosing the number of employees quarterly. For example, Pfizer Inc. started providing quarterly employment information in the first quarter of 2010 and ceased quarterly disclosures in the third quarter of 2013.
[5] During the sample period, disclosing firms voluntarily disclosed their workforce size for 28 quarters on average.

use firms' net hiring to construct a measure of investment efficiency. I extend prior literature and proxy for firm's real activities using quarterly workforce data. Quarterly data enables observing managerial decisions, as opposed to inferring them from reported expenses (Cohen, Mashruwala, and Zach 2010). Having more granular data permits studying changes in the flow of the size of the work force in the short-run and examining whether managers use employment to manage earnings.[6]

A manager could alter the workforce to achieve short-term reporting goals. On the one hand, managers may decrease the workforce by firing or simply not hiring new employees. This reduces expenses and cash outflows, thus increasing reported earnings. On the other hand, managers may choose to increase production to report lower cost of goods sold (COGS) under absorption costing or to channel stuff (Roychowdhury 2006). These latter practices likely require hiring additional employees in the short-run, particularly in human capital-intensive industries like services and high-tech. If managers engage in real earnings management through net hiring, abnormal patterns in employment should mirror the findings of prior literature (Roychowdhury 2006, Gunny 2010, Zang 2012).

I document that if firms just meet or beat analysts' forecasts, or report small earnings growth, they have larger abnormal workforce, while if they report small positive earnings, they have smaller abnormal workforce. These results are consistent with managers employing different producing and employment practices to achieve different reporting goals.

Better understanding firms' employment policies is important as labor market frictions generate substantial costs for firms, employees, and the economy. Moreover, the relationship between employers and employees shape labor laws and employment incentives schemes. Nonetheless, scant empirical research investigates firms' employment decisions,

[6] The annual number of employees disclosed in firms' annual reports (10-K form), provides information about the net change in the workforce over the fiscal year but not within the year. Firms may report the same number of employees in consecutive years, although, during the year, their workforces may fluctuate substantially. For example, based on Caterpillar Inc.'s annual number of employees, it appears that the firm's net hiring in 2012 was 0.2%. Nonetheless the quarterly employment disclosures suggest that Caterpillar increased its labor force by 1.7% and 4.4% in the first two quarters and decreased it by 2.8% and 2.9% in the last two quarters of 2012.

partly because firm-level employment data is scarce.[7] The data set I constructed is based on voluntary disclosure of large pubic firms, which may limit the generalizability of this paper's findings.

I separately investigate the decision to provide quarterly employment disclosures, at a higher frequency than mandated by the SEC. To signal firm quality, managers may choose to increase transparency by providing employment information in interim reports (Verrecchia 1983, Dye 1985). If earnings management is a *purposeful intervention* (Schipper 1989) that could be inferred from abnormal employment levels, then voluntarily quarterly disclosure may act as a disciplining mechanism. Thus, quarterly disclosures would be associated with fewer incidences of just meeting earnings benchmarks. Nonetheless, higher disclosure frequency may also indicate that managers focus on shorter horizons, implying a positive association between quarterly employment disclosures and incidences of just meeting earnings benchmarks.

I find that providing quarterly employment disclosures is associated with a higher likelihood of just meeting or beating analyst forecasts and reporting small earnings growth. Taken together, these findings suggest that the disclosure decision reveals managerial characteristics and that quarterly disclosing firms manage earnings more often.

This paper extends the literatures on real earnings management and voluntary disclosure in three ways. First, this paper is the first to document that changes in employment may be governed by earnings benchmarks. Managers respond to accounting-based performance targets by changing real decisions. The analysis validates that real earnings management is manifested in firms' hiring and firing decisions. Consistent with the work of Graham, Harvey and Rajgopal (2005), these findings imply that managers take real actions, such as delaying or expediting firing and hiring, to meet short-term reporting goals and smooth earnings. Second, I present an alternative approach to measuring real earnings management

[7] Although firms disclose their workforce size annually, these annual disclosures do not allow capturing fluctuations in the workforce within the financial year. Data on changes in workforce size at the firm level is not readily available, although some firms voluntarily disclose information regarding their employees' turnover rate in their SCR reports.

based on firm-level analysis. Prior literature defines abnormal behavior based on deviations from industry mean. Using time-series analysis, my estimation is based on deviations from each firm's predicted normal levels. Third, the paper suggests that disclosure choices are not independent of subsequent managerial actions. In this setting, the employment disclosure frequency decision is informative about managerial actions, implying that more frequent disclosures may indicate a stronger focus on short-term performance.

The rest of the chapter is organized as follows. Section 1.2 reviews prior studies on employment policy and real earnings management. Section 1.3 describes the data and the estimation models. Section 1.4 presents the analysis results. Section 1.5 examines the disclosure choice and discusses the relation between the disclosure choice and managerial actions. Section 1.6 concludes. All variables are defined in Appendix 1.7.1.

1.2 Employment and Real Earnings Management

1.2.1 Firms' Employment Policies

Firms require capital and labor to provide goods and services. While ample research investigates capital investment decisions and asset management, scant empirical research studies their employment decisions and workforce management. One potential reason for the smaller number of papers on employment is the lack of transparency and data about corporations' employment practices. The private sector provides around 85% of the nonfarm employment in the US,[8] and large public firms such as Walmart, Amazon and IBM employ hundreds of thousands. Nonetheless, the only information readily available on public firms' workforces is the number of employees disclosed in annual reports.

The literature relies on layoff announcements to gain insights into firms' employment decisions. Companies announce planned layoffs when they are material; that is, when layoffs are likely to influence a significant part of the workforce and when they are part of a substantial

[8] As of May 2018, see BLS, Table B-1: Employees on nonfarm payrolls by industry sector and selected industry (https://www.bls.gov/news.release/empsit.t17.htm).

restructuring or strategic shift. Generally, firms are not required to publicly announce layoffs,[9] and thus the announcement may be a signal used by managers to communicate private information. Elayan et al. (1998) find that layoff announcements convey negative information to the market about firms' investment and growth opportunities as well as future cash flows. While, Hillier et al. (2007) suggest that layoff announcements are not followed by changes to operating performance. Hillier et al. (2007) cannot reject that operating performance remains unchanged following layoff announcements by U.K. firms, although, they do find significant improvements in operating efficiency, as measured by sales and operating profit per employee.

Layoff announcements are not always equivalent to actual downsizing, and their timing may not be random. Chen et al. (2001) show that layoff announcements made by U.K. firms are not followed by a reduction in total employment in the subsequent three years. Hallock (2006) studies layoff announcements by Fortune 500 firms between 1970 and 1999. He analyzes over 4,600 layoff announcements and 40 interviews conducted with senior managers in these firms. Consistent with Yermack (1997), Hallock (2006) reports that some managers admit to timing the layoff announcements to benefit senior managers[10] and that layoffs were announced and carried out to permit starting a financial period (year or quarter) "clean."[11] Hallock (2006) also documents that some managers overstate the number of employees to be laid off to avoid announcing bad news twice. Overall, empirical and anecdotal evidence suggests that managers may time workforce changes to contribute to better performance in subsequent periods.

[9] Public firms must disclose material events to shareholders. Thus, firms may be required to disclose planned layoffs, especially if they are done as part of plant closures. Moreover, the Worker Adjustment and Retraining Notification Act (WARN Act) mandates employers with 100 or more full-time employees to provide 60 calendar-day advance notification of plant closings and mass layoffs of employees, subject to certain exemptions.

[10] In a related study, Hallock (1998) examines the relation between layoff announcements and executive compensation. He shows that firms announcing layoffs tend to pay their CEO more in subsequent years. However, controlling for CEO and firm characteristics, the higher pay for laying off employees is not statistically significant.

[11] Managers reported that, given flexibility in timing layoffs announcements, they tend to focus on fiscal quarter-ends: "The idea being that they may have already been suffering financially and therefore would take an additional 'bath' and count charges such as severance in a quarter that was already bad. They could then go into the new quarter (or year) 'fresh.'" (Hallock 2006, p. 147)

1.2.2 Real Earnings Management and Employment

Managers may modify resource allocation to achieve financial reporting objectives. Graham et al. (2005) state that managers are willing to take real economic actions to maintain accounting appearances. These actions include reducing R&D, advertising, and maintenance expenses to meet earnings targets. Roychowdhury (2006) finds that managers manipulate real activities to avoid reporting annual losses. He argues that managers use price discounts, overproduction and reduction of discretionary expenditures to improve reported margins. Cohen et al. (2010) likewise document that managers temporarily reduce advertising spending to improve reported quarterly and annual earnings. Bens, Nagar, and Wong (2002) demonstrate another manipulation channel in which managers shift resources from real investments toward stock repurchases around employee stock option exercise.

Real earnings management entails changing the firm's capital and labor, but, absent empirical investigation, its effect on a company's workforce is unclear. On the one hand, a reduction in discretionary expenses and investments could decrease headcount, due to understaffing, layoffs or impede new hires. A manager may administrate headcount reductions to rapidly decrease cash outflows. On the other hand, efforts to increase revenues, such as channel stuffing and overproduction[12] might induce over hiring, delay employment termination and expedite new hires. In order to accelerate revenues, a manager may increase headcount and sustain over-employment (Benson 2015), especially when the firm relies on personnel to provide goods and services.[13]

Firing or hiring employees as a form of real earnings management is not fully explored by prior research. Several studies document patterns that are consistent with firms changing their workforces to meet financial reporting benchmarks. First, Pinnuck and Lillis (2007) use

[12] Overproduction allows the manager to spread the fixed costs (which typically include some labor costs) over a higher number of units such that COGS decreases (assuming marginal costs do not increase). In subsequent periods, the firm incurs production and holding costs on the produced items that were not recovered in the same period through sales.
[13] Higher employment level supports higher revenues in the short-run when marginal revenue is positive.

annual number of employees to show a discontinuity of net hiring around the zero earnings benchmark. They hypothesize that reporting an accounting loss acts as a trigger to abandon investments and divest resources, and thus attribute the discontinuity to small loss firms having lower than expected net hiring. Building on their work, Jung et al. (2014) illustrate that higher quality financial reporting is associated with more efficient net hiring.

Second, Dierynck et al. (2012) study private Belgian firms and focuse on their cost structure. They report that around the zero earnings benchmark, firms are more likely to modify their labor force (symmetric labor cost behavior). However, more profitable firms, less pressured by the earnings benchmark, react to decreases in activity by reducing the number of hours worked, instead of reducing headcount because of the costs associated with layoffs (asymmetric labor cost behavior). Hall (2016) also investigates labor cost behavior. Using public and private banks' labor costs, he documents that public banks have a more flexible cost structures, that is, their elasticity of labor costs to revenues is higher. Hall (2016) also examines whether changes in labor costs are a form of real earnings management. He finds that banks substitute between labor cost reduction and accrual earnings management (high abnormal loan loss provisions) in response to financial reporting and regulatory pressures.

Finally, Serfling (2016) predicts that firing costs create frictions that constrain firms from laying off employees, leading them instead to alter their financing structure. To test his prediction, he exploits a shock to firing costs, the staggered adoption of one of the Wrongful Discharge Laws (WDL) exemption, the good faith exemption, by US state courts.[14] He shows that, when firing costs increase, the elasticity of earnings to sales increases, earnings persistence declines, and firms are less likely to discharge workers after a decline in earnings.

[14] Prior to my sample periods, these laws were gradually adopted by state courts, starting with California in 1959 and most recently with Louisiana in 1998. State courts recognized three exemptions to the termination "at will" employment tradition. These are (i) good faith, (ii) implied contract, and (iii) public policy. Of particular interest is the good faith exemption, as it protects employees from termination for any reason other than for a "just cause" (Bai, Fairhurst, and Serfling 2017), thus increasing the legal risks and potential costs of firing.

The empirical evidence suggests that managers modify the number of employees and labor costs to meet financial reporting benchmarks. Managers may use temporary labor adjustments to improve their profitability and efficiency measures. The real earnings management literature reports that managers may alter discretionary expenses and production schedules. When managers decrease discretionary expenses, reduce R&D or postpone maintenance, they likely eliminate jobs or postpone new hires.[15] This in turn will result in a smaller workforce. In contrast, when managers over produce or increase marketing, production, and distribution, they likely need additional workers. Thus, firms may add positions and postpone layoffs.

The earnings management literature identifies firms with earnings right at or just above benchmarks as more likely to manage earnings (Burgstahler and Dichev 1997, Degeorge, Patel, and Zeckhauser 1999, Bartov, Givoly, and Hayn 2002). I follow prior literature and define firm-quarters as suspect of "earnings management" if they just meet or beat zero earnings, zero earnings growth, or analyst consensus forecast. My first hypothesis is as follows (stated in the null form):

H1: Other things being equal, suspect firm-quarters do not exhibit unusually high or low employment levels.

1.2.3 Voluntary Employment Disclosure and Myopic Behavior

If workforce size or workforce growth rate is informative about the firm's underlying economic activity, one might expect all firms to disclose their workforce quarterly (Grossman, 1981). However, not all firms choose to provide employment information quarterly.

[15] Employment is the outcome of a successful match between a firm and an employee (Pissarides 2000). The match is not permanent, and it may be broken by the firm or the employee. A match breaks when the firm lays off an employee or when an employee voluntarily leaves. For the United States, the monthly separation rate in the private sector was estimated as 3.4% in 2003, implying that around four out of 10 employees left their companies in 2003. This rate is close to the estimated hiring rate (Silva and Toledo 2009), suggesting firms are likely to extract effort and resources to maintain their workforce over time.

An extensive literature investigates managers' decision to voluntary disclose information. Managers may possess superior information about their firms, even in efficient capital markets (Healy and Palepu 2001). They may choose to disclose their private information to outsiders or may choose to withhold this information to achieve some economic benefit. The analytical literature demonstrates the conditions under which rational managers choose to voluntarily disclose private information (Verrecchia 1983, Dye 1985).

In the absence of voluntary disclosure, rational investors infer that managers possess negative information. Dye (1985) articulates three general conditions under which voluntary disclosure does not happen: when a principal-agent conflict arises, when uncertainty exists about whether the manager is informed, or when some of the information is proprietary. In my setting, a manager knows the size of the firm's workforce. Furthermore, the cost of obtaining, verifying and disclosing the number of employees on a quarterly basis is probably low. Nonetheless, the number of employees could be seen as proprietary information that managers would want to refrain from disclosing more frequently than mandated to limit potential damage to their competitive position (e.g., Wagenhofer 1990, Darrough and Stoughton 1990, Darrough 1993).

Einhorn and Ziv (2012) consider the joint problem of voluntarily disclosing and disclosing truthfully, a setting that mirrors the joint decision to disclose information and manage earnings. Einhorn and Ziv (2012) show that in equilibrium, the decision to voluntarily disclose is robust to the relaxation of the truthful disclosure assumption. Overall, work on voluntary disclosure suggests that the decision to disclose the number of employees quarterly may be motivated by information asymmetry and proprietary cost considerations, implying the decision should be independent from engagement in earnings management.

Nevertheless, managers that manage earnings by changing their workforce size, may wish to avoid disclosing information about their employees. If earnings management is a *purposeful intervention* (Schipper 1989) that could be inferred from abnormal employment levels, then managers may prefer to refrain from providing voluntary employment disclosures.

Moreover, if abnormal employment levels could be deduced from quarterly employment disclosures, managers may use these employment disclosures to signal firm quality. Managers may increase transparency by providing employment information in interim reports (Verrecchia 1983, Dye 1985). These voluntary disclosures may also act as a disciplining mechanism, as a manager that provides voluntary employment disclosures is unable to change the workforce to manage earnings without disclosing these workforce changes to stakeholders. As such, voluntarily disclosing employment information would be consistent with the manager pledging to not manage earnings. Thus, voluntary quarterly employment disclosures would be associated with fewer incidences of just meeting earnings benchmarks.

Prior empirical-archival research also investigates the effect of providing more frequent disclosures. Butler, Kraft, and Weiss (2007) study the choice of public firms to report annually, semi-annually, or quarterly, before the SEC mandated semi-annual and quarterly reporting. They find small differences between the stock price behavior of firms reporting quarterly and those reporting semi-annually, challenging the notion that higher frequency of reporting adds substantial new information. Nevertheless, firms that voluntarily increased their reporting frequency exhibit increased timeliness.

Using a similar setting, Fu, Kraft, and Zhang (2012) show that voluntary and mandatory higher reporting frequency reduces information asymmetry and cost of equity, while Kraft, Vashishtha, and Venkatachalam (2018) find a negative association between increased reporting frequency and investments, suggesting a real effect of more frequent disclosures. Ernstberger et al. (2017) exploit the EU's Transparency Directive which requires all public EU firms to provide narrative disclosures more frequently (on a quarterly basis) from 2007. They report that the more frequent disclosures increase real activities manipulation.

In related work, Edmans, Heinle, and Huang (2016) analytically demonstrate that managers may choose to provide less disclosure to avoid myopic pressures. However, managers cannot credibly commit to disclosing less, and thus, in equilibrium, they disclose more and under invest in long-run projects. Furthermore, Hermalin and Weisbach (2012) argue that, although increased information permits shareholders and boards to better monitor managers, the increased monitoring may also incentivize managers to engage in value-reducing activities, intended to make them appear more able. Finally, Gigler et al. (2014) analyze the costs and benefits of increasing the frequency of financial reporting. They demonstrate that additional new information could motivate firms to change their business decisions such that price efficiency improves but economic efficiency worsens.

Overall, both empirical and analytical research suggest that more frequent disclosures have an impact on resource allocation and are associated with myopic behavior. Providing disclosures at a higher frequency may be associated with managers focusing on short-term goals. These findings imply that firms that disclose their number of employees more frequently, are more likely to manage earnings.[16] Thus, voluntary quarterly employment disclosures would be associated with more incidences of just meeting earnings benchmarks.

My second hypothesis is as follows (stated in the null form):

H2: Voluntary quarterly employment disclosures are not associated with earnings management.

1.3 Data and Methodology

1.3.1 Employment Data

Regulation S-K requires firms to disclose the number of employees in their annual reports as part of the narrative description of the business.[17] The SEC does not require firms

[16] A positive association may also arise when the manager rationally attempts to decrease information asymmetry and shareholders' perception of the firm's volatility (Dye 1988, Trueman and Titman 1988).
[17] 17 CFR 229.101(Item 101) Description of business.

to report the number of employees on a quarterly basis. Nonetheless, some firms choose to voluntarily provide information about the size or growth rate of their workforce.[18]

Using hand-collected voluntary disclosures on employment from January 2006 until December 2016, I construct a data set that covers the largest 500 firms (by market capitalization) listed on the NYSE and NASDAQ that report under US GAAP. My sample includes 749 firms for which quarterly financial reports are available. For each firm, I search the most recent quarterly report available in 2016 for disclosures of the number of employees, using search words such as “employ,” “people,” “full-time,” “labor,” “worker,” “workforce,” “personnel,” “staff,” “associates,” and “partners.” Firms that disclose employment-related information in their most recent quarterly report are defined as disclosing firms for that quarter.[19] For firms that do not disclose relevant information in their most recent quarterly report, I examine their disclosure policy in prior quarters.[20] If a firm discloses relevant information in prior periods, I also define the firm as a disclosing firm. Otherwise, I define the firm as a non-disclosing firm. I review all quarterly reports of disclosing firms and record the number of employees reported in each quarter.

[18] For example, LinkedIn in its 10-Q form for the period ended March 31, 2016, states: "Our Talent. We expect to continue to expand our workforce in 2016. However, such expansion, specifically related to our sales and product development teams, will be at a slower rate than in 2015. We expect that the increased headcount will result in an increase in related expenses, including stock-based compensation expense and capital expenditures related to facilities. As of March 31, 2016, we had 9,732 employees, which represented an increase of 27% compared to the same period last year." Furthermore, as part of the discussion on risk factors LinkedIn explains: “We continue to experience rapid growth in our headcount and operations, which will continue to place significant demands on our management and our operational and financial infrastructure. As of March 31, 2016, approximately 33% of our employees had been with us for less than one year and approximately 60% for less than two years.”

[19] I note that firms define their number of employees in various ways. Some firms report the total number of employees, and others the full-time equivalent. Interestingly, firms tend to disclose additional information about their labor force, such as the composition of employees (full-time or part-time; permanent or temporary), location (US or Non-US.; by regions), and exposure to labor unions (number of workers that are members of unions). Some firms provide only partial workforce information. Apple, for example, discloses in some quarters only the number of retail segment employees.

[20] I review prior interim financial reports on EDGAR in intervals of five. That is, I review every 5th quarterly report starting from quarterly financial statements published in the last quarter of 2016 (between September 2016 and December 2016), and going back until the first quarter of 2006. Thus, I review different fiscal quarters in different years. This procedure increases the likelihood of identifying firms that initiate or cease employment disclosure during the sample period.

Moreover, using EDGAR, I identify the interim financial report in which each disclosing firm provide information about its workforce size for the first time. Thirty-nine companies disclose their number of employees in the first 10-Q they filled with the SEC. Nine companies provide employment disclosures as early as of the first quarter of 1994,[21] and out of these, five firms disclose their number of employees every quarter from the first quarter of 1994 until the end of the sample period in 2016 (92 consecutively quarters).

Overall, 154 firms provide information about their workforce in their interim reports during the sample period, and 143 firms (4028 firm-quarter) have consecutive disclosures that permit constructing quarterly employment time-series.[22] Over a span of up to 44 quarters examined, 20.5% of the firms choose to voluntarily disclose the size or growth rate of their workforce for at least part of the sample period. Disclosing firms provide information about their personnel for 28 quarters on average. Thus, the voluntary disclosure choice appears to be sticky, and firms tend to voluntarily disclose repeatedly over time.

The properties of disclosing firms differ from non-disclosing firms. Panel A of Table 1.9.1 provides descriptive statistics[23] for the annual change in the number of employees for all sample firms. The mean (median) change in the number of employees for the full sample is 6.4% (2.5%). The mean (median) annual change in the number of employees of disclosing firms is 9.5% (3.0%), while the mean (median) annual change for non-disclosing firms is 5.7% (2.3%). The mean change in the number of employees of disclosing firms is statistically significantly higher than the mean change of non-disclosing firms (t=3.804).[24] This suggests that disclosing firms change their workforce more abruptly from one year to the next.

Panel B of Table 1.9.1 presents the descriptive statistic for the quarterly change in the number of employees for disclosing firms. The mean (median) firm-quarter change (pooled)

[21] Companies start filling through EDGAR in 1994.
[22] At least two consecutive quarters.
[23] The annual number of employees and the quarterly and annual financial data are from Compustat.
[24] A nonparametric test, Wilcoxon-Mann-Whitney, suggests that the underlying distributions of the two samples are statistically significant different (Z=2.803).

in the number of employees is 1.9% (0.5%), and the mean (median) firm increases its workforce by 2.2% (1.3%) per quarter on average (cross-sectional). The quarterly change in employment is more volatile than the average cross-sectional change (variance of 0.009 and 0.003, respectively), implying that employment fluctuates more across firms than within firms. The maximum (minimum) quarterly change is 174.1% (–45.3%), suggesting that changes in employment may reflect acquisition and divesting activities.

The decision to disclose appears to be associated with industry membership. Table 1.9.2 presents the number of firms in the full sample and the number of disclosing firms by industry division (SIC). Voluntary employment disclosures are most common for firms in finance, insurance, and real estate (36% of the sample firms) and in services (32%). These industries rely on human capital for their operations and may use these disclosures to provide investors with information regarding their current level of economic activity and prospects.

Furthermore, banks are required to disclose their workforce size on form Y-9C, which all banks with assets greater than $500 million must file with the Federal Reserve quarterly. This regulatory requirement may explain why financial institutions are more likely to provide quarterly disclosures regarding their labor force. Financial institutions also have a business model that differs substantially from firms in other industries. Thus, I exclude banks and financial institutions (SIC codes between 6000 and 6500) from the main analyses.

I proceed by examining changes in the firms' employment disclosure policy. Figure 1.8.1 describes the number of firms that change their disclosure policy between 1994 and 2016. I define a firm-quarter t as a "Start Disclosure" quarter, if the firm discloses its workforce size in quarter t but does not disclose information about its workforce size in quarter $t-1$. Similar, a "Stop Disclosure" quarter is defined as a quarter in which the firm does not disclose information about employment, although in the prior quarter $t-1$, the firm provides information on its workforce size.

Figure 1.8.1 shows that more firms initiate employment disclosure during the sample period. In general, it appears that over time, more firms start providing employment disclosures than stop providing such disclosures. The difference between the number of firms that start disclosing and the number of firms that stop disclosing in each period, is positive on average. During the sample period, 2006-2016, the difference between the number of firms that start providing employment disclosures and stop providing these disclosures in each quarter, is 0.659 on average (statistically significant different from zero at a 10% level). Extending the time period to 1994, the average difference is 0.772 (statistically significant different from zero at a 1% level).

The main analysis and remaining tests use both disclosing and non-disclosing firms. I use the Heckman (1979) procedure to correct for potential sample selection bias from the nonrandom choice of providing quarterly disclosures. I estimate a selection model for firm *i* at time *t*, using the full sample and construct the inverse Mills ratio. The selection model is as follows.

$$\text{(1.1) } \Pr(Disclose)_{i,t} = \beta_0 + \beta_1 TotalAssets_{i,t} + \beta_2 MVE_{i,t} + \beta_3 IntangibleAssets_{i,t} + \beta_4 IntangibleRatio_{i,t} + \beta_5 \Delta Employees_{i,t} + \beta_6 Fortune_i + \beta_7 Leverage_{i,t} + \beta_8 MTB_{i,t} + \beta_9 TurnoverRatio_{i,t} + IndustryFE + TimeFE + \varepsilon_{i,t}$$

All variables are defined in Appendix 1.7.1.

The dependent variable (*Disclose*) is an indicator variable equal to 1 if the firm provides voluntarily employment disclosure for the fiscal quarter t, and 0 otherwise. In my sample,[25] firms that choose to disclose quarterly have, on average, higher market capitalization, more assets, and are more likely to belong to the high-tech industry.[26] Thus I expect the likelihood of disclosing the number of employees quarterly ($\Pr(Disclose)$) to increase with total assets (*TotalAssets*) and market value of equity (*MVE*). Furthermore, as

[25] In sections 1.4 and 1.5, I further discuss the characteristics of disclosing and non-disclosing firms.
[26] I follow Kasznik and Lev's (1995) classification of high-technology industries. A firm is classified as high-tech if it is a member of pharmaceuticals (SIC codes 2833–2836), R&D services (8731–8734), programming (7371–7379), computers (3570–3577), or electronics (3600–3674) industries.

disclosing firms have more intangible assets, I control for the level of intangibles (*IntangibleAssets*) as well as for the ratio of intangibles to total assets (*IntangibleRatio*). A firm that has more intangible assets or a higher ratio is likely relying more on human capital for production and growth. Thus, providing quarterly disclosures regarding the number of employees would be more informative to the firm's stakeholders. However, the firm's employment policy or number of employees may also be proprietary information, and this would be associated with lower likelihood of voluntary disclosure.

I also control for characteristics of the firm's employment policy using two proxies. First, I control for the annual percentage change in the number of employees (*ΔEmployees*). Firms that experience larger changes in their workforce from one year to the next may be less willing to share the nature or speed of these changes. Nevertheless, these firms may be more occupied with personnel management and thus would find it beneficial to share employment information with their investors. Second, I use *Fortune*'s *100 Best Companies To Work For* list as a proxy for firms' employer-employee relationship (*Fortune*). The list, published annually, ranks US companies based on employee happiness and perks.[27] I use the ranking for 2005–2016 to identify firms that are more likely to expend resources to attract and retain employees. I expect firms on the list will view the quantity and quality of their employees as more critical and thus will make more frequent disclosures regarding personnel.

Finally, I include controls for financial constraint (*Leverage*), growth opportunities (*MTB*), and asset turnover ratio (*TurnoverRatio*), as well as fixed effects for industry (*IndustryFE*) and time (*TimeFE*). I expect firms to have lower likelihood of quarterly disclosure if they are financially constrained and have less growth opportunities and lower production efficiency.

[27] To identify the 100 Best Companies to Work For, *Fortune* and *Great Place to Work* survey US corporations. Each company's score is based on Trust Index survey feedback from a random sample of employees. People anonymously assess their workplace, including the quality of their leaders, support for their personal and professional lives, and their relationships with colleagues. Survey results are compared with peer organizations of like size and complexity. In addition, Great Place to Work scores a Culture Audit management questionnaire from each company, which reports details such as compensation and benefits, hiring practices, recognition, training, and diversity programs (see http://fortune.com/best-companies/).

1.3.2 Normal Employment Model

To test my first hypothesis, I investigate patterns in the number of employees to detect real activities manipulation. Relaying on the firm's business model and production inputs, I construct a prediction model for the firm's level of employment in the short-run. I estimate the following employment model and use the estimated residuals as proxies for the firms' abnormal employment level.[28] Equation (1.2) denotes the normal level of employment.

$$
\begin{aligned}
(1.2)\ Employees_{i,t} &\\
&= \beta_0 + \beta_1 Employees_{i,t-1} + \beta_2 Assets_{i,t} + \beta_3 Sales_{i,t-1} + \beta_4 Inventory_{i,t-1} \\
&+ \beta_5 NCA_{i,t-1} + \beta_6 IntangibleRatio_{i,t-1} + \beta_7 PPE_{i,t-1} + \beta_8\ QuickRatio_{i,t-1} \\
&+ \beta_9 Leverage_{i,t-1} + \beta_{10} Acquirer_{i,t-1} + \beta_{11} Divestor_{i,t-1} + \beta_{12} Q4Dummy_{i,t} \\
&+ \beta_{13} Q3Dummy_{i,t} + \beta_{14} Q2Dummy_{i,t} + \beta_{15} Mills_{i,t} + FirmFE + TimeFE \\
&+ \varepsilon_{i,t}
\end{aligned}
$$

Firms experience voluntary and involuntary employee turnovers such that even maintaining a stable workforce size requires financial and operational resources. Workforce changes are costly and these costs come in the form of hiring and training (Barron, Berger, and Black 1997, Merz and Yashiv 2007, Blatter, Muehlemann, and Schenker 2012), severance payments, survivor's syndrome (Cascio 1993), and reorganization costs.[29] To minimize costs, firms should aim to maintain stable employment levels, particularly when relying on highly skilled workers (Ghaly, Dang, and Stathopoulos 2017). Accordingly, their total number of employees in the next period (*$Employees_t$*) depends chiefly on the number of employees they already employ (*$Employees_{t-1}$*). Furthermore, larger firms that have more assets (*TotalAssets*) likely require more staff. Hence, I expect bigger employers and larger firms to have a higher headcount.

The workforce size is determined by the firm's economic activity. Firms that have higher sales turnover (*Sales*) and less inventory (*Inventory*) are expected to have higher demand for labor in subsequent periods. Firms that have high levels of noncurrent assets

[28] I note that the labor estimation is a dynamic model, where the lagged number of employees is used as an explanatory variable. Hence, effectively the estimated residuals are equivalent to abnormal changes in the number of employees.

[29] The estimates of the costs of employee turnover vary widely and depend on whether all costs are recognized. These estimates fluctuate between 25% and 200% of annual compensation for a departing employee (Silva and Toledo 2009).

(*NCA*) own many tangible and intangible assets. On the one hand, these firms may rely on capital-intensive production processes and business models. Thus, high levels of noncurrent assets may be associated with lower future employment. On the other hand, more productive assets may indicate that these firms need more employees to develop, operate, and maintain their assets, thus leading to higher future employment.

The ratios of intangible assets (*IntangibleRatio*) and property plant and equipment (*PPE*) to total assets attempt to control for production processes. Firms that have more intangible assets and more PPE relative to their total assets likely rely on more personnel. Thus I expect a positive association between these two ratios and employment.

I follow Pinnuck and Lillis (2007) and control for short-term liquidity (*QuickRatio*) and long-term financing (*Leverage*). The quick ratio controls for changes in labor due to cash flow shortages and short-term liquidity problems. Leverage controls for financial constraints, a reduction in funds available for investment which may hinder labor demand. I also control for large changes in the firm's assets: I expect a positive association between acquiring firms (*Acquirer*) and the number of employees, and a negative association between divesting firms (*Divestor*) and the number of employees.

Prior literature focuses on financial measures of real earnings management such as abnormal operating cash flows, abnormal discretionary expense and abnormal production costs. This literature estimates normal operating cash flows, normal discretionary expense and normal production at the industry level, and then defines the difference between the predicted normal and actual as abnormal. My approach differs as I use Equation (1.2) to define the normal employment level at the firm level. Equation (1.2) is a prediction model of the firm's next period level of employment based on the firm's current assets, finances and business activity.[30]

[30] This approach allows me to control for variation within industry and for firm specific characteristics. Firms operating in the same industry may use various technologies and have varied business models, which implies different employment policies.

I estimate Equation (1.2) using quarterly data. I control for the fiscal quarter (*Q_jDummy*) and also include time and firm fixed effects. The regression residuals denote the abnormal employment, the deviation from the firm's normal employment level as predicted by the model in Equation (1.2). I examine whether firms that just meet or beat earnings benchmarks exhibit higher or lower abnormal employment relative to the rest of the sample firms.

1.3.3 Selection of Suspect Firm-quarters

Prior literature suggests that reported earnings to the right of benchmarks (just at the benchmark or slightly above) may indicate that the earnings were likely managed (Burgstahler and Dichev 1997, Degeorge et al. 1999, Bartov et al. 2002).

To test the hypothesis about earnings management, I define the following three indicators for when earnings management is more likely to occur.

1. Firm-quarters with small income. These are firm-quarters where a firm just meets or beats the zero earnings benchmark. To be consistent with prior literature, I adjust the annual bin width used by Roychowdhury (2006) and Zang (2012) to quarterly frequencies and define firm-quarters as suspect of engaging in earnings management when income before extraordinary items (IBEI) scaled by lagged total assets is between 0 and 0.00125.
2. Firm-quarters with small earnings growth. These are firm-quarters where a firm just meets or beats the zero-earnings growth benchmark. Again, to be consistent with prior literature, I adjust the annual bin width used by Gunny (2010) to quarterly frequencies and define firm-quarters as suspect of engaging in earnings management when changes in net income scaled by lagged total assets are between 0 and 0.0025.
3. Firm-quarters that just meet or beat analyst forecasts. These are firm-quarters where the difference between actual earnings-per-share and the last analyst forecast consensus[31] is between 0 and 1 cent (Degeorge et al. 1999, Roychowdhury 2006, Zang 2012).

[31] I use the actual EPS and construct the analyst forecast consensus using data provided by I/B/E/S. Following Roychowdhury (2006), I define the forecast consensus as the mean of all analysts' final forecasts outstanding prior to the earnings announcement date.

During the sample period, there are 521 (1.85%) firm-quarters just beating or meeting the zero earnings benchmark, 4,429 (15.8%) just bearing or meeting the zero-earnings growth benchmark, and 2,062 (7.35%) just beating or meeting analyst forecast consensus.

1.4 Empirical Analysis

1.4.1 Choice Model Estimation

Table 1.9.3 provides descriptive statistics for disclosing and non-disclosing firms. Disclosing firms seems to be bigger in terms of total assets (*TotalAssets*) and market capitalization (*MVE*), relative to non-disclosing firms. Disclosing firms have mean (median) $27.76 billion ($9.09 billion) in *TotalAssets* and $28.86 billion ($11.26 billion) *MVE*, compared to non-disclosing firms with $19.28 billion ($9.38 billion) in *TotalAssets* and $21.03 billion ($9.92 billion) *MVE*. The difference in total assets means is statistically significant for the parametric test (t=7.66). The difference in market capitalization is statistically significant for the parametric test (t=8.99) and for the Wilcoxon-Mann-Whitney non-parametric test (Z=6.394), rejecting the null that these two samples have equal means and medians. Also, the average disclosing firm has more intangible assets (t=10.1231). Interestingly, the median disclosing firm and the median non-disclosing firm appear to have similar intangible assets (Z=0.816), and a similar intangible ratio (Z=0.963).

Disclosing firms have statistically significantly higher mean (median) annual percentage change in the number of employees (*ΔEmployees)* and are, on average, more likely to appear in *Fortune*'s *100 Best Companies to Work For* list (16% of disclosing firms, relative to 8% of non-disclosing firms). Thus, disclosing firms appear to invest more resources in managing and maintaining their workforce. Furthermore, disclosing firms are, on average, less leveraged (*Leverage*) and have lower asset turnover ratios (*TurnoverRatio*). Finally, disclosing firms are more likely to belong to a high-technology industry (25% of disclosing firms relative to 17% of non-disclosing firms).

Table 1.9.4 presents the *Probit* estimation of the disclosure choice model. As expected, firms with higher labor growth rates (*ΔEmployees)* and those that appear on *Fortune*'s *100 Best Companies to Work For* list (*Fortune)* are more likely to provide quarterly employment disclosures. The regression results do not support that total assets and market capitalization are associated with the disclosure likelihood. Interestingly, the coefficient on intangible ratio (*IntangibleRatio*) is statistically significant and negative, which is consistent with the notion that the number of employees may contain proprietary information.

The estimation of the disclosure choice model is the first stage of the Heckman (1979) procedure to correct for potential sample selection bias. The residuals from the disclosure choice estimation are used to construct the inverse Mills ratio. I include the inverse Mills ratio (*Mills*) in subsequent regression analysis to control for the choice to provide employment disclosures at a higher frequency than mandated by the SEC.

1.4.2 Abnormal Employment Estimation

I estimate the baseline model for normal employment and use the regression residuals as a measure for abnormal employment. Table 1.9.5 presents the descriptive statistics of the normal employment model's variables. The sample size is smaller, compared to Table 1.9.3, due to stronger data requirements, as more variables are required for the estimation of the normal employment model.

Table 1.9.5 presents the descriptive statistics for quarterly data, which covers 87 firms (over up to 44 quarters), employing between 150 and 390,000 employees, where the average (median) firm employs 40,891 (16,850) employees. Furthermore, the average (median) firm has total assets equal to \$25.19 billion (\$83.70 billion) and quarterly mean (median) sales equal \$4.05 billion (\$1.58 billion).

The normal employment model estimation is reported in Table 1.9.6. The coefficients on lag employees and log assets (*Assets*) are significant and consistent with the predication. Table 1.9.6 suggests that *Leverage* is positively associated with quarterly employment. Interestingly, both *Acquirer* and *Divestor* are associated with lower employment. The coefficient on *Acquirer* is negative and statistically significant, consistent with the view that mergers and acquisitions allow for synergies, and thus permits headcount reductions (relative to the underlying economic activity). Overall, the results presented in Table 1.9.6 indicate that the normal employment model has strong explanatory power with adjusted R^2 =0.96.[32]

I note that the normal employment model is dynamic. The estimation presented in Table 1.9.6 is based on a pooled cross-sectional model with firm and time fixed effects as well as correction for autocorrelation in the residuals. This estimation is based on lagged variables to mitigate confounding effects that arise when using contemporaneous variables. Nonetheless, the literature suggests that fixed effect specifications do not remove unobservable heterogeneity in dynamic panel data, such that the lagged variable is correlated with the error terms (Nickell 1981). Thus the standard estimation approach may yield biased, although consistent and asymptotically efficient, coefficients estimates (Kiviet 1995). This bias is more severe for moderate time dimensions and moderate number of data panels. To address this concern, I also estimate Equation (1.2) using the Arellano and Bond (1991) and Blundell and Bond (1998) approaches, which uses lagged variables and first differences as instruments and corrects for autocorrelated errors. When I construct the abnormal employment measure using this alternative specification and repeat my analysis, the main results are unaffected.

1.4.3 Real Earnings Management

The residuals from the normal employment estimation presented in Table 1.9.6 are used to proxy for abnormal employment. The abnormal employment measure denotes the percentage deviation[33] from the predicted labor force size. Hence positive (negative) abnormal employment indicates that the firm's personnel is larger (smaller) than predicted based on the

[32] All firms are mandated to disclose annual employment data in their annual reports. As a sensitivity test, I also estimate the normal employment level for all firms using annual data. However, due to the dynamic nature of employment data, the prediction model for normal employment, does not perform as well for annual data (adjusted R^2 = 0.66). Thus, I focus on quarterly data in an attempt to capture short-term changes in the workforce.

[33] The dependent variable in the labor estimation is log of total number of employees. Hence, the residuals are the difference of two logs, which is equivalent to the log of the ratio: log(x) - log(y) = log(x/y). For ease of presentation, I take the exponential of the residuals and subtract one, which denotes the percentage deviation from the predicted number of employees: exp(log(x/y)) - 1 = x/y - 1.

firm's fundamentals. If firms that just meet or beat reporting benchmarks alter their workforce to reduce costs, generate higher revenues, or create an appearance of lower marginal production costs, then the abnormal employment for these firm-quarters, should exhibit different patterns relative to the rest of the sample. I follow Roychowdhury (2006) and estimate the abnormal employment (*Abn Employment*) using the following model:

$$(1.3)\ Abn\ Employment_{i,t} = \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 BTM_{i,t-1} + \beta_3 NI_{i,t} + \beta_4 Suspect_{i,t} + \beta_5 Mills_{i,t} + IndustryFE + TimeFE + \varepsilon_{i,t}$$

I control for market value of equity (*Size*) and book-to-market ratio (*BTM*), expressed as deviations from industry-quarter mean. Dechow, Sloan, and Sweeney (1995, 1996) and Roychowdhury (2006) argue that the estimation of abnormal accruals and abnormal measurements of real activities may have measurement errors correlated with firm performance. Similarly, my estimation of abnormal employment may have measurement errors positively correlated with firm performance. To address this concern, I include as a control the concurrent ratio of income before extraordinary items (IBEI) to lagged total assets, expressed as deviation from industry-quarter mean (*NI*).

I also include an indicator variable for suspect firms (*Suspect*). As previously discussed, I consider three types of suspect firms: (i) IBEI/Assets suspect equals 1 for firm-quarters that report IBEI scaled by lagged total assets between 0 and 0.00125 and 0 otherwise (*IBEI/Assets suspect*). (ii) ΔEarnings/Assets suspect equals 1 for firm-quarters that report changes in net income scaled by lagged total assets between 0 and 0.0025 and 0 otherwise (*ΔEarnings/Assets suspect*). (iii) Analyst consensus suspect equals 1 for firm-quarters for which the difference between actual earnings per share and the last analyst forecast consensus is between 0 and 1 cent and 0 otherwise (*Analyst consensus suspect)*.

Table 1.9.7 reports the cross-sectional analysis.[34] Column 2 indicates that suspect firms that report small profits (*IBEI/Assets suspect*) have lower abnormal employment (*Abn Employment*) compared to the rest of the sample. These suspect firms' number of employees is smaller on average by 5.5% quarterly. These differences are statistically and economically significant, as this implies under-employment of 2,249 employees for the average firm.

Column 3 reveals that suspect firms that report small earnings growth (*ΔEarnings/Assets suspect*) are associated with higher abnormal employment (*Abn Employment*). Firms that report small quarterly earnings growth, employ on average 3.0% more employees. This result is statistically significant at a 1% level as well as economically significant, as it implies over-employment of 1,227 employees for the average firm.

Finally, Column 4 presents a positive association between *Analyst consensus suspect* firms and *Abn Employment*. Firms that just meet or beat analyst consensus appear to have more employees. These firms employ on average 2.6% more employees.

Overall, the results presented in Table 1.9.7 suggest that firms alter their workforce to meet reporting benchmarks, and thus, I reject the null that suspect firm-quarters do not exhibit unusual employment levels. Interestingly, firms that report small profits appear to have insufficient number of employees. This finding is consistent with the findings of Pinnuck and Lillis (2007), who document a discontinuity in net hiring around zero earnings and argue reporting negative earnings disciplines firms' investments in employees. Nonetheless, this finding may also indicate that firms reduce the number of employees to reduce expenses and avoid reporting losses.

Furthermore, firms that report small earnings growth or just meet or beat analyst forecasts appear to have excess staff. This suggests firms may use different practices to meet different benchmarks. The analysis implies that firms may increase their workforce to generate

[34] Fama-MacBeth (1973) procedure (untabulated) yield similar results.

more sales and revenues (accelerate sales, channel staffing, over-production) to meet or beat market expectations.[35]

Roychowdhury (2006) argues that firms engaging in earnings management by manipulating sales, discretionary expenditure and production, have lower abnormal operating cash flows.[36] If managers alter their sales and production schedules to meet earnings goals, employment levels should mirror these earnings management activities. Thus, the association between abnormal employment and abnormal cash flows should be negative for firms engaging in real earnings management.

I estimate a fully interacted model to examine the association between abnormal cash flows (*Abnormal CFO*) and abnormal employment (*Abn Employment*) for suspect firms. Column 1 of Table 1.9.8 presents the baseline estimation. The association between abnormal employment and abnormal cash flows is negative. The results for the fully interacted model are presented in Column 2 - Column 4 of Table 1.9.8. These results suggest that firms with higher (lower) abnormal cash flows that report small earnings growth or just meet or beat analyst forecast, are associated with lower (higher) abnormal employment.[37] Consistent with Roychowdhury (2006), suspect firms with lower abnormal cash flows are associated with higher abnormal employment, suggesting that these firms change their resource allocation to meet earnings benchmarks.

---

[35] Prior literature suggests that firms may trade-off between accrual-based earnings management and real earnings management (Zang 2012). In untabulated results, I include discretionary accruals, estimated following the modified Jones (1991) model, in the baseline model for normal employment. I construct the abnormal employment measure using this specification and repeat my analysis. The main results are unaffected.

[36] I follow Roychowdhury (2006) and define abnormal cash flows as the deviations from the predicted values from the corresponding industry-year regression: (Operating cash flows$_t$ /Assets$_{t-1}$) = α_0 + α_1(1/Assets$_{t-1}$) + α_2(Sales$_t$ /Assets$_{t-1}$) + α_3(ΔSales$_t$ /Assets$_{t-1}$) + ε_t.

[37] Untabulated results suggest that firms exhibiting higher abnormal production and report small earnings growth or just meet or beat analyst forecast, are associated with higher abnormal employment. Furthermore, firms exhibiting lower discretionary expenses and report small earnings growth or just meet or beat analyst forecast, are associated with lower abnormal employment.

1.4.4 Subsequent Performance

The labor market has frictions and workforce adjustments are costly for firms. Oi (1962) argues that labor is a quasi-fixed production factor, where the fixed employment costs arise from investments in hiring[38] and training.[39]

While over- or under-employment permit managers to meet or beat earnings benchmarks, the potential costs of abnormal employment are borne by the firm in the long-run. Search and training costs, labor market reputation and production efficiency are not directly observable in financial statements, however, they are likely to influence the firm's future productivity.

Abnormal employment may generate substantial costs for firms in the short and long-run, mainly as hiring costs are considered convex (Blatter et al. 2015). Training costs exhibit some economics of scale (Blatter et al. 2015), nonetheless, short-term changes to the labor force may lead to tacit knowledge loss, as well as lower returns on training and reduced productivity.

If abnormal employment captures deviations from firms' long-term employment levels, the costs associated with these deviations should be reflected in future firm performance. I follow Gunny (2010) and examine future firm performance using the following model:

[38] Hiring costs are those costs that do not affect the worker's productivity (Oi 1962). Such costs include searching and recruiting employees, conducting interviews and examinations, and various admin costs related to processing applications and payroll records. Barron et al. (1997) analyze the 1982 Employment Opportunity Pilot Project (EOPP) survey and the 1992 Small Business Administration (SBA) survey. These surveys asked employers a series of questions concerning hiring and training new employees. Based on these two surveys, they find that an employer spends 11.24-15.99 hours per each hire. Their findings imply that the average time spent on filing a vacancy is 2.2 percent to 3.2 percent of quarterly hours worked, which according to Silva and Toledo (2009) is equivalent to 3 percent to 4.5 percent of the quarterly wage of a new hire.

[39] Training expenses are direct investments in human capital, enhancing general and firm-specific skills, and are designed to improve the worker's productivity (Oi 1962; Acemoglu and Pischke 1998, 1999; Kessler and Lülfesmann 2006). Barron et al. (1997) document that the average training cost of a newly hired worker is equivalent to 55% of their quarterly wage. These findings are consistent with Dolfin (2006), who studies the EOPP survey data. She shows that a new employee spends 201 hours in training activities during the first three months on the job, and that existing employees spend on average 146 hours training a new employee. Furthermore, Bishop (1997) and Silva and Toledo (2009) report that the starting productivity gap between a new employee and an incumbent employee is around 40%. This gap is closed after on-the-job training period and learning by doing.

$$
\begin{aligned}
(1.4)\ Future\ performance_{i,t} \\
&= \beta_0 + \beta_1 Assets_{i,t-1} + \beta_2 MVE_{i,t-1} + \beta_3 Abs(Abn\ Employment)_{i,t-1} \\
&+ \beta_4 Acquirer_{i,t-1} + \beta_5 Divestor_{i,t-1} + \beta_6 ZScore_{i,t-1} + \beta_7 Return_{i,t-1} \\
&+ \beta_8 \Delta CurrentLiabilities_{i,t-1} + \beta_9 QuickRatio_{i,t-1} \\
&+ \beta_{10} Q4Dummy_{i,t} + \beta_{11} Q3Dummy_{i,t} + \beta_{12} Q2Dummy_{i,t} \\
&+ \beta_{13} Mills_{i,t} + IndustryFE + TimeFE + \varepsilon_{i,t}
\end{aligned}
$$

In contrast to Gunny (2010), I do not examine suspect firms directly, but focus on a potential measure of real earnings management defined as absolute abnormal employment *(Abs(Abn Employment))*, the absolute percentage deviation from normal employment level. I use the absolute value of abnormal employment as both over- or under-employment may generate costs for the firm.

Column 1 of Table 1.9.9 reports the estimation of Equation (1.4), where future performance is denoted by future operating cash flows, expressed as deviations from industry-quarter mean. The results presented in Column 1 of Table 1.9.9 indicate that absolute abnormal employment is associated with lower future cash flows (*CFO*). In columns 2 and 3 of Table 1.9.9, future performance is given by future operating income (*Operating Income*) and future operating expense (*Operating Expense*), respectively, expressed as deviations from industry-quarter means. Absolute abnormal employment does not appear associated with higher future operating income, however, absolute abnormal employment is associated with lower future operating expense.

Overall, the analysis presented in Table 1.9.9 suggests that short-term labor adjustments, captured by the absolute value of abnormal employment, are associated with future costs for firms. Furthermore, these adjustments may not contribute to higher subsequent economic activity as reflected by operating income and operating cash flows.

1.5 Voluntary Employment Disclosure and Managerial Behavior

The analysis presented above is based on a voluntary disclosure setting. Only some firms disclose their number of employees quarterly, more often than mandated by the SEC. The descriptive evidence suggests that firms' choice to disclose information about their workforce size more often, does not appear random. Some firms provide quarterly employment disclosures starting from their initial public financial statement. Other firms have been disclosing their workforce size every quarter since the firm's first EDGAR filling. The decision to provide more frequent (quarterly) employment disclosures may be correlated with firm characteristics, as previously discussed in the choice model in section 1.4.

On the one hand, disclosing employment information at a higher frequency than required by the SEC may reveal managerial actions, such as earnings management through the firm's workforce. Hence, managers may choose to provide voluntary employment disclosures to signal firm quality and limit real earnings management activities. Nevertheless, managers may also withhold voluntary employment disclosures to council real earning management activities. Overall, these arguments suggest a negative association between voluntary quarterly employment disclosures and earnings management.

On the other hand, disclosing employment information at a higher frequency than mandated by the SEC may bring managers to focus on shorter horizons (Hermalin and Weisbach 2012, Gigler et al. 2014). Prior literature suggests that more frequent disclosures have an impact on resource allocation and induce myopic behavior. Thus, firms that provide quarterly employment disclosures may be more prone to managing earnings, suggesting a positive association between voluntary quarterly employment disclosures and earnings management.

To test these predictions, I examine the relation between more frequent employment disclosures and earnings management. I estimate the probability of a firm to be considered as a suspect firm, using the three types of suspect firms as previously defined. I estimate the following regression.

$$(1.5)\ Pr(Suspect)_{i,t} = \beta_0 + \beta_1 Disclose_{i,t} + \beta_2 Assets_{i,t} + \beta_3 HabitualBeater_{i,t} + \beta_4 QuickRatio_{i,t} + \beta_5 \Delta CurrentLiabilities_{i,t} + \beta_6 MVE_{i,t} + \beta_7 ZScore_{i,t} + \beta_8 Q4Dummy_{i,t} + \beta_9 Q3Dummy_{i,t} + \beta_{10} Q2Dummy_{i,t} + \beta_{11} Mills_{i,t} + IndustryFE + TimeFE + \varepsilon_{i,t}$$

I control for changes in firm size (*Assets*) and include a dummy variable for firms that meet or beat the earnings benchmark repeatedly (*HabitualBeater*) as these firms have stronger incentives to maintain their track record (Bartov et al. 2002, Kasznik and McNichols 2002, Zang 2012). I also attempt to control for firms' financing needs, as Richardson, Tuna, and Wu (2002) suggest that attracting external financing at a lower cost is a primary motivation for earnings manipulation.

Table 1.9.10 present the estimation of Equation (1.5) using quarterly data for disclosing and non-disclosing firms. Firms that provide quarterly employment disclosures (*Disclose*) are not associated with higher likelihood of managing earnings, as measured by IBEI to lagged total assets. Just meeting or beating the zero earnings benchmark is not associated with the disclosure decision. Nonetheless, firms that provide quarterly employment disclosures are more likely to report small profit growth and just meet or beat the analyst forecast.

These findings provide some support for the notion that firms that provide more frequent disclosures are more focused on short-term reporting goals and more sensitive to capital market pressures.

1.6 Conclusion

This chapter documents that 20.5% of large public US firms voluntarily disclose their number of employees in their interim financial reports. These firms choose to provide information regarding their personnel more often than is required by the SEC.

I use the voluntary disclosures of the number of employees to study whether managers alter their workforces to manage earnings. My findings are consistent with managers decreasing workforce size to avoid reporting losses and increasing it to support revenue increasing activities, which, in turn, permits reporting small earnings growth and meeting or beating analyst forecasts. Thus, financial performance measures appear to induce fluctuations to non-financial variables.

My analysis of firms' employment policies is based on a voluntary disclosure setting, which may limit the generalizability of my results. I separately examine whether the decision to provide quarterly employment disclosures is informative about managerial actions. The literature suggests that frequent financial reporting induces myopic behavior and causes investors and firms to become too focused on short-term performance (Kraft et al. 2018). Consistent with the literature, I document a positive association between providing more frequent employment disclosures and the likelihood of reporting small earnings growth and just meeting or beating analyst forecasts.

Overall, this chapter demonstrates another channel for real earnings management. Managers appear to change their firms' workforces to meet short-term reporting goals. This practice may destroy value over time, as hiring and firing employees is costly, and may reduce production efficiency. Furthermore, this form of real earnings management may introduce noise into labor-market matching and increase labor market fluctuations. My analysis suggests that higher frequency reporting and capital market pressures may create distortions in the labor market and increase inefficiencies—an insight that may contribute to discussions regarding the costs and benefits of more frequent disclosures.

1.7 Appendix

APPENDIX 1.7.1

Variable Descriptions

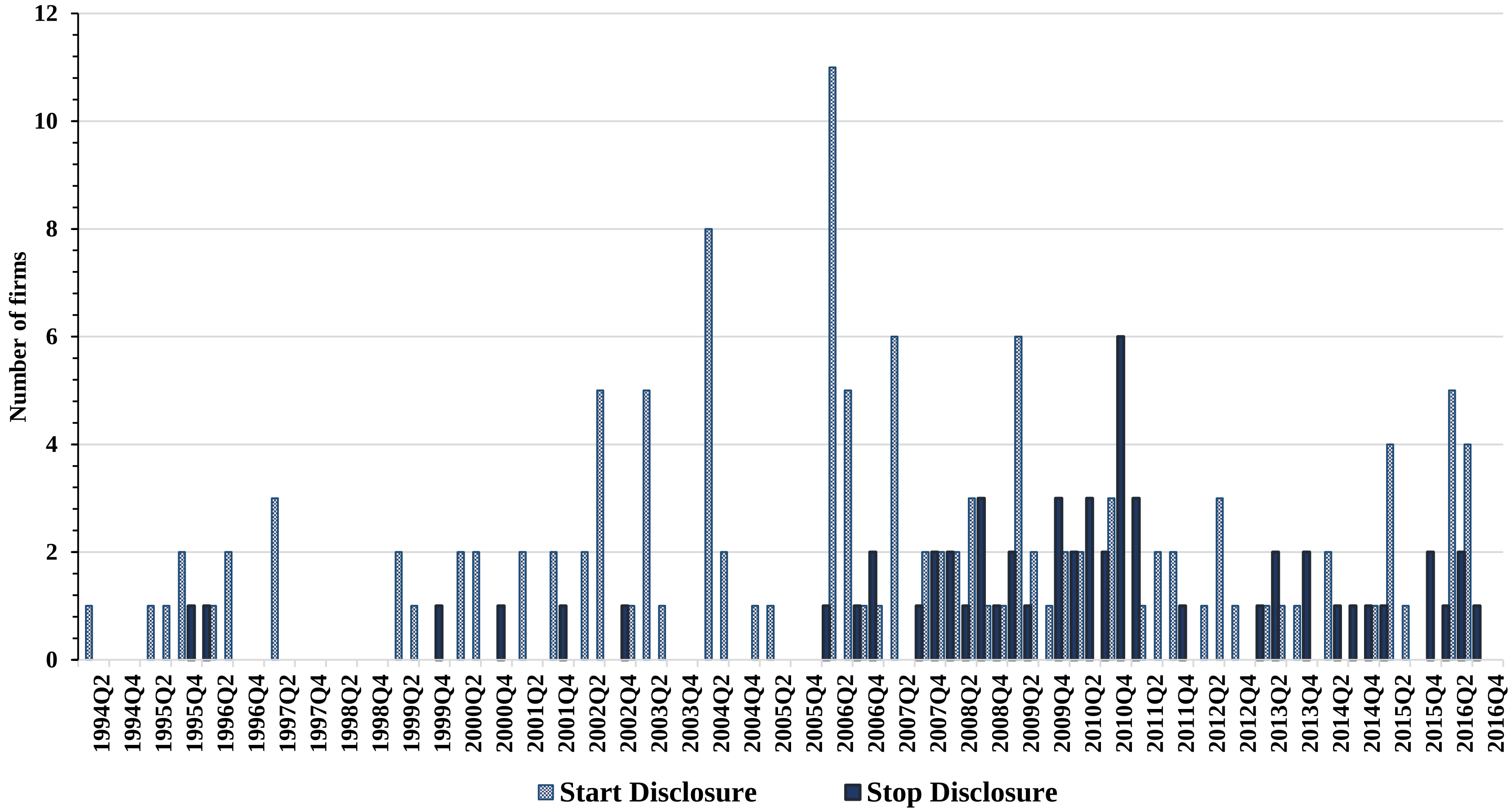
$Disclose_t$	An indicator variable set equal to 1 if the firm provides voluntarily employment disclosure for the fiscal quarter t.
$TotalAssets_t$	Total assets at the end of the fiscal quarter t.
MVE_t	Market value of equity the end of the fiscal quarter t
$IntangibleAssets_t$	Total intangible assets at the end of the fiscal quarter t.
$IntangibleRatio_t$	Total intangible assets to total assets at the end of the fiscal quarter t.
$\Delta Employees_t$	Annual percentage change in the number of employees during the recent fiscal year.
Fortune	An indicator variable set equal to 1 if the firm is listed on Fortune's *100 Best Companies to Work For* between 2005 and 2016, and 0 otherwise.
$Leverage_t$	The ratio of total debt to total assets at the end of the fiscal quarter t.
MTB_t	The ratio of market value of equity to book value of equity at the end of the fiscal quarter t.
$TurnoverRatio_t$	The ratio of sales to lagged total assets at the end of the fiscal quarter t.
$Employees_t$	Log of the total number of employees a firm discloses in its interim financial report for fiscal quarter t.
$Sales_t$	Total sales turnover at the end of the fiscal quarter t.
$Inventory_t$	Total inventory at the end of the fiscal quarter t.
NCA_t	Total noncurrent assets at the end of the fiscal quarter t.
PPE_t	Total property, plant, and equipment (PPE) to total assets at the end of the fiscal quarter t.
$QuickRatio_t$	Quick ratio at the end of the fiscal quarter t, defined in Penman (2004). (Cash and Short Term Investments + Receivables)/ Current Liabilities
$Acquirer_{t-1}$	An indicator variable set equal to 1 if in the prior quarter the book value of total assets at the end of the fiscal quarter increases by more than 25% from the beginning of the fiscal quarter, and 0 otherwise.
$Divestor_{t-1}$	An indicator variable set equal to 1 if in the prior quarter the book value of total assets at the end of the fiscal quarter decreases by more than 25% from the beginning of the quarter, and 0 otherwise.
Q_jDummy_t	An indicator variable set equal to 1 for fiscal quarters j={2,3,4}, and 0 otherwise.

$Mills_t$	Inverse Mills ratio using the residuals from the disclosure choice estimation.
IBEI/Assets $suspect_t$	An indicator variable set equal to 1 if income before extraordinary items (IBEI) scaled by lagged total assets is between 0 and 0.00125, and 0 otherwise.
ΔEarnings/Assets $suspect_t$	An indicator variable set equal to 1 if changes in net income scaled by lagged total assets are between 0 and 0.0025, and 0 otherwise.
Analyst consensus $suspect_t$	An indicator variable set equal to 1 if the difference between actual earnings-per-share and the last analyst forecast consensus is between 0 and 1 cent, and 0 otherwise.
Hightech	An indicator variable set equal to 1 if the firms it is a member of pharmaceuticals (SIC codes 2833–2836), R&D services (8731–8734), programming (7371–7379), computers (3570–3577), or electronics (3600–3674) industries. I follow Kasznik and Lev's (1995) classification of high-technology industries.
$Assets_t$	Log of total assets at the end of the fiscal quarter t.
$Size_t$	MVE_t expressed as deviations from industry-quarter mean, at the end of the fiscal quarter t.
BTM_t	The ratio of book value of equity to market value of equity at the end of the fiscal quarter t, expressed as deviations from industry-quarter mean.
NI_t	Income before extraordinary items (IBEI) to lagged total assets, expressed as deviation from industry-quarter mean, at the end of the fiscal quarter t.
Abnormal CFO_t	As in Roychowdhury (2006), abnormal cash flows is the deviations from the predicted values from the corresponding industry-year regression: $(\text{Operating cash flows})_t/\text{Assets}_{t-1}=\alpha_0 + \alpha_1(1/\text{Assets}_{t-1}) + \alpha_2(\text{Sales}_t /\text{Assets}_{t-1}) + \alpha_3(\Delta\text{Sales}_t /\text{Assets}_{t-1})+\varepsilon_t$
CFO_t	Operating cash flows, expressed as deviations from industry-quarter mean, at the end of the fiscal quarter t.
Operating $Income_t$	Operating income, expressed as deviations from industry-quarter mean, at the end of the fiscal quarter t.
Operating $Expense_t$	Operating expense, expressed as deviations from industry-quarter mean, at the end of the fiscal quarter t.
$ZScore_t$	A measure of financial health modified from Altman's Z-score (Altman 1968, Mackie-Mason 1990) and annualized based on past four quarters
$Return_t$	The one quarter holding period return on an investment in firm j's common stock.
$\Delta CurrentLiabilities_t$	The change in total current liability over lagged total assets, at the end of the fiscal quarter t
$HabitualBeater_t$	An indicator variable set equal to 1 if the firm beat or meet an earnings benchmark in the past two quarters, and 0 otherwise.

1.8 Figure

FIGURE 1.8.1

Changes in Disclosure Policy (Non-Financial Firms)



1.9 Tables

TABLE 1.9.1
Descriptive Statistics

Panel A: Annual Percentage Change in the Number of Employees

	N	Mean	Median	Std. Dev	Min	Max
Non-Disclosing Firms	5,745	0.057	0.023	0.276	-0.888	7.290
Disclosing Firms	1,410	0.095	0.030	0.521	-0.738	17.000
Full Sample	7,155	0.064	0.025	0.339	-0.888	17.000

Panel B: Quarterly Percentage Change in the Number of Employees

	N	Mean	Median	Std. Dev	Min	Max
Pooled	3,812	0.019	0.005	0.09	-0.453	1.741
Cross-sectional	143	0.022	0.013	0.03	-0.453	1.741

TABLE 1.9.2
Number of Firms and Disclosing Firms by Industry Division

Industry	**Disclosing Firms**	**% Disclosing Firms**	**Non-Disclosing Firms**	**% Non-Disclosing Firms**	**Full Sample**
Agriculture, Forestry and Fishing	0	0%	1	100%	1
Mining	9	16%	46	84%	55
Construction	1	10%	9	90%	10
Manufacturing	44	16%	229	84%	273
Transportation, Communications, Electric, Gas and Sanitary service	18	16%	98	84%	116
Wholesale Trade	2	17%	10	83%	12
Retail Trade	1	2%	49	98%	50
Finance, Insurance and Real Estate	49	36%	88	64%	137
Services	30	32%	65	68%	95
Total	**154**	**21%**	**595**	**79%**	**749**

TABLE 1.9.3
Descriptive Statistics: Disclosure Choice Model

	Disclosing Firm-quarters (N=2,523)		Non-disclosing Firm-quarters (N=21,286)		Difference[a]: (Disclosing) - (Non-disclosing)	
	Mean	Median	Mean	Median	Mean	Median
TotalAssets	27,758.88	9,090.30	19,278.36	9,380.57	8,480.52***	-290.27
MVE	28,857.74	11,264.25	21,027.88	9916.96	7,829.86***	1,347.30***
IntangibleAssets	6,568.22	1,338.50	4,375.53	1,313.51	2,192.69***	24.99
IntangibleRatio	0.22	0.20	0.23	0.17	0.00	0.03
ΔEmployees	0.11	0.40	0.06	0.02	0.05***	0.38***
Fortune	0.16	0.00	0.08	0.00	0.08***	0.00***
Leverage	0.25	0.23	0.29	0.27	-0.04***	-0.04***
MTB	0.39	0.33	0.40	0.33	-0.00	0.01***
TurnoverRatio	0.20	0.18	0.22	0.17	-0.02 ***	0.01***
Hightech	0.25	0.00	0.17	0.00	0.08***	0.00***

[a] The significance of the differences in the means (medians) between the suspect firms and other firms is based on t statistics (z-statistics) from t-tests (Wilcoxon tests).
*, **, and *** denote statistical significance at the 10%, 5%, and 1% (two-tail) levels, respectively.
All continuous variables are winsorized at the 1% and 99% level.

TABLE 1.9.4
Regression Results: Estimation of the Disclosure Choice Model

		$Pr(Disclose)_t$
Intercept		-2.163***
		0.000
$TotalAssets_t$	+	0.000***
		0.000
MVE_t	+	-0.000***
		0.000
$IntangibleAssets_t$	?	0.000**
		0.032
$IntangibleRatio_t$	?	-0.271***
		0.001
$\Delta Employees_t$	+	0.154***
		0.000
Fortune	+	0.385***
		0.000
$Leverage_t$	-	-0.527***
		0.000
MTB_t	+	-0.000***
		0.000
$TurnoverRatio_t$	+	0.398***
		0.000
$Q1Dummy_t$		0.022
		0.636
$Q2Dummy_t$		0.013
		0.788
$Q3Dummy_t$		0.027
		0.571
Industry Fixed Effects		Yes
Time Fixed Effects		Yes
N		23,809
Pseudo R^2		0.13

I report p-values in italics and *, **, and *** denote statistical significance at the 10%, 5%, and 1% (two-tail) levels, respectively. Standard errors are clustered at the firm level. All continuous variables are winsorized at the 1% and 99% level.

TABLE 1.9.5

Descriptive Statistics: Disclosing Firms

	N	Mean	Median	Std.Dev	Min	Max
Number of Employees	2,255	40,891.93	16,850.78	57,294.16	150.00	390,000.00
TotalAssets	2,255	25,194.36	8,370.70	42,362.02	492.13	220,000.00
Sales	2,255	4,050.01	1,585.00	6,153.61	54.90	37,576.00
Inventory	2,255	982.00	293.00	2,083.13	0.00	13,921.00
NCA	2,255	18,129.73	4,430.30	37,128.51	87.57	250,000.00
IntangibleRatio	2,255	0.23	0.22	0.19	0.00	0.82
PPE	2,255	0.27	0.17	0.25	0.00	0.93
QuickRatio	2,255	1.76	1.25	1.66	0.10	13.15
Leverage	2,255	0.24	0.22	0.17	0.00	0.98
Acquirer	2,255	0.03	0.00	0.17	0.00	1.00
Divestor	2,255	0.00	0.00	0.05	0.00	1.00

All continuous variables are winsorized at the 1% and 99% level.

TABLE 1.9.6
Regression Results: Estimation of Labor Model

		$Employees_t$
Intercept		-0.095
		0.740
$Employees_{t-1}$	+	0.853***
		0.000
$Assets_t$	+	0.117***
		0.000
$Sales_{t-1}$	+	0.000***
		0.000
$Inventory_{t-1}$	+	-0.000**
		0.021
NCA_{t-1}	?	-0.000***
		0.000
$IntangibleRatio_{t-1}$	+	-0.002
		0.952
PPE_{t-1}	+	-0.055
		0.152
$QuickRatio_{t-1}$	-	-0.002
		0.420
$Leverage_{t-1}$	-	0.109***
		0.000
$Acquirer_{t-1}$	+	-0.020**
		0.020
$Divestor_{t-1}$	-	-0.120***
		0.000
$Q4Dummy_t$		0.012**
		0.031
$Q3Dummy_t$		-0.008
		0.125
$Q2Dummy_t$		0.002
		0.761
$Mills_t$		-0.358***
		0.000
Firm Fixed Effects		Yes
Time Fixed Effects		Yes
N		2,046
No. of Firms		87
Adjusted R^2		0.96

I report p-values in italics and *, **, and *** denote statistical significance at the 10%, 5%, and 1% (two-tail) levels, respectively. All continuous variables are winsorized at the 1% and 99% level. Regression with firm and time fixed effects and AR(1) disturbance term.

TABLE 1.9.7
Comparison of Suspect Firm-quarters with the Rest of the Sample
Dependent Variable: Abnormal Employment

	(1)	(2)	(3)	(4)	(5)
Siz$_{t-1}$	0.042***	0.042***	0.042***	0.043***	0.042***
	0.000	*0.000*	*0.000*	*0.000*	*0.000*
BTM$_{t-1}$	0.000	0.000	0.000	0.000	0.000
	0.307	*0.287*	*0.283*	*0.305*	*0.264*
NI$_t$	0.002	-0.009	0.003	0.0000	-0.010
	0.986	*0.947*	*0.979*	*0.998*	*0.940*
IBEI/Assets suspect$_t$		**-0.055*** **			**-0.056*** **
		0.009			*0.005*
ΔEarnings/Assets suspect$_t$			**0.030*** **		**0.029*** **
			0.002		*0.002*
Analyst consensus suspect$_t$				**0.026** **	**0.024** **
				0.021	*0.030*
Mills$_t$	0.141***	0.141***	0.145***	0.141***	0.146***
	0.000	*0.000*	*0.000*	*0.000*	*0.000*
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	2,124	2,124	2,124	2,124	2,124
Adjusted R^2	0.650	0.651	0.651	0.652	0.654

I report p-values in italics and *, **, and *** denote statistical significance at the 10%, 5%, and 1% (two-tail) levels, respectively. Regression with time and industry fixed effects. Robust standard errors corrected for heteroskedasticity and autocorrelation using the Newey-West procedure.

TABLE 1.9.8
Comparison of Suspect Firm-quarters with the Rest of the Sample, Full Interaction
Dependent Variable: Abnormal Employment

	(1) Baseline	(2) Suspect = IBEI/Assets suspect	(3) Suspect = ΔEarnings/Assets suspect	(4) Suspect = Analyst consensus suspect
Abnormal CFO$_t$	**-0.703*** **	**-0.700*** **	**-0.669*** **	**-0.602*** **
	0.000	*0.000*	*0.000*	*0.000*
Size$_{t-1}$	0.047***	0.046***	0.043***	0.045***
	0.000	*0.000*	*0.000*	*0.000*
BTM$_{t-1}$	0.000	0.000	0.000	0.000
	0.668	*0.687*	*0.447*	*0.683*
NI$_t$	0.293**	0.271**	0.158	0.1
	0.011	*0.028*	*0.217*	*0.333*
Suspect$_t$		**-0.016**	**0.044*** **	**0.062*** **
		0.448	*0.000*	*0.000*
*Abnormal CFO$_t$ * Suspect$_t$*		**-0.159**	**-0.354** **	**-1.130*** **
		0.608	*0.012*	*0.000*
*Size$_{t-1}$ * Suspect$_t$*		0.046	0.014	0.021**
		0.106	*0.161*	*0.026*
*BTM$_{t-1}$ * Suspect$_t$*		-0.005*	0.001***	0.000
		0.090	*0.010*	*0.908*
*NI$_t$ * Suspect$_t$*		0.75	2.704***	2.339***
		0.717	*0.000*	*0.000*
Mills$_t$	0.124***	0.124***	0.116***	0.140***
	0.000	*0.000*	*0.000*	*0.000*
Industry Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
N	1,623	1,623	1,623	1,623
Adjusted R^2	0.527	0.527	0.540	0.543

I report p-values in italics and *, **, and *** denote statistical significance at the 10%, 5%, and 1% (two-tail) levels, respectively. Regression with time and industry fixed effects. Robust standard errors corrected for heteroskedasticity and autocorrelation using the Newey-West procedure.

TABLE 1.9.9
Regression Results: Future Performance

	(1) CFO_{t+1}	(2) Operating $Income_{t+1}$	(3) Operating $Expense_{t+1}$
Intercept	0.064	-0.033	0.146
	0.350	*0.329*	*0.157*
$Assets_t$	-0.012**	-0.001	-0.005
	0.024	*0.702*	*0.407*
MVE_t	0.000***	0.000**	-0.000**
	0.006	*0.021*	*0.036*
Abs(Abn Employment)$_t$	**-0.052****	**-0.015**	**0.169****
	0.020	*0.204*	*0.042*
$Acquirer_t$	-0.018**	-0.010**	-0.041***
	0.042	*0.014*	*0.000*
$Divestor_t$	0.023*	-0.023	0.040
	0.074	*0.406*	*0.324*
$ZScore_t$	0.018***	0.013***	0.021***
	0.000	*0.000*	*0.001*
$Return_t$	0.019**	0.009**	0.013
	0.043	*0.013*	*0.128*
$\Delta CurrentLiabilities_t$	-0.004	-0.015	0.015
	0.922	*0.324*	*0.703*
$QuickRatio_t$	-0.003	-0.002*	-0.007**
	0.138	*0.067*	*0.038*
$Q4Dummy_{t+1}$	0.096***	0.002	0.014**
	0.000	*0.182*	*0.014*
$Q3Dummy_{t+1}$	0.052***	0.002	-0.001
	0.000	*0.117*	*0.874*
$Q2Dummy_{t+1}$	0.024***	0.000	-0.004
	0.000	*0.956*	*0.437*
$Mills_{t+1}$	-0.030	0.019	-0.051
	0.138	*0.112*	*0.237*
Industry Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
N	1,960	1,931	1,956
Adjusted R^2	0.436	0.420	0.592

I report p-values in italics and *, **, and *** denote statistical significance at the 10%, 5%, and 1% (two-tail) levels, respectively. Standard errors are clustered at the firm level. All continuous variables are winsorized at the 1% and 99% level.

TABLE 1.9.10
Regression Results: Probability of Just Meeting or Beating Earnings Benchmarks

	Pr(Small earnings)	Pr(ΔEarnings)	Pr(Analyst consensus)
Intercept	-7.828***	-6.177***	-1.457
	0.000	*0.000*	*0.121*
$Disclose_t$	0.133	0.227***	0.293***
	0.548	*0.001*	*0.001*
$Assets_t$	0.732***	0.162***	-0.054
	0.000	*0.000*	*0.117*
$HabitualBeater_t$	2.066***	0.533***	1.775***
	0.004	*0.000*	*0.000*
$QuickRatio_t$	0.031	0.002	-0.034
	0.193	*0.915*	*0.184*
$\Delta CurrentLiabilities_t$	-0.199	-0.171***	0.067
	0.316	*0.005*	*0.201*
MVE_t	-0.000***	-0.000***	0.000***
	0.000	*0.009*	*0.002*
$ZScore_t$	-0.103***	0.061***	0.047**
	0.000	*0.001*	*0.027*
$Q4Dummy_t$	-0.097	-0.048	-0.025
	0.684	*0.542*	*0.790*
$Q3Dummy_t$	-0.507**	0.290***	0.001
	0.045	*0.000*	*0.988*
$Q2Dummy_t$	-0.230	0.341***	-0.033
	0.373	*0.000*	*0.734*
$Mills_t$	0.491	0.420***	-0.442**
	0.355	*0.004*	*0.012*
Industry Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
N	20,289	20,289	20,289
Pseudo R^2	0.118	0.044	0.059

I report p-values in italics and *, **, and *** denote statistical significance at the 10%, 5%, and 1% (two-tail) levels, respectively. Robust standard errors. All continuous variables are winsorized at the 1% and 99% level.

Chapter 2

IFRS Adoption and Litigation Risk: Evidence from Directors' and Officers' Liability Insurance

Brian M. Burnett

Daphne Hart

Paige H. Patrick

2.1 Introduction

As more countries adopt more principles-based accounting standards, such as International Financial Reporting Standards (IFRS), it becomes increasingly important to understand the costs and benefits of such standards. Regulators argue that transitioning to more principles-based standards leads to benefits, including improvement in financial reporting quality, increased comparability across countries, and improved alignment among shareholders, auditors, and reporting firms (e.g., SEC 2003). Empirical research documents such positive outcomes when European firms adopt IFRS (e.g., Barth et al. 2008, Daske et al. 2008, Armstrong et al. 2010, Brüggemann et al. 2013). However, individual firms incur costs associated with IFRS adoption, such as transition costs and increases in audit fees (e.g., Kim et al. 2012, De George et al. 2013).

We appreciate the comments of Vasiliki Athanasakou, Hong Kim Duong (discussant), Bjorn Jorgensen, Wim Van der Stede, and seminar participants at the 2017 IE Doctoral Consortium, London School of Economics and Political Science, Tel Aviv University, the 2018 International Accounting Section Midyear conference, the 41st EAA Annual Congress and the 2018 AAA Annual Meeting. We thank Alexander Barrett and Rani Suleman for excellent research assistance.

We extend the discussion of the costs and benefits of principles-based accounting standards by investigating whether litigation risk changes upon adoption of more principles-based accounting standards.

To understand the effect of principles-based accounting standards on litigation risk, we study changes in two established proxies for litigation risk, Directors' and Officers' (D&O) liability insurance and excess cash holdings (Core 1997, Core 2000, Chung and Wynn 2008, Wynn 2008), around the adoption of IFRS in Canada. D&O liability insurance policies are corporate insurance policies that are purchased by firms and cover the firms' directors and officers.[1] Firms may also hold cash as a form of self-insurance (Wynn 2008). For firms that carry D&O insurance, excess cash available for indemnification may be used as an additional cushion in case of litigation, while for firms that do not carry D&O insurance, excess cash may substitute for insurance.

We investigate changes in litigation risk in Canadian firms for several reasons. First, Canadian firms face relatively high levels of litigation risk, probably only second to US firms. Second, unlike US firms, public Canadian firms are required to disclose whether they purchase D&O liability insurance, and these disclosures often include information about the insurance premium and coverage limit. Third, Core (1997) finds meaningful variation in the proportion of Canadian firms that purchase D&O insurance. In his sample, two-thirds of firms carry D&O insurance, whereas more than 90% of US firms carry D&O insurance.

In addition, Canada offers a natural setting for empirical-archival studies of the effects of adopting more principles-based accounting standards. Canada switched its reporting standards from Canadian Generally Accepted Accounting Principles (GAAP) to IFRS for fiscal years starting on or after 1 January 2011. Pre-IFRS Canadian GAAP was close to US GAAP (Bandyopadhyay, Hanna and Richardson 1994, Cormier and Magnan 2016), which is considered

[1] We discuss the details of D&O liability insurance in greater detail in Section 2.2.

a more rules-based standard.[2,3] Furthermore, IFRS adoption in Canada was not accompanied by other significant changes to the regulatory environment or enforcement intensity that would otherwise confound our inferences.

Ex ante, whether or how Canadian IFRS adoption affects litigation risk is unclear. On the one hand, litigation risk may be higher once Canadian firms adopt IFRS. Lack of specific rules means managers will have to rely more on their own judgment, which could result in more legal challenges to their decisions (Hail et al. 2010, Donelson et al. 2012). Furthermore, the additional discretion and relative lack of guidance may allow managers to engage in more opportunistic behavior (e.g., Nelson et al. 2002, Donelson et al. 2016), which would likely result in an increase in firms' litigation risk.

On the other hand, IFRS adoption may reduce litigation risk relative to pre-IFRS Canadian GAAP. As IFRS provides less guidance, it could reduce the occurrence of transaction structuring to obtain specific accounting treatment (Nelson et al. 2002, Ewert and Wagenhofer 2005, Hail et al. 2010). Moreover, if IFRS adoption improves financial reporting quality or allows for the less costly dissemination of private information as some suggest (e.g., SEC 2003, Hail et al. 2010, Joos and Leung 2013), the occurrence of lawsuits and their expected costs should decrease accordingly. IFRS may permit firms to produce financial statements that are more informative and better represent the firm's financial standing, thus, IFRS adoption may reduce firms' litigation risk.

[2] While US GAAP is considered a more rules-based standard, pre-IFRS Canadian GAAP is considered a more principles-based standard. However, pre-IFRS Canadian GAAP is relatively more rules-based than IFRS, largely due to harmonization efforts with US GAAP. Prior to 2004, a primary objective of the Canadian's Accounting Standards Board's (AcSB) was to minimize differences from US GAAP (Discussion Paper of Accounting Standards in Canada: Future Directions June 24, 2004). Each year the AcSB performed a detailed review of differences between Canadian GAAP and US GAAP for a random sample of Canadian firms cross-listed in the US that reported reconciliations from Canadian GAAP to US GAAP. The AcSB then developed standards that eliminated or minimized these differences.

[3] Cormier and Magnan (2016) note that, while a full-fledged convergence between Canadian GAAP and US GAAP took place around the mid-1990s, Canadian accountants and auditors may have applied the standards differently than their US counterparts due to the more principles-based approach in Canada.

To examine the effect of IFRS adoption on litigation risk, we hand-collected D&O insurance data for all firms listed on the Toronto Stock Exchange (TSX) with available Compustat data. Following Core (1997, 2000), Chung and Wynn (2008) and Wynn (2008), we analyze changes in perceived litigation risk using four proxies for litigation risk: D&O coverage limit, D&O premiums, the premium-to-coverage ratio, and excess cash holdings.

In our first set of analyses, we find mixed evidence of the effect of IFRS adoption on litigation risk. For non-cross-listed Canadian firms, we show that D&O insurance premiums, the premium-to-coverage ratio and excess cash holdings decreased around IFRS adoption, consistent with a decrease in litigation risk. However, we find that D&O insurance coverage increased, suggesting an increase in litigation risk. Kim (2015) finds that high-tech firms have lower coverage limits and posits that the high premiums charged to these firms result in reduced coverage limits. Thus, we interpret the combination of increases in coverage limits and decreases in premiums, along with reductions in the price per unit of insurance as evidence consistent with a decrease in litigation risk. The reduction in excess cash holdings provides additional support to our interpretation.

In our second set of analyses, we separately study Canadian firms that are cross-listed on US exchanges. Canadian firms cross-listed in the US were permitted to report under either Canadian GAAP or US GAAP prior to the mandated IFRS adoption, but after January 2011, these firms were permitted to report under IFRS or US GAAP (Burnett et al. 2015). We focus on Canadian firms cross-listed in the US that switched from Canadian GAAP to IFRS and document a reduction in D&O insurance premiums, premium-to-coverage ratio and excess cash holdings, whereas D&O insurance coverage is unchanged. The results from this analysis are consistent with a reduction in litigation risk.

While cross-listing in the US may lead to higher exposure to litigation risk, litigation and enforcement efforts in the US were likely unaffected by IFRS adoption in Canada. As such, our second set of analysis provides additional evidence that our main results are not driven by changes in enforcement in Canada that were concurrent with IFRS adoption.

We also conduct a difference-in-differences analysis comparing changes in litigation risk of Canadian firms that are cross-listed in the US to those of New York State incorporated (NY) firms. The difference-in-differences analysis allows us to further control for confounding effects. We use NY firms as a control group because these firms are required to disclose information about their D&O insurance policies and continuously report under US GAAP. NY firms always reported under a rules-based system, while some Canadian firms cross-listed in the US adopted a more principles-based system after January 2011.We document that the insurance coverage for those cross-listed firms that switched to IFRS decreased relative to NY firms that always report under US GAAP. The reduction in insurance coverage is consistent with lower litigation risk following IFRS adoption.

Overall, we find evidence that IFRS adoption decreases litigation risk. This is contrary to the results in Donelson et al. (2012) who find that principles-based standards result in greater litigation risk. Our study differs substantially from theirs: we utilize proxies for expected litigation, rather than litigation outcomes. Moreover, Donelson et al. (2012) exploit variation in the extent to which US GAAP standards are rules- or principles-based, while we focus on an externally mandated change from a more rules-based accounting standard to a more principles-based standard, rather than variation among standards at a point in time.

Our findings should be of interest to regulators and investors. We document that modifications of accounting regulations alter litigation risk, as measured by the cost of D&O insurance and excess cash holdings. We contribute to the understanding of the costs and benefits associated with adopting a more rules-based standard, such as IFRS. Our results may also inform policy debates in the US on the effects of adopting more principle-based standards.

The rest of the chapter is organized as follows. Section 2.2 describes D&O insurance contract and the related literature. Section 2.3 develops the hypotheses and section 2.4 discusses the research design. Section 2.5 presents the main analysis results. We conduct robustness tests in Section 2.6 and conclude in Section 2.7. All variables are defined in Appendix 2.8.1.

2.2 Directors' and Officers' (D&O) Liability Insurance

In this section, we review prior literature documenting an association between D&O insurance and firm characteristics and corporate governance as well as shareholders' and insurance providers' risk assessment.

Directors' and officers' liability insurance is a contract between a firm and an insurance company. Although the firm purchases and owns the insurance policy, the firm's directors and officers are the beneficiaries of the policy. In the event directors or officers are named as defendants in a lawsuit related to their duties, the D&O liability insurance provider either reimburses the directors and officers directly for all the associated expenses (provided directors acted in good faith and met the applicable standard of conduct), or the firm indemnifies the directors and officers for their expenses, and then claims the expenses from the insurance provider.

D&O liability insurance contracts specify the quantity and the price of insurance, as agreed by both the insurance provider and the firm. The coverage limit (quantity) is the maximum dollar value of the D&O insurance policy. The coverage limit is the maximum amount the insurance provider may be liable for and as such, is an assessment of the aggregate potential costs of litigation given the insurance premium (price). D&O insurance premium is the total cost of the insurance policy, which represents an estimation of the likelihood of litigation and its expected costs, with a markup for the insurer. As insurance institutions perform risk sharing and risk management functions efficiently (Cummins 1991), insurance contracts, in general, are informative about firms' risk exposures.

Prior literature demonstrates that D&O insurance reflects firm-level litigation risk. Using a sample of public Canadian firms, Core (1997) documents that firms with greater litigation risk and higher distress probability are more likely to purchase D&O insurance and carry higher coverage limits. Further, Core (2000) uses D&O liability insurance as a measure of ex-ante litigation risk and demonstrates that weaker governance is associated with higher premiums and excess CEO compensation. O'Sullivan (2002) finds similar results for public UK firms: companies carrying D&O insurance tend to be larger and associated with greater likelihood of litigation, greater proportions of non-executive board members, and less managerial ownership.

D&O insurance reflects the firm's as well as the insurer's expected litigation risk. Gillan and Panasian (2015) argue that D&O insurance limits and premiums appear informative about the firm specific probability of lawsuits and governance quality. Furthermore, Cao and Narayanamoorthy (2014) view the insurance premiums charged as indicative for the insurers' assessment of the firm's litigation risk. For a sample of public US firms, they show that firms with prior accounting restatements or lower earnings quality, pay higher premiums. These results are consistent with Lin et al. (2013) who detect a positive association between D&O coverage and earnings restatements.

Prior literature also argues that D&O insurance is used to improve corporate governance and protect shareholders. Holderness (1990) emphasizes the role of D&O insurance as a mechanism to monitor executives. O'Sullivan (1997) argues that, as firm size increases, external ownership becomes a costly monitoring scheme. He shows that larger public UK firms are more likely to utilize outside directors and D&O insurance to monitor executives.

In related work, Boyer (2014) provides empirical evidence suggesting that shareholders use D&O insurance to protect their own wealth in case of managerial incompetence. The more shareholders have at risk, the larger the insurance protection. Moreover, Caskey (2014) illustrates analytically that while carrying D&O insurance increases the likelihood of litigation, the insurance also partly alleviates investors' incorporation of the potential litigation costs into the stock price. Thus, D&O insurance may reduce expected costs and overall, increase firm value.

To the extent that legal liability insurance alters managers' behavior, D&O insurance and litigation risk are interdependent (Pauly 1974, Holmstrom 1979). Wynn (2008) hypothesizes that excess D&O insurance and excess cash available for indemnification are primary determinants of firms' disclosure policy. She studies a sample of Canadian firms and document a negative association between exposure to litigation risk and legal liability coverage, and the timeliness of bad news disclosures and the frequency of bed news forecasts. Moreover, managers with higher legal liability coverage tend to disclose bad news more precisely.

D&O insurance also reflects managers' private information about expected firm performance. Chalmers, Dann and Harford (2002) study D&O insurance around US initial public offerings (IPOs) and find that D&O insurance premiums are positively related to IPO size and negatively related to leverage, the percentage sold by venture capitalists, and the average operating income. Moreover, Chalmers et al. (2002) document a significant negative relation between the three-year post-IPO stock price performance and the insurance coverage purchased in conjunction with the IPO, which suggests the coverage limits are set opportunistically prior to IPOs. In contrast, Boyer and Stern (2014) study Canadian IPOs and find that insurance providers charge higher premium per dollar of coverage to firms with poor stock performance, higher volatility and lower Sharpe ratios post-IPO. Boyer and Stern's (2014) results indicate that in their setting, insurers have superior information relative to investors.

Prior literature proposes that D&O insurance is associated with managerial entrenchment and affect risk-taking incentives. Core (1997) argues that entrenched managers demand higher levels of D&O insurance. Consistent with this argument, Chung, Hillegeist and Wynn (2015) use D&O liability insurance to construct a proxy for managerial opportunism and document a positive association between excess D&O insurance coverage and audit fees. Lin et al. (2011) present evidence of an association between D&O insurance and real decisions. For a sample of publicly traded Canadian firms, they show that managers of firms carrying high D&O insurance coverage limits make poor M&A decisions. Particularly, those managers pay higher premiums for their acquisitions and their acquisitions exhibit lower synergies. Lin et al. (2011) conclude that acquirer firms with high levels of D&O insurance generate lower returns for their stockholders, indicating those firms' managers are more inclined to risk taking and are less sensitive to shareholder discipline. Furthermore, Lin et al. (2013) document a positive relation between D&O insurance levels and loan spreads, suggesting that lenders associate higher D&O insurance limits with greater risk taking. Similarly, Chen, Li and Zou (2016) show that D&O insurance limits are positively associated with the ex-ante cost of capital as implied by stock prices and analyst forecasts.

2.3 Hypothesis Development

A more principles-based accounting standard may require the exercise of additional managerial discretion and professional judgment relative to a more rules-based accounting standard. The effect of increased discretion on litigation risk has been debated. Schipper (2003) raises the concern that principles-based standards result in greater expected litigation costs, whereas the SEC (2003) predicts lower litigation costs.

On the one hand, litigation risk may be higher under more principles-based accounting standards than under more rules-based accounting standards. Rules provide a "safe harbor", which protects firms from litigation (Schipper 2003, Donelson et al. 2012). Lack of specific rules means managers will necessarily rely more on their own judgment, which could result in more legal challenges to their decisions (Hail et al. 2010). Moreover, additional discretion and less guidance may affect managers' opportunistic behavior. Nelson et al. (2002) show that imprecise standards are associated with more earnings management via discretion in accounting judgments than are precise standards. An increase in opportunistic financial reporting would likely result in an increase in firms' litigation risk. While prior research does not find significant changes in earnings quality around IFRS adoption in Canada (e.g., Burnett et al. 2015, Liu and Sun 2015), IFRS adoption may still alter litigation risk if it facilitates opportunistic behavior.

On the other hand, adoption of more principles-based accounting standards such as IFRS may reduce litigation risk. Donelson et al. (2012) also propose that rules-based systems provide shareholders a “road map” for potential litigation. They argue that violations of clear guidance are likely to be intentional, and therefore, litigation outcomes are more likely to favor plaintiffs. As IFRS provides less guidance, it could also reduce the occurrence of transaction structuring to obtain specific accounting treatment (Nelson et al. 2002, Ewert and Wagenhofer 2005, Hail et al. 2010). Similarly, Joos and Leung (2013) argue that more principles-based accounting standards have fewer bright-line rules and are considered less complex. Thus, principles-based standards may allow firms to better balance between complying with accounting standards and producing financial reports that reflect firms’ underlying economics.

Furthermore, the SEC (2003) suggests that the joint implementation of principles-based standards and effective enforcement, better aligns incentives among auditors, reporting firms, and investors, which increases reporting quality and decreases litigation costs. Finally, the additional managerial discretion required under IFRS, enables managers to convey private information to the markets in a more effective and less costly fashion (Hail et al. 2010). Consistent with these predictions, Cormier and Magnan (2016) document an increase in value relevance for Canadian firms cross-listed in the US that adopt IFRS. In sum, if IFRS permits firms to produce financial statement that are more informative and better represent the firm’s financial standing, it may reduce the occurrence and expected costs of lawsuits.

Scant empirical research investigates the association of litigation risk with rules-based versus principles-based accounting standards. Donelson et al. (2012) find evidence suggesting that more rules-based accounting standards reduce the threat of litigation. They document that restatements involving a violation of rules-based standards are associated with a lower probability of litigation. Moreover, they show that when firms are sued with no prior related restatement, plaintiffs are more likely to allege a violation of principles-based standards. Donelson et al. (2016) investigate why US accounting standards take on more rules-based characteristics. They find that both cross-sectional and time-series variation in rules-based characteristics of US GAAP are related to changes in litigation risk and to changes in the complexity of the underlying transaction and accounting treatment. The empirical findings in Donelson et al. (2012, 2016) suggest that more principle-based standards are associated with higher litigation risk, thus, switching from Canadian GAAP to IFRS would be associated with increased litigation risk.

A related stream of literature investigates audit fees around IFRS adoption. Audit fees capture the auditor’s assessment of the firm's litigation risk while D&O insurance captures the firm's individual risk. IFRS adoption may alter audit fees due to changes in financial reporting incentives affecting earnings quality, or because of changes in litigation risk.[4] Kim et al. (2012) find that European Union firms’ audit fees increased by 5.4 percent around IFRS adoption in 2005. They show that IFRS-related audit fee premiums increase with the audit complexity introduced by IFRS adoption but decrease with the improvement in financial reporting quality arising from IFRS adoption. De George et al. (2013) find similar results for Australian firms. They document an increase in audit fees around IFRS adoption and argue that average audit fees increase in excess of 8 percent beyond the normal annual fee growth in the pre-IFRS adoption period.

Overall, prior literature finds that audit fees increase around IFRS adoption. This increase is consistent with higher litigation risk following IFRS adoption. Nevertheless, as auditors are likely to increase audit effort to manage the risk of IFRS adoption (De George et al. 2013), audit quality may improve, inducing a decrease in litigation risk. Thus, the documented increase in audit fees may also be consistent with lower litigation risk following IFRS adoption.

Collectively, the above arguments and corresponding empirical evidence suggest that the association between IFRS adoption and ex-ante perceived litigation risk may be either positive or negative. On the one hand, switching to IFRS may increase legal exposure by eliminating the shield provided to Canadian firms by the more explicit rules and guidance in Canadian GAAP. On the other hand, IFRS adoption may facilitate transferring private information from managers

[4] Examining D&O liability insurance around IFRS adoptions extends prior literature and provides another perspective on the costs and benefits of IFRS adoption for individual firms.

to investor and producing financial statements that better reflect the firm's underlying economics. This leads to our formal hypothesis (stated in the null form):

H: IFRS adoption does not affect perceived litigation risk.

2.4 Research Design

2.4.1 The Canadian Setting

Canada offers a natural setting for empirical-archival studies of the effects of adopting a more principle-based accounting standard on litigation risk. First, public Canadian firms are required to disclose whether they purchase D&O liability insurance, and these disclosures often specify the cost and terms of the insurance contract. We use the information regarding the cost and terms of the insurance contracts to measure perceived litigation risk at the firm level.

Second, Canada switched its reporting standards from Canadian GAAP to IFRS for fiscal years starting on or after 1 January 2011. Prior to 2011, most Canadian public firms reported using Canadian GAAP. While Canadian GAAP is a principles-based standard, it provides more detailed, rules-oriented guidance than does IFRS.[5] Thus, the Canadian setting permits examining whether more detailed accounting guidance influences either the incidence or the cost of litigation.

Moreover, IFRS adoption in Canada took place in a period that follows the introduction of strengthened corporate governance requirements, such as the National Instrument 52-109 which became effective in Canada in 2008 (Lu et al. 2011) and the Sarbanes-Oxley Act of 2002, in the US, which was effective for Canadian firms cross-listed in the US from 2007. Our sample period has consistently high levels of enforcement throughout, and we are unaware of any significant changes to enforcement or regulation that coincide with IFRS adoption in Canada.

[5] Prior to 2004 the Canadian Accounting Standards Board (AcSB) was actively implementing a strategy of harmonizing Canadian GAAP with US GAAP. Each year it reviewed US-cross-listed firms' reconciliations between Canadian GAAP and US GAAP and worked on revising standards to minimize these differences.

2.4.2 Canadian Firms Cross-listed in the US

Since IFRS adoption in Canada is clustered in time, other events that took place around 2011 may have altered firms' litigation risk and any observed association between IFRS adoption and litigation risk is due to alternative explanations.[6] We address this concern in two ways. First, we examine Canadian firms cross-listed in the US that adopted IFRS. These firms operate in the US, which was likely unaffected by the accounting standard change in Canada or other regulatory and enforcement acts that happened in Canada around 2011. Second, we compare the costs of D&O insurance for Canadian firms cross-listed in the US and US firms incorporated in the state of New York.

The US is considered more litigious than Canada. Hence, the sample of Canadian firms cross-listed in the US permits examining the effect of adopting IFRS in a more litigious country while using D&O insurance information as a proxy for litigation risk and holding fixed the disclosure requirements.

Under the Multi-Jurisdictional Disclosure System (MJDS) adopted in 1991, Canada and the US permit Canadian (US) firms to access US (Canadian) capital markets using prospectuses prepared in accordance with Canadian (US) disclosure requirements. Hence, Canadian firms can access US capital markets with limited oversight from the SEC (Burnett et al. 2017) and without additional disclosure requirements.

Moreover, prior to IFRS adoption in 2011, Canadian firms cross-listed in the US were permitted to choose between Canadian GAAP and US GAAP, and, firms reporting under Canadian GAAP were exempted from the requirement to reconcile to US GAAP (Burnett et al. 2017). After Canada adopted IFRS in 2011, Canadian firms cross-listed in the US were permitted to prepare their financial statements in accordance with IFRS or US GAAP. As the SEC exempted

[6] See for example Christensen, Hail and Leuz (2013), which suggests that capital market benefits of IFRS adoption are driven by increased enforcement that coincide with IFRS adoption periods.

all non-US firms reporting under IFRS from reconciliation to US GAAP, Canadian firms that choose to adopt IFRS maintained the exemption from the reconciliation requirement.

While information about D&O insurance is not generally publicly disclosed by US firms (Griffith 2006), Canadian firms cross-listed in the US do provide information[7] regarding their indemnification policy and D&O insurance as required by the Canada Business Corporations Act.[8] This mandatory disclosure requirement of D&O insurance information allows us to a measure perceived litigation risk for Canadian firms cross-listed in the US.

We also use NY firms as a control group for Canadian firms cross-listed in the US in a difference-indifferences research design. New York Business Corporation Law mandates public firms incorporated in New York State to disclose their D&O insurance policy information to their shareholders.[9] Thus, similar to Canadian firms, NY firms are required to disclose whether they purchase D&O insurance policy. Furthermore, they are required to specify the insurance costs. Unlike the sample of Canadian firms cross-listed in the US, NY firms did not change their accounting standard during the sample period - these firms always report under US GAAP.

2.4.3 Specifications

Our main variable of interest is $POST_t$, defined as 1 if a firm reports under IFRS at time t, and 0 otherwise. We are interested in the effect of IFRS adoption (*POST*) on litigation risk and use three proxies for litigation risk for firms with D&O liability insurance: the insurance coverage limit, insurance premiums, and the premium-to-coverage ratio. If IFRS adoption increases (decreases) a firm's litigation risk, the coefficient on *POST* will be positive (negative).

First, D&O insurance coverage (*COVERAGE*), the log of the maximum amount D&O insurance provider may be liable for, is used as a proxy for litigation risk where, ceteris paribus,

[7] We exclude US firms cross-listed in Canada from our sample, as these firms are not required to disclose whether they carry D&O insurance.
[8] Canada Business Corporations Act (CBCA) - R.S.C., 1985, c. C-44 (Section 124).
[9] New York Business Corporation Law, Article 7, Section 726.

firms with higher coverage face higher litigation risk. We model D&O insurance coverage as follows:[10]

$$
\begin{aligned}
(2.1) \quad & COVERAGE_t \\
& = \beta_0 + \beta_1 POST_t + \beta_2 SIZE_{t-1} + \beta_3 DEBTRATIO_{t-1} + \\
& \beta_4 ACQUIRER_{t-1} + \beta_5 DIVESTOR_{t-1} + \beta_6 HIGHTECH_{t-1} + \\
& \beta_7 VOLATILITY_{t-1} + \beta_8 QUEBEC_{t-1} + \beta_9 EXCASH_{t-1} + \\
& IndustryFE + \varepsilon
\end{aligned}
$$

All variables are defined in Appendix 2.8.1.

If adopting IFRS increases (decreases) litigation risk or the expected cost of litigation, then directors and officers are likely to demand higher (lower) D&O insurance coverage to mitigate their exposure to this risk.

We follow prior literature in controlling for other determinants of D&O insurance coverage. Larger firms (*SIZE*) are expected to face higher litigation risk because expected settlements from small firms are less likely to be sufficient to merit lawsuits (Alexander 1991). We expect business risk associated with debt financing, measured by the debt ratio (*DEBTRATIO*) to be positively associated with coverage. Moreover, firms engaging in acquiring (*ACQUIRER*) and divesting (*DIVESTOR*) activities are expected to carry higher coverage limits (Core 1997).

Firms in the high technology industry (*HIGHTECH*) face higher litigation risk (e.g., Francis et al. 1994, Johnson et al. 2001, Jones and Weingram 2000). We follow Chung and Wynn (2008) and use Kasznik and Lev's (1995) classification scheme of high technology industries. Prior research also documents that stock price volatility (*VOLATILITY*) is positively associated with investor lawsuits (e.g., Alexander 1991, Jones and Weingram 2000). We also control for firms that are headquartered in one province in Canada, *QUEBEC*, as it has civil law legal origin

[10] Prior literature on D&O insurance estimates a first-stage Probit model for the decision to purchase D&O insurance. These Heckman (1979) models' estimations are intended to correct for potential sample-selection biases in the coefficient estimates of D&O insurance coverage and premiums. Core (1997, 2000) report that the first-stage provides no evidence consistent with a selection bias from the decision to purchase D&O insurance. Since Core (1997) argues that OLS estimates are more efficient than the Heckman estimates in the absence of selection bias, we follow prior literature (see Lin et al. 2011, Lin et al 2013, Chen et al. 2016 among others) and report only the OLS estimates.

while the remaining provinces and territories have common legal origin. Under civil law, firms tend to adopt a 'stakeholders' governance model where major interest groups, i.e. labor unions and banks, are represented and any information asymmetry between managers and stakeholders is resolved through insider communication. Thus, civil litigation is comparatively rare, and the size of awards is comparatively small (Ball et al. 2000).

Lastly, we follow Wynn (2008) and Chung and Wynn (2008) and include a measure of excess cash (*EXCASH*) since firms can increase their cash holdings for indemnification instead of increasing D&O coverage. Excess cash for indemnification is a form of self-insurance (Wynn 2008) and may be used as an additional cushion for incident of litigation if the firm exhausts its insurance coverage.

We include fixed effects for industry (*IndustryFE*). Furthermore, all independent variables used in the analysis are measured as of the beginning of the fiscal year prior to the proxy disclosure of the purchase of D&O insurance under the assumption that the insurance was purchased at the beginning of the most recent fiscal year (Core 2000).

Second, D&O insurance premiums (*PREMIUM*) are used as a proxy for litigation risk where, ceteris paribus, firms with higher (lower) premiums are perceived as having higher (lower) litigation risk by the insurance underwriter. We model D&O insurance premiums as follows:

$$\begin{aligned}(2.2)\qquad PREMIUM_t = {} & \beta_0 + \beta_1 POST_t + \beta_2 SIZE_{t-1} + \beta_3 DEBTRATIO_{t-1} \\ & + \beta_4 ACQUIRER_{t-1} + \beta_5 DIVESTOR_{t-1} + \beta_6 HIGHTECH_{t-1} \\ & + \beta_7 VOLATILITY_{t-1} + \beta_8 QUEBEC_{t-1} + \beta_9 EXCASH_{t-1} \\ & + \beta_{10} COVERAGE_{t-1} + IndustryFE + \varepsilon\end{aligned}$$

Following Core (2000) and Chung and Wynn (2008) we include the log of coverage (*COVERAGE*) in the regression because the premiums depend on how much coverage is purchased.

Core (2000) also considers a second stage regression model of the insurance premiums where instead of the log of coverage, he includes the residual from Equation (2.1). Including the residual (*EXADJCOV*) controls for information that is orthogonal to the other regressors. Part of this information arises because coverage is typically purchased in discrete blocks of $5 million and therefore the actual coverage limit may not be the firms desired coverage limit. By including the residuals from Equation (2.1) we attempt to control for potential omitted correlated variables.

$$\begin{aligned} (2.3) \qquad PREMIUM_t = {} & \beta_0 + \beta_1 POST_t + \beta_2 SIZE_{t-1} + \beta_3 DEBTRATIO_{t-1} \\ & + \beta_4 ACQUIRER_{t-1} + \beta_5 DIVESTOR_{t-1} \\ & + \beta_6 HIGHTECH_{t-1} + \beta_7 VOLATILITY_{t-1} \\ & + \beta_8 QUEBEC_{t-1} + \beta_9 EXCASH_{t-1} + \beta_{10} EXADJCOV_{t-1} \\ & + IndustryFE + \varepsilon \end{aligned}$$

Our third proxy for litigation risk, the ratio of D&O insurance premium to D&O insurance coverage (*PREMIUM/COVERAGE*), represents the price of buying a dollar of D&O insurance coverage. A higher (lower) ratio indicates a firm faces higher (lower) litigation risk. We model the ratio of D&O insurance premium to D&O insurance coverage as follows:

$$\begin{aligned} (2.4) \qquad & (PREMIUM/COVERAGE)_t \\ & = \beta_0 + \beta_1 POST_t + \beta_2 SIZE_{t-1} + \beta_3 DEBTRATIO_{t-1} \\ & + \beta_4 ACQUIRER_{t-1} + \beta_5 DIVESTOR_{t-1} \\ & + \beta_6 HIGHTECH_{t-1} + \beta_7 VOLATILITY_{t-1} \\ & + \beta_8 QUEBEC_{t-1} + \beta_9 EXCASH_{t-1} + IndustryFE + \varepsilon \end{aligned}$$

A positive (negative) coefficient on POST indicates that the price of coverage increased (decreased), consistent with the notion that insurance underwriters perceive IFRS adoption as increasing (decreasing) litigation risk.

Finally, in addition to the three proxies that are based on D&O insurance contracts, we also examine a proxy for litigation risk for firms that do not have D&O insurance, excess cash holdings (*EXCASH*), which is the residual from a regression of cash on cash holdings determinants (Wynn 2008). Firms may hold cash for indemnification and as a form of self-insurance, thus, excess cash holding is used as a proxy for litigation risk where, ceteris paribus, firms with higher excess cash face higher litigation risk. We model excess cash holding as follows:

$$\begin{aligned} (2.5) \qquad & EXCASH_t \\ & = \beta_0 + \beta_1 POST_t + \beta_2 SIZE_{t-1} + \beta_3 DEBTRATIO_{t-1} + \\ & \beta_4 ACQUIRER_{t-1} + \beta_5 DIVESTOR_{t-1} + \beta_6 HIGHTECH_{t-1} + \\ & \beta_7 VOLATILITY_{t-1} + \beta_8 QUEBEC_{t-1} + IndustryFE + \varepsilon \end{aligned}$$

For the sample of firms that are cross-listed in the US[11] we augment Equation (2.1) through Equation (2.5) with the inverse Mills ratio (*MILLS*). The inverse Mills ratio attempts to control for the choice of accounting standard that was available in 2011 for Canadian firms cross-listed in the US, by implementing two-stage Heckman procedure (Heckman, 1979). Burnett et al. (2015) examines the determinants of US-cross-listed Canadian firms' choice between IFRS and US GAAP. They find that firms are more likely to choose IFRS if IFRS is the standard most commonly used by the leading global firms in their industry. In addition, they find that firms more likely to choose IFRS are larger, of civil law legal origin, have less US operations, report exploration expense, have fewer US shareholders, and report higher stockholders' equity under Canadian GAAP than under US GAAP. Of these, they find that the convergence benefits of comparability with industry peers are the most significant determinant in firms' choice of standard. We model the first-stage Heckman (1979) using Burnett et al.'s (2015) model of firms' choice of standard between IFRS and US GAAP.

For the sample of Canadian firms cross-listed in the US, we also employ a difference-in-differences research design, where we use a sample of US firms incorporated in the state of New York as a control group. NY firms that carry D&O liability insurance are required to disclose the premiums they pay. Furthermore, these firms report under US GAAP throughout our sample period. Thus, they provide a good control group for studying Canadian firms cross-listed in the US, allowing us to control for time trends and potential confounding effects. We use the difference-in-differences design to examine the effect of IFRS adoption on D&O premiums. We model D&O insurance premiums as follows:

$$\begin{aligned} \text{(2.6)} \qquad PREMIUM_t = \; & \beta_0 + \beta_1 POST_t + \beta_2 IFRS + \beta_3 POST_t * IFRS + \beta_4 SIZE_{t-1} \\ & + \beta_5 DEBTRATIO_{t-1} + \beta_6 ACQUIRER_{t-1} \\ & + \beta_7 DIVESTOR_{t-1} + \beta_8 HIGHTECH_{t-1} \\ & + \beta_9 VOLATILITY_{t-1} + \beta_{10} QUEBEC_{t-1} + \beta_{11} MILLS \\ & + IndustryFE + \varepsilon \end{aligned}$$

[11] We focus our analysis on Canadian firms cross-listed in the US that switched from reporting under Canada GAAP to reporting under IFRS.

Where *POST* is defined as before for Canadian firms. For NY firms, *POST* equals 1 if the firm would have been required to adopt IFRS based on its fiscal year-end (pseudo-IFRS adoption year), and 0 otherwise. *IFRS* equals 1 if the firm adopts IFRS and 0 otherwise. We include the inverse Mills ratio (*MILLS*) to control for the choice of accounting standard that was available in 2011 for Canadian firms cross-listed in the US.

Our main coefficient of interest is the interaction term, *POST*IFRS*, which captures the effect of reporting under IFRS in the periods after IFRS was mandated in Canada. A positive (negative) coefficient on this interaction term indicates that the price of D&O insurance increased (decreased) once firms adopted IFRS. Thus, a positive (negative) coefficient on the interaction term is consistent with IFRS adoption being associated with higher (lower) litigation risk relative to firms that were using US GAAP before and after Canadian firms switched to reporting under IFRS.

2.4.4 Sample Selection and Data Description

The sample consists of Canadian firms in Compustat listed on the Toronto Stock Exchange (TSX). These firms are required to disclose if they purchase D&O insurance. Their D&O data are publicly available in a proxy circular on SEDAR[12] because it is mandatory for firms to disclose if they purchase D&O insurance under the Canada Business Corporations Act and the TSX requires firms to disclose this as part of their risk management practices. Our sample is a constant sample, spanning from 2009 to 2013, as we require firms to have data two years before and after IFRS adoption.

We use non-cross-listed Canadian firms as well as Canadian firms cross-listed in the US. The Canadian Accounting standards Board (AcSB) required all publicly accountable enterprises to apply IFRS for firm years beginning on or after January 1, 2011. Firms with fiscal year ends from December 31 to May 31 adopted IFRS in fiscal year 2011, while firms with fiscal year ends

[12] SEDAR is the Canadian electronic filing system which is available at www.sedar.com.

from June 1 to December 30 adopted IFRS in fiscal year 2012. For Canadian firms cross-listed in the US, the provincial securities regulators, who have authority over the application of accounting standards, gave the option to choose IFRS or US GAAP. We focus on firms cross-listed in the US that adopt IFRS to examine the effects of moving from a relatively rules-based standard to a more principles-based standard, and because the sample of firms that adopt US GAAP with sufficient data is small (11 firms).

Table 2.9.1 Panel A details our sample formation process for Canadian firms that adopted IFRS. There were 670 firms listed on TSX with Compustat data for two year before and two years after IFRS adoption. One hundred and eight firms are investment companies (mutual funds). We exclude 57 firms that initiate or cease D&O insurance during the sample period[13] and 49 firms that disclose they purchase D&O insurance, but not the policy premiums and coverage.

Twenty-eight cross-listed firms do not disclose D&O insurance information because they do not have Foreign Private Issuer status with the SEC. Therefore, they must file the same forms as US domestic issuers using US Form 10-K and are not required to disclose D&O insurance information.[14] We exclude the four firms in the sample that were not cross-listed in the US that obtained special permission to adopt US GAAP. Lastly, we exclude 11 firms cross-listed in the US that adopt US GAAP. This results in a sample of 318 firms not cross-listed in the US and 81 firms cross-listed in the US that adopt IFRS, a total of 399 firms. Since we employ a balanced sample requiring two years of data before and after IFRS adoption, this results in 1,596 firm-years.

---

[13] We note that the percentage of firms purchasing D&O insurance is consistent before and after IFRS adoption. 56 percent of the firms not cross-listed in the US purchased D&O insurance two years prior to IFRS adoption compared to 54.2 percent two years after IFRS adoption (untabulated tests indicate the difference is not statistically significant). Similarly, 58.3 percent of firms cross-listed in the US purchased D&O insurance two years prior to IFRS adoption compared to 52.7 percent two years after IFRS adoption (untabulated tests indicate the difference is not statistically significant; further, this is a difference of only six firms in our sample).

[14] The TSX does not require Canadian firms cross-listed in the US reporting as full domestic US filers to disclose D&O insurance information.

Table 2.9.1 Panel B details our sample partition by whether or not the firms purchase D&O insurance policy. Overall, we have a sample of 159 firms not cross-listed in the US and 42 firms cross-listed in the US that purchase D&O insurance, a total of 201 firms; and a sample of 159 firms not cross-listed in the US and 39 firms cross-listed in the US that do not purchase D&O insurance, a total of 198 firms.

Table 2.9.2 reports descriptive statistics for firms in the year prior to IFRS adoption. Panel A of Table 2.9.2 indicates that the mean (median) D&O insurance coverage for firms not cross-listed in the US is $36.93 million ($25.00 million).[15] As expected, this is lower than the D&O coverage reported in Chung and Wynn (2008) since we hand-collected data for all firms on the TSX, not just the TSE 300 index (currently the S&P/TSX Composite index) which are the largest firms listed on the TSX. The mean (median) D&O insurance premium for firms not cross-listed in the US is $0.17 million ($0.11 million). The cost of a dollar of D&O coverage is measured by the premium-to-coverage ratio, for which the mean (median) is 0.005 (0.004). That is, on average it costs a half cent to purchase a dollar of D&O insurance coverage.

Panel B of Table 2.9.2 reports descriptive statistics for firms cross-listed in the US. The mean (median) D&O coverage is $102.15 million ($68.41 million). While this is higher coverage than the firms not listed in the US, US-cross-listed firms are larger than US-non-cross-listed firms with mean total assets of $3,498.2 million compared to $361.4 million, respectively. The mean (median) D&O premium is $0.97 million ($0.61 million) consistent with cross-listed firms being larger and having more coverage. The premium-to-coverage ratio reveals that firms listed in the US pay a higher price for coverage consistent with firms facing higher litigation risk in the US compared to Canada. Specifically, the mean (median) premium-to-coverage ratio is 0.010 (0.009)

---

[15] All dollar amounts reported are denominated in Canadian dollars. For those companies that report in US dollars, amounts have been converted into Canadian dollars using a monthly series of the spot exchange rate (obtained from Compustat). Flow amounts such as income (or amounts such as D&O coverage and premiums) were converted at the 12-month average rate. Static amounts such as assets were converted at the month-end closing exchange rate.

for firms listed in the US is nearly double the ratio for firms not listed in the US at 0.005 (0.004) (untabulated tests of differences indicate the difference is significant at the 1% level).

Panel C and Panel D of Table 2.9.2 report descriptive statistics for non-cross-listed and cross-listed firms that did not purchase insurance, respectively. Firms that do not purchase D&O insurance appear different from firms that purchase insurance. Non-cross-listed firms (US-cross-listed firms) that do not purchase D&O insurance are smaller than firms that purchase insurance, with average total assets of $202.35 million ($228.15 million). Also, firm that do not purchase D&O insurance have lower debt ratios and higher stock volatility compared to non-cross-listed and cross-listed firms that purchase D&O insurance. As firms that do not purchase insurance differ from firms that purchase insurance, and as excess cash may substitute for D&O insurance for firms that do not purchase liability insurance, we focus our analysis of excess cash holdings on firms that do not have D&O insurance.

2.5. Empirical Results

2.5.1 Univariate Results

Table 2.9.3 compares firms' D&O coverage, premiums and premium-to-coverage ratio when reporting under Canadian GAAP to when reporting under IFRS. Panel A of Table 2.9.3 shows that the average coverage for firms not cross-listed in the US statistically significantly increases by $2.91 million (8%) after adopting IFRS while the median coverage statistically significantly increases $3.28 million (15%). This is consistent with firms increasing coverage in response to higher perceived litigation risk under IFRS.

Nevertheless, the mean (median) premiums statistically significantly decrease by $0.022 million ($0.002 million) or 12% (2%) after adopting IFRS. Furthermore, the mean (median) premium-to-coverage ratio statistically significantly decreases by 0.001 (0.001) or 20% (20%), indicating the price of D&O coverage decreases post-IFRS adoption. This reduction is consistent with D&O underwriters pricing D&O insurance at a lower cost when firms report using IFRS. In contrast to D&O coverage, the reduction in D&O premiums and premium-to-coverage ratio suggests that firms face lower litigation risk after adopting IFRS.

The results in Table 2.9.3 Panel B for firms cross-listed in the US, mirror the results from Panel A. Specifically, D&O coverage statistically significantly increases by 8% ($8.16 million) on average while the median coverage statistically significantly increases by 28% ($19.74 million). The mean (median) premiums statistically significantly decrease by $0.122 million ($0.015 million) or 12% (2%) after adopting IFRS. The mean (median) premium-to-coverage ratio statistically significantly decreases by 0.002 (0.002) or 18% (20%) indicating the price of D&O coverage decreases post-IFRS adoption.

Table 2.9.4 presents the firms' excess cash when reporting under Canadian GAAP and when reporting under IFRS. Panel A of Table 2.9.4 shows that the average (median) excess cash holdings for firms that do not purchase D&O insurance and that are not cross-listed in the US, decrease (increase) post-IFRS adoption. Table 2.9.4 Panel B mirrors these results for firm cross-listed in the US. The differences are not statistically significant for both non-cross-listed firms and cross-listed firms.

Overall, the univariate analysis suggests that both non-cross-listed in the US and cross-listed in the US firms obtain more coverage but pay lower premiums for that coverage. The univariate comparison assumes firms are relatively similar before and after IFRS. However, firm characteristics that determine coverage, premiums and cash holdings may have changed during the sample period, thus, it is important that we perform multiple regression analyses to examine these relationships.

2.5.2 Regression Analyses of D&O Insurance Policy

Table 2.9.5 reports our regression analyses for firms that are not cross-listed in the US. Column 1 of Table 2.9.5 shows the regression results for D&O coverage. The positive and statistically significant coefficient of 0.14 (p-value 0.000) indicates that D&O coverage increases by 15.03% post-IFRS adoption.[16] This suggests that, on average, firms increase coverage after adopting IFRS. As expected, the coefficients on *SIZE* and *DIVESTOR* are positive and statistically significant. The positive coefficient on *VOLATILITY* is consistent with stock price volatility increasing firms' litigation risk. The negative and statistically significant coefficient on *QUEBEC* is consistent with civil law jurisdictions being less litigious and requiring lower coverage.

Column 2 and column 3 of Table 2.9.5 show the regression results for D&O premium. The negative and statistically significant coefficients on *POST* indicates that D&O premium decreases by 8.6-11.3% post-IFRS adoption.[17] Consistent with prior literature, *SIZE*, *DEBTRATIO*, *VOLATILITY* and coverage limits are positively and statistically significant associated with D&O premium. Thus, larger and more leveraged firms pay more for D&O liability insurance. Further, firms engaging in divesting activities pay higher premiums (22.1-56.8%) and so do firms operating in higher risk industries (37.7-60.0%).

Column 4 of Table 2.9.5 shows similar results for premium-to-coverage ratio. The coefficient on *POST* is negative (-0.0005) and statistically significant (p-value 0.002), the premium-to-coverage ratio for the average firm decreases by 10% post-IFRS adoption.[18] This implies that, on average, firms pay less per dollar of coverage post-IFRS adoption.

The multiple regression analysis presented in Table 2.9.5 indicates that while coverage limits increase post-IFRS adoption, the total cost of D&O insurance and the price of D&O insurance decrease, implying that switching to IFRS generates real benefits for firms. The decline in the price of D&O insurance indicates that the insurance providers' assessment of the firm's litigation risk decreases (Cao and Narayanamoorthy 2014). Collectively, our analysis suggests

[16] In Column 1 Table 2.9.4, the depended variable is the natural logarithm of D&O coverage limit and the independent variable *POST* is a dummy variable. We note that exp(0.14) = 1.1503, thus the percentage change in D&O coverage limit post-IFRS adoption is 15.03%.
[17] We note that exp(-0.09) = 0.914 and exp(-0.12) = 0.887.
[18] The average premium-to-coverage ratio pre-IFRS adoption is 0.005 (see Table 2.9.2). The average premium-to-coverage ratio decreases by 0.0005 post-IFRS adoption, implying that for the average firms, the premium-to-coverage declines by 10%.

that to some extent, litigation risk diminishes around IFRS-adoption for Canadian firms not cross-listed in the US.

Table 2.9.6 reports our regression analyses for firms that are cross-listed in the US. In column 1 of Table 2.9.6, we examine D&O coverage limit and do not find that coverage limits change around IFRS adoption. Thus, we cannot reject the null that IFRS adoption does not affect litigation risk as captured by the D&O liability insurance coverage limits. As expected, the coefficients on *SIZE*, *HIGHTECH* and *VOLATILITY* are positive and statistically significant. The significant coefficient on *QUEBEC* indicates that firms headquartered in Quebec have substantially lower coverage limits relative to firms headquartered in the rest of Canada.

Column 2 and column 3 of Table 2.9.6 suggest that D&O premium decreases for firms cross-listed in the US post-IFRS adoption, which is consistent with our analysis for firms not cross-listed in the US. The negative and statistically significant coefficients on *POST* indicate that D&O premium decreases by 11.3-17.3% post-IFRS adoption.

Based on column 3 of Table 2.9.5, we note that, for firms cross-listed in the US, divesting activities (*DIVESTOR*) and more volatile stock returns (*VOLATILITY*) are associated with higher D&O premiums. This result is consistent with prior literature (Core 1997). The negative and statistically coefficient on *QUEBEC* indicates firms headquartered in Quebec pay lower premiums consistent with lower litigation risk.

Column 4 of Table 2.9.6 shows the regression results for premium-to-coverage ratio. The coefficient on *POST* is negative (-0.0025) and statistically significant (p-value 0.009), implying that on average, firms pay 25%[19] less per dollar of coverage post-IFRS adoption. The positive and significant coefficient on *HIGHTECH* is in line with the expectation of a higher cost of D&O coverage for firms in the higher risk industries.

---

[19] The average premium-to-coverage ratio pre-IFRS adoption is 0.010 (see Table 2.9.2). The average premium-to-coverage ratio decreases by 0.0025 post-IFRS adoption, implying that for the average firms, the premium-to-coverage declines by approximately 25%.

Collectively, we interpret the multivariate regression analysis presented in Table 2.9.6 as being consistent with a decrease in litigation risk after US-cross-listed firms adopt IFRS. D&O underwriters had been pricing D&O insurance for foreign private issuers reporting under IFRS in US markets for at least four years when cross-listed Canadian firms began reporting under IFRS. As such, the underwriters would be relatively well informed about the litigation risks associated with reporting under IFRS and it appears that they assess that risk lower than when Canadian firms reported under Canadian GAAP. This result should be of interest to US regulators in assessing potential litigation costs if the US were to ever adopt IFRS.

2.5.3 Regression Analyses of Excess Cash

As D&O insurance may be substitute using cash available for indemnification, we examine excess cash holdings by firms that do not own D&O insurance policy. Table 2.9.7 reports our regression analyses for firms that are not cross-listed in the US. The negative and statistically significant coefficient on *POST* of -0.06 (p-value 0.001) indicates that excess cash decreases post-IFRS adoption. As expected, the coefficient on *SIZE* is positive and statistically significant, suggesting bigger firms hold more cash available for indemnification. The coefficient on *DEBTRATIO* is significant but negative. This may suggest that financial constraints reduce firms' excess cash holdings.

Table 2.9.8 reports our regression analyses for firms that do not own D&O insurance policy and that are cross-listed in the US. The coefficient on *POST* is negative (-0.10) and statistically significant (p-value 0.043), consistent with firms holding less excess cash post-IFRS adoption. Similar to our results for non-cross-listed firms, the coefficient on *SIZE* is positive and statistically significant and the coefficient on *DEBTRATIO* is negative and statistically significant. Table 2.9.8 also indicates that firms involving in acquisitions (*AQUIRER*) have more excess cash while firms headquartered in Quebec (*QUEBEC*) appear to hold less excess cash.

Overall, our multivariate analysis indicates that firms without a D&O insurance policy hold less excess cash available for indemnification post-IFRS adoption. We document a reduction in excess cash for firms not cross-listed in the US as well as for firms cross-listed in the US. These results lend additional support to the conjecture that IFRS adoption is associated with a reduction in litigation risk.

2.6 Robustness Tests

To control for time trends and potential confounding effects, we employ a difference-in-differences research design using firms incorporated in NY as a control sample. These firms were likely not affected by the adoption of IFRS in Canada.

US firms incorporated in the state of New York are required to disclose whether they purchase directors' and officers' liability insurance and the premiums they pay if they have insurance. Note that if these firms have insurance, they are not required to disclose their insurance coverage limits.

We hand-collect the premium data for US firms in Compustat that are incorporated in NY. We collect the data for two years before and after the year NY incorporated firms would have been required to adopt IFRS had they been in Canada based on their fiscal year-end. Twenty-nine NY firms disclose premium data for two years before and after the pseudo-IFRS adoption date and have all the necessary data for our analysis. We note that our sample size is comparable to Linck, Netter and Yang (2009) who document an increase in D&O insurance premiums for NY firms following Sarbanes-Oxley Act (SOX).

Table 2.9.9 reports descriptive statistics for NY firms in the year prior to their pseudo-IFRS adoption date, which is the date they would have switched to reporting under IFRS if they had to follow the Canadian regulation and adopt IFRS in 2011. Their mean (median) D&O premium is $2.30 million ($0.87 million). When scaled by total assets, the average D&O premium for NY firms of 0.0007 is similar to Canadian firms cross-listed in the US at 0.0008. The mean (median) total assets of NY firms is $2,591.5 million ($2,807.4 million) and is similar to Canadian firms cross-listed in the US at $3,498.2 million ($2,921.9 million).

Table 2.9.10 provides the difference-in-differences regression analysis comparing the premiums of Canadian firms cross-listed in the US to US NY firms. The negative (-0.13) and statistically significant (p-value 0.087) coefficient on the interaction term *POST*IFRS* indicates that the premiums for Canadian firms cross-listed in the US decrease more than for NY firms after adopting IFRS. Consistent with our cross-sectional analysis, the positive and statistically significant coefficients on *SIZE, VOLATILITY*, and *HIGHTECH*, indicate that larger, more volatile firms pay higher premiums, and so do firm operating in higher risk industries.

Our analysis indicates that the perceived litigation risk decreased following IFRS adoption in Canada. The difference-in-differences analysis results are consistent with IFRS adoption causing the decline in D&O insurance premiums for Canadian firms cross-listed in the US, and not just a general trend in the D&O market in the US. Canadian firms cross-listed in the US benefit from a decline of 12.2% in their D&O insurance premiums, equivalent to an average saving of $0.118M, once they switched to reporting under IFRS.

This result informs US regulators, investors, lawyers, and managers as they continue to evaluate and monitor the consequences of IFRS adoption if the US ultimately adopts IFRS or more principles-based standards. Canadian firms cross-listed in the US are arguably the most similar firms to US firms of any non-US firms. Our evidence is consistent with IFRS decreasing litigation risk for firms previously reporting using Canadian GAAP, arguably the most similar accounting standard to US GAAP.

2.7 Conclusion

In this chapter, we study the effect of adoption of more principle-based standards on litigation risk. Specifically, we investigate changes in perceived litigation risk around the adoption of IFRS in Canada. To proxy for litigation risk, we focus our analysis on changes in D&O liability insurance coverage, premiums, and the ratio of premiums-to-coverage. We also examine excess cash holdings available for indemnification by firms that do not own D&O liability insurance policy.

The IFRS framework places greater reliance on managerial discretion in the preparation of financial reports and allows managers more flexibility when choosing accounting policies. De George et al. (2016) state that IFRS can raise concerns about independent verifiability of reported figures and increase potential for manipulation of financial accounting. The increased managerial discretion after IFRS adoption has implications for the litigation exposure of firms, especially during the initial periods when uncertainty about the new accounting regime is relatively high (De George et al. 2016). The change in the legal environment induced by the accounting standard change may therefore modify the coverage and premiums of D&O insurance and the amount of cash firms choose to hold.

Furthermore, we expect IFRS adoption to affect D&O insurance since D&O insurance is associated with earnings quality as well as with audit fees, both of which were affected by IFRS adoption (Chung et al. 2015). Prior literature documents change in audit fees around IFRS adoption (ICAEW 2007, De George et al. 2013, Kim et al. 2012) possibly due to changes in financial reporting incentives that affect earnings quality, or due to changes in litigation risk. While converting to IFRS is also likely to affect financial reporting, accounting standards are only one of the determinants of overall accounting quality (Soderstrom and Sun 2007).

Overall, we document an additional consequence of IFRS adoption, namely the cost of D&O insurance. We find consistent evidence that perceived litigation risk decreased for Canadian firms following IFRS adoption for both firms that are not cross-listed in the US, and those that are. Our analyses suggest that switching to more principles-based standards is associated with a reduction in the litigation risk of firms and their directors and officers. Our findings should be of interest to shareholders and regulators as they suggest that modification of accounting regulations has real effects on litigation risk and litigation costs.

One caveat to our analysis is that we cannot rule out the alternative explanation that factors other than IFRS adoption caused the change in litigation risk. However, our sample period has consistently high levels of enforcement throughout, and we are unaware of any significant changes to the regulatory, economic, or governance environments that coincide with IFRS adoption in Canada. We further address this concern in two ways. First, by focusing on Canadian firms cross-listed in the US and examining an environment that is likely unaffected by the standard change or other regulatory and enforcement acts that happened in Canada around 2011. Second, by employing a difference-in-differences research design where we compare D&O insurance premiums of Canadian firms cross-listed in the US with a sample of NY incorporated firms that are also required to disclose information regarding their D&O insurance.

With increasingly dispersed ownership around the world and the rising prominence of equity ownership, litigation may become a more widespread mechanism for resolving disputes. One possible avenue for future research on D&O insurance could be to investigate the cross-country determinants of D&O insurance and the cross-country D&O disclosure requirements. A natural extension of our paper would be to examine whether the determinants of D&O insurance differ between countries with more rules-based standards and more principle-based standards. Moreover, future research may wish to examine the litigation risk of foreign firms cross-listed in the US, focusing on the ex-post litigation risk reflected in D&O insurance contracts.

2.8 Appendix

APPENDIX 2.8.1

Variable Descriptions

$COVERAGE_t$	Log of maximum amount the D&O insurance provider may be liable for at year t
$POST_t$	A year dummy set equal to 1 for fiscal years after IFRS adoption in Canada, and 0 otherwise. For NY firms, the variable is set equal to 1 for fiscal years after pseudo-IFRS adoption date (i.e. the date after which the US firm should have adopted IFRS given its fiscal year end if it had been a Canadian firm).
$SIZE_{t-1}$	Log of total assets at the beginning of the fiscal year t
$DEBTRATIO_{t-1}$	Debt over the sum of debt and market value of equity at the beginning of the fiscal year t
$ACQUIRER_{t-1}$	An indicator variable set equal to 1 if in the prior year the book value of total assets at the end of the fiscal year increases by more than 25% from the beginning of the fiscal year, and 0 otherwise
$DIVESTOR_{t-1}$	An indicator variable set equal to 1 if in the prior year the book value of total assets at the end of the fiscal year decreases by more than 25% from the beginning of the fiscal year, and 0 otherwise
$HIGHTECH_{t-1}$	An indicator variable set equal to 1 if a firm is a member of Pharmaceuticals (SIC codes 2833–2836), R&D Services (8731–8734), Programming (7371–7379), Computers (3570–3577), or Electronics (3600–3674) industries, and 0 otherwise
$VOLATILITY_{t-1}$	The standard deviation of daily stock returns during the previous year
$QUEBEC_{t-1}$	An indicator variable set equal to 1 if the firm is headquartered in Quebec at the beginning of the year, and 0 otherwise
$EXCASH_{t-1}$	The residual from the regression of cash on determinants of cash holdings at the beginning of the year, which include the log of total assets, market-to-book value ratio, cash flows (defined as earnings before depreciation and amortization, less interest, taxes, and common dividends), debt, net working capital (excluding cash), and membership in high-tech industry
$PREMIUM_t$	Log of total cost of D&O insurance policy at year t
$(PREMIUM/COVERAGE)_t$	Ratio of total cost of D&O insurance policy to aggregate dollar value of D&O insurance policy at year t
MILLS	Inverse Mills ratio from a selection model of firms' choice of standard between IFRS and US GAAP. We model the first-stage

	Heckman (1979) using Burnett et al.'s (2015), where the choice is a function of the distance between stockholders' equity under Canadian GAAP than under US GAAP, if a firm reports R&D expense, if a firm reports exploration expense, if IFRS is the most commonly used standard by leading global firms in their industry, firms have more operations located in IFRS countries than operations in the US, the level of US ownership, leverage, size, return on assets, and legal origin
IFRS	An indicator variable set equal to 1 if the firm chooses IFRS as its new reporting standard, and 0 otherwise (i.e. this variable is set equal to 1 for Canadian firms that adopt IFRS, prior to IFRS adoption date).

2.9 Tables

TABLE 2.9.1
Sample Formation

Panel A: Canadian Firms that Adopted to IFRS

	Not Cross-listed in US	Cross-listed in U.S.	Total
Canadian firms on TSX with COMPUSTAT data two years before and after IFRS adoption	531	139	670
Less Investment Companies	(108)	0	(108)
Firms that initiate or cease D&O insurance	(52)	(5)	(57)
Firms with D&O insurance that do not disclose terms of coverage	(49)	(14)	(63)
Cross-listed firms that do not have Foreign Private Issuer status	0	(28)	(28)
Firms that obtain special approval to adopt US GAAP	(4)	0	(4)
Firms that adopt US GAAP	0	(11)	(11)
No. of firms	318	81	399
No. of firm-years	1,272	324	1,596

Panel B: Sample Partitioned by D&O Insurance Purchase

	Not Cross-listed in US	Cross-listed in U.S.	Total
Firms that purchase D&O insurance	159	42	201
Firms that do not purchase D&O insurance	159	39	198
Total firms	318	81	399

Panel A reports the sample selection of Canadian firms in COMPUSTAT that were listed on the Toronto Stock Exchange with financial data and with D&O insurance for the two years before and after IFRS adoption. Panel B partitions the sample by whether or not the firms purchase D&O insurance.

TABLE 2.9.2
Descriptive Statistics

Panel A: Firms Not Cross-listed in the US That Purchase D&O Insurance

	N	Mean	Median	Std. Dev.
D&O Coverage (m$)	159	36.93	25.00	40.94
D&O Coverage/TA	159	0.17	0.06	0.33
D&O Premium (m$)	159	0.17	0.11	0.22
D&O Premium/TA	159	0.0009	0.0002	0.0024
Premium/Coverage	159	0.005	0.004	0.002
SIZE	159	5.89	5.77	2.04
DEBTRATIO	159	0.21	0.16	0.22
ACQUIRER	159	0.15	0.00	0.36
DIVESTOR	159	0.05	0.00	0.22
HIGHTECH	159	0.15	0.00	0.36
VOLATILITY	159	0.03	0.02	0.02
QUEBEC	159	0.21	0.00	0.41
EXCASH	159	0.04	0.01	0.29

Panel B: Firms Cross-listed in the US That Adopt IFRS and Purchase D&O Insurance

	N	Mean	Median	Std. Dev.
D&O Coverage (m$)	42	102.15	68.41	104.81
D&O Coverage/TA	42	0.09	0.02	0.31
D&O Premium (m$)	42	0.97	0.61	0.95
D&O Premium/TA	42	0.0008	0.0002	0.0023
Premium/Coverage	42	0.010	0.009	0.006
SIZE	42	8.16	7.98	3.05
DEBTRATIO	42	0.18	0.11	0.22
ACQUIRER	42	0.21	0.00	0.42
DIVESTOR	42	0.02	0.00	0.15
HIGHTECH	42	0.07	0.00	0.26
VOLATILITY	42	0.03	0.02	0.02
QUEBEC	42	0.12	0.00	0.33
EXCASH	42	-0.01	0.00	0.26
MILLS	42	0.28	0.29	0.12

TABLE 2.9.2 (CONTINUED)

Panel C: Firms not Cross-listed in the US That Do Not Purchase D&O Insurance

	N	Mean	Median	Std. Dev.
SIZE	159	5.31	5.16	1.76
DEBTRATIO	159	0.16	0.09	0.21
ACQUIRER	159	0.17	0.00	0.38
DIVESTOR	159	0.06	0.00	0.24
HIGHTECH	159	0.04	0.00	0.19
VOLATILITY	159	0.05	0.04	0.04
QUEBEC	159	0.06	0.00	0.24
EXCASH	159	0.01	-0.07	0.32

Panel D: Firms Cross-listed in the US That Adopt IFRS and Do Not Purchase D&O Insurance

	N	Mean	Median	Std. Dev.
SIZE	39	5.43	4.66	2.27
DEBTRATIO	39	0.07	0.02	0.10
ACQUIRER	39	0.31	0.00	0.47
DIVESTOR	39	0.05	0.00	0.22
HIGHTECH	39	0.08	0.00	0.27
VOLATILITY	39	0.06	0.05	0.03
QUEBEC	39	0.05	0.00	0.22
EXCASH	39	-0.07	-0.12	0.36
MILLS	39	0.29	0.29	0.14

TABLE 2.9.3
Univariate Tests of Changes in D&O Coverage and Premiums After IFRS Adoption

Panel A: Firms Not Cross-listed in the US

	Pre-IFRS (N=318)		Post-IFRS (N=318)		Difference	
	Mean	Median	Mean	Median	Mean	Median
D&O Coverage (m$)	36.97	21.72	39.88	25.00	2.91**	3.28***
D&O Premium (m$)	0.180	0.102	0.158	0.100	-0.022***	-0.002***
Premium/Coverage	0.005	0.005	0.004	0.004	-0.001***	-0.001***

Panel B: Firms Cross-listed in the US

	Pre-IFRS (N=84)		Post-IFRS (N=84)		Difference	
	Mean	Median	Mean	Median	Mean	Median
D&O Coverage (m$)	102.42	69.79	110.58	89.54	8.16**	19.74**
D&O Premium (m$)	0.982	0.666	0.860	0.651	-0.122*	-0.015**
Premium/Coverage	0.011	0.010	0.008	0.008	-0.002***	-0.002***

The table presents univariate tests of differences for both non-cross-listed and cross-listed Canadian firms that adopt IFRS. If indicated, we use the natural logarithm of the raw values. All continuous variables are winsorized at the 1% and 99% level. *, **, *** denote statistical significance at the 0.10, 0.05, and , 0.01 levels, respectively, based on t-test for the difference in means and a nonparametric Wilcoxon signed-rank test for the difference in medians.

TABLE 2.9.4
Univariate Tests of Changes in Excess Cash After IFRS Adoption for Firms That Do Not Purchase D&O Insurance

Panel A: Firms Not Cross-listed in the US That Do Not Purchase D&O Insurance

	Pre-IFRS (N=318)		Post-IFRS (N=318)		Difference	
	Mean	Median	Mean	Median	Mean	Median
EXCASH	-0.02	-0.08	-0.04	-0.07	-0.02	0.01

Panel B: Firms Cross-listed in the US That Do Not Purchase D&O Insurance

	Pre-IFRS (N=82)		Post-IFRS (N=82)		Difference	
	Mean	Median	Mean	Median	Mean	Median
EXCASH	-0.10	-0.15	-0.17	-0.14	-0.07	0.01

The table presents univariate tests of differences for both non-cross-listed and cross-listed Canadian firms that adopt IFRS and never purchased D&O insurance. All continuous variables are winsorized at the 1% and 99% level. *, **, *** denote statistical significance at the 0.10, 0.05, and, 0.01 levels, respectively, based on t-test for the difference in means and a nonparametric Wilcoxon signed-rank test for the difference in medians.

TABLE 2.9.5

Regression of the Effect of IFRS Adoption on D&O Coverage and Premiums for Canadian Firms Not Cross-listed in the US

Variable	Predicted Sign	(1) Coverage	(2) Premium	(3) Premiu m	(4) Premium / Coverage
Intercept		0.76***	-6.06***	-5.59***	0.0014***
		0.000	*0.000*	*0.000*	*0.000*
POST	+/-	0.14***	-0.09***	-0.12***	- 0.0005***
		0.000	*0.002*	*0.004*	*0.002*
SIZE	+	0.41***	0.16***	0.49***	0.0003***
		0.000	*0.000*	*0.000*	*0.004*
DEBTRATIO	+	-0.18	0.47***	0.27*	0.0018**
		0.444	*0.010*	*0.094*	*0.028*
ACQUIRER	+/-	-0.11	-0.04	-0.11**	-0.0002
		0.132	*0.358*	*0.023*	*0.489*
DIVESTOR	+/-	0.29***	0.20*	0.45***	0.0008
		0.006	*0.052*	*0.000*	*0.171*
HIGHTECH	+	2.68	0.32**	0.47***	0.0010**
		0.111	*0.014*	*0.000*	*0.037*
VOLATILITY	+	2.68*	5.82***	8.10***	0.0247***
		0.095	*0.000*	*0.000*	*0.002*
QUEBEC	-	-0.17**	0.03	-0.09	0.0002
		0.035	*0.353*	*0.104*	*0.258*
EXCASH	-	0.27			
		0.180			
COVERAGE			0.76***		
			0.000		
EXADJCOV				0.76***	
				0.000	
Industry Fixed Effects		Yes	Yes	Yes	Yes
No. of Observations		636	636	636	636
No. of Firms		159	159	159	159
Adjusted R^2		66.3%	82.7%	82.6%	6.1%

All continuous variables are winsorized at the 1% and 99% level. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 levels (one-tailed test if a predicted sign, and two-tailed test if no predicted sign), respectively, based on robust standard errors clustered by firm.

TABLE 2.9.6
Regression of the Effect of IFRS Adoption on D&O Coverage and Premiums for Canadian Firms Cross-listed in the US

Variable	Predicted Sign	(1) Coverage	(2) Premium	(3) Premium	(4) Premium / Coverage
Intercept		1.35***	-4.93***	-3.62***	0.0074***
		0.001	*0.000*	*0.000*	*0.000*
POST	+/-	0.07	-0.19***	-0.12**	-0.0025***
		0.274	*0.001*	*0.031*	*0.009*
SIZE	+	0.38***	-0.05	0.40***	-0.0001
		0.000	*0.360*	*0.000*	*0.397*
DEBTRATIO	+	0.32	-0.20	0.10	0.0019
		0.240	*0.257*	*0.365*	*0.193*
ACQUIRER	+/-	-0.06	0.06	0.03	0.0004
		0.629	*0.506*	*0.689*	*0.651*
DIVESTOR	+/-	0.20	0.37	0.52*	0.0088
		0.562	*0.213*	*0.090*	*0.171*
HIGHTECH	+	0.43*	0.18	0.59*	0.0032*
		0.066	*0.284*	*0.051*	*0.095*
VOLATILITY	+	2.31**	1.40	3.62**	0.01
		0.037	*0.213*	*0.034*	*0.297*
QUEBEC	-	-0.66***	0.08	-0.66***	-0.0004
		0.000	*0.311*	*0.000*	*0.386*
MILLS	+/-	-0.25	0.29	-0.04	0.0072
		0.637	*0.636*	*0.953*	*0.339*
EXCASH	+	0.58*			
		0.067			
COVERAGE			1.13***		
			0.000		
EXADJCOV				1.14***	
				0.000	
Industry Fixed Effects		Yes	Yes	Yes	Yes
No. of Observations		168	168	168	168
No. of Firms		42	42	42	42
Adjusted R^2		85.1%	91.5%	90.7%	23.3%

All continuous variables are winsorized at the 1% and 99% level. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 levels (one-tailed test if a predicted sign, and two-tailed test if no predicted sign), respectively, based on robust standard errors clustered by firm.

TABLE 2.9.7
Regression of the Effect of IFRS Adoption on Excess Cash for Canadian Firms Not Cross-listed in the US That Do Not Purchase D&O Insurance

Variable	Predicted Sign	*EXCASH*
Intercept		-0.32***
		0.000
POST	+/-	-0.06***
		0.001
SIZE	+	0.06***
		0.000
DEBTRATIO	+	-0.26***
		0.000
ACQUIRER	+/-	0.03
		0.140
DIVESTOR	+/-	0.10
		0.121
HIGHTECH	+	0.01
		0.458
VOLATILITY	+	-0.37
		0.200
QUEBEC	-	-0.05
		0.147
Industry Fixed Effects		Yes
No. of Observations		636
No. of Firms		159
Adjusted R^2		15.4%

All continuous variables are winsorized at the 1% and 99% level. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 levels (one-tailed test if a predicted sign, and two-tailed test if no predicted sign), respectively, based on robust standard errors clustered by firm.

TABLE 2.9.8
Regression of the Effect of IFRS Adoption on Excess Cash for Canadian Firms Cross-listed in the US That Do Not Purchase D&O Insurance

Variable	Predicted Sign	*EXCASH*
Intercept		-0.28
		0.246
POST	+/-	-0.10**
		0.043
SIZE	+	0.04*
		0.061
DEBTRATIO	+	-0.72***
		0.002
ACQUIRER	+/-	0.16**
		0.021
DIVESTOR	+/-	0.13
		0.327
HIGHTECH	+	0.22
		0.155
VOLATILITY	+	-0.20
		0.464
QUEBEC	-	-0.25**
		0.030
MILLS	+/-	-0.09
		0.620
Industry Fixed Effects		Yes
No. of Observations		156
No. of Firms		39
Adjusted R^2		9.1%

All continuous variables are winsorized at the 1% and 99% level. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 levels (one-tailed test if a predicted sign, and two-tailed test if no predicted sign), respectively, based on robust standard errors clustered by firm.

TABLE 2.9.9
Descriptive Statistics for New York State Incorporated Firms

	N	Mean	Median	Std. Dev.
D&O Premium (m$)	29	2.30	0.87	3.09
D&O Premium/TA	29	0.0007	0.0004	0.0008
SIZE	29	7.86	7.94	2.66
DEBTRATIO	29	0.24	0.21	0.19
ACQUIRER	29	0.07	0.00	0.26
DIVESTOR	29	0.00	0.00	0.00
HIGHTECH	29	0.10	0.00	0.31
VOLATILITY	29	0.02	0.02	0.01

The table presents descriptive statistics for US firms that are incorporated in New York State and that disclose D&O premiums for two years before and after the year they would have had to adopt IFRS had they been in Canada. Data is presented for the year prior to pseudo IFRS-adoption year.

TABLE 2.9.10
Regression of the Effect of IFRS Adoption on Premiums for Canadian Firms Cross-listed in the US Compared to Firms Incorporated in New York State

Variable	Predicted Sign	Premium
Intercept		-4.22***
		0.000
IFRS	*?*	-0.53
		0.132
POST	+/-	-0.01
		0.840
*IFRS*POST*	+/-	-0.13*
		0.087
SIZE	+	0.49***
		0.000
DEBTRATIO	+	0.04
		0.472
ACQUIRER	+/-	0.12
		0.301
DIVESTOR	+/-	0.67
		0.200
HIGHTECH	+	0.42*
		0.085
VOLATILITY	+	2.88*
		0.081
QUEBEC	-	-0.32*
		0.082
MILLS	+/-	0.39
		0.718
Industry Fixed Effects		Yes
No. of Observations		284
No. of Canadian Firms		42
No. of New York Firms		29
Adjusted R^2		78.2%

All continuous variables are winsorized at the 1% and 99% level. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 levels (one-tailed test if a predicted sign, and two-tailed test if no predicted sign), respectively, based on robust standard errors clustered by firm.

Chapter 3

Accounting-Based Valuation for Multiple Firms: The Case of Cross Holdings

Daphne Hart

Bjorn N. Jorgensen

3.1 Introduction

This chapter develops an accounting-based valuation model for firms with cross holdings. We extend Feltham and Ohlson (1995) (FO henceforth) to study an economy with multiple firms connected through mutual inter-company equity investments, called cross holdings.[1]

We also model linear information dynamics in a setting with multiple firms and inter-firm information transfers, for firms with and without equity investments. Overall, we find that market values appear distorted for firms with mutual equity investments and that the degree of ownership determines the magnitude of this perceived distortion. These findings should be of interest to investors and regulators.

Cross holdings are believed to be common in Germany, Japan (keiretsu) and South Korea (chaebol), however, the phenomenon is not limited to those countries. Becht and Roëll (1999) document high concentration of voting power in continental Europe. Holderness

---

We thank Vasiliki Athanasakou, Stefano Cascino, Denis Gromb, Stephen Penman, Zane Swanson (discussant), Wim Van der Stede, Martin Wallmeier (discussant) and participants at the 2017 AAA annual meeting, the 10th Accounting Research Workshop in Basel and the 2nd HEC PhD Finance Workshop.

[1] We use the terms cross holdings and equity investments interchangeably throughout the chapter.

(2009) shows that public US firms have a large percentage of concentrated equity ownership, 11 percent of US firms have block holders that are public and private non-financial corporations. These block holders have 39 percent of the voting stock on average.

The incentives for corporate equity ownership and the effects of block holdings on target firms (investees) are well documented (see Allen and Phillips 2000, Ouimet 2012, Liao 2014, among others). However, less is known about the long-term effects of corporate equity ownership on the valuation of the investing firms (investors). One exception is Fedenia, Hodder and Triantis (1994) who study the consequences of cross holdings in a capital market setting. Based on an asset pricing model, they show that stock returns and risk premia are distorted when firms hold corporate equity.[2] While Fedenia et al. (1994) model the behavior of stock returns, they do not derive stock market values and returns from accounting fundaments.

In this paper, we rely on the accounting-based valuation framework and complements the asset pricing analysis in Fedenia et al. (1994). Accounting-based valuation studies the relation between accounting information and firm valuation. The advantage of using the accounting-based valuation framework for our setting, is that we can undo distortions generated by the accounting treatment.[3]

Prior accounting-based valuation research focuses on a single firm setting with operating and financing activities. In an influential paper, Ohlson (1995) studies a single firm with operating activities and demonstrates how clean surplus allows valuation based on *abnormal earnings* and *book value of equity*. FO (1995) consider a single firm with both operating activities and financing activities. They assume that each year, the firm places cash in either an operating asset ("operating activities") or a risk-free bond without future abnormal

[2] Specifically, Fedenia et al. (1994) demonstrate how cross holdings lead to a non-stationary covariance matrix of observed stock returns, thus, increasing estimates of priced risk.
[3] As further discussed below, the distortion is due to the accounting treatment. Alternative valuation models, such as discounted future cash flows, may not capture the "double counting" introduced by accounting.

earnings ("financing activates").[4] FO (1995) derive valuation based on *abnormal operating earnings, operating assets* and *financial assets*. Extending these papers, we consider a setting with multiple firms with operating activities, financing actives, as well as investments in corporate equity. In our setting, each firm places cash in an operating asset, a risk-free bond, or a risky equity security issued by another firm.

We model the investments in corporate equity based on the accounting guidance on equity investments. US Generally Accepted Accounting Principles (US GAAP) and International Financial Reporting Standards (IFRS) classify equity ownership into two categories: *Financial instruments*[5] and *investment in common stock*[6] (Investment in associates). We focus on equity investments classified as financial instruments that are accounted for using the *fair value method*.[7]

Under the fair value method, the investment is an asset on the investing firm's balance sheet. When the investee's price appreciates (depreciates) the investor's assets increase against unrealized holding gains (losses) in the equity account.[8] When the investee pays dividends, the investor records an increase in cash and earnings. Any accounting profit or loss generated by the investee is unrecorded by the investing firm. We note that investments accounted for

[4] We follow FO's (1995) conventions in the accounting-based valuation literature. First, we define *financing activities* as investments in a riskless bond. Furthermore, we consider all equity firm.
[5] Under US GAAP, the main guidance on Financial Instruments is given in ASC 320 Investments - Debt and Equity Securities. Under IFRS the main guidance is described in IAS 32, Financial Instruments: Presentation; IFRS 7, Financial Instruments: Disclosures; and IFRS 9, Financial Instruments.
[6] Guidance on Investment in Common Stock under US GAAP is presented in ASC 323 Investments-Equity Method and Joint Ventures, and under IFRS in IAS 28, Investment in Associates. IAS 28 generally requires investors to use the equity method for their investments in associates in consolidated financial statements, however, if separate financial statements are presented (i.e., by a parent or investor), subsidiaries and associates can be accounted for at either cost method or fair value method. (Ernst and Young, 2012)
[7] In Appendix 3.5.3, we consider unconsolidated equity positions accounted for using the *equity method* and find qualitatively similar results as those reported in the body of the chapter relying on the *fair value method*. Further, in appendix 3.5.4, we illustrate the implications of the accounting methods for market-to-book ratios and return on equity.
[8] Equity securities within the scope of ASC 320 are classified as *trading* or *available-for-sale*. For investments classified as trading, all gains and losses are reported in current earnings. For investments classified as available-for-sale, realized gains and losses are recorded in current earnings while unrealized gains and losses are recorded in other comprehensive income. Other-than-temporary impairments of available-for-sale securities are recorded in current earnings (Ernst and Young, 2015).

using the fair value method do not require consolidation, since the investor and the investee are separate entities for financial reporting purposes.[9]

While (i) managers' choice between the equity method and the fair value method[10] and (ii) managers' motivation for engaging in equity transaction are outside the scope of the accounting-based valuation literature, we note that purchasing equity stakes in a related or rival firm have economic rationales, such as strategic reasons, operational reasons, and for investment diversification.[11] Furthermore, corporate equity ownership has implications for firms' corporate governance and product market decisions.[12] In this paper, we take the ownership structure as given and do not analyze the managers' motivations for purchasing equity. We assume any synergies or goodwill created upon the equity investment are reflected in the initial transaction prices. This paper merely considers the consequences of (unconsolidated) equity holdings on accounting-based valuation. Finally, we abstract from risk adjustments of variables as analyzed in Feltham and Ohlson (1999), among others.

We assume clean surplus and derive an augmented valuation model based on FO (1995) when firms have mutual equity ownership. While prior finance research documents that cross-firm ownerships distort market values due to "double counting", we show that

---

[9] For example, from 2009 to 2015 *Ryanair* held a 29.8% interest in *Aer Lingus Group plc*, which during 2007 to 2009 was recorded at a total cost of €407.2 million. This investment was an asset carried at fair value. Ryanair reports its investment in Aer Lingus as available-for-sale financial assets, because "…the company does not have the power to exercise any influence over the entity." (Ryanair Annual Report 2013, note 4).

[10] The choice of the appropriate accounting treatment, equity method or fair value method, may depend on the ability of the holding firm to exercise control over the investee. One example of this discretion is Freedom Foods Group (FFG), which was the largest single shareholder of a2 Milk Company (a2MC) with 17.8% equity interest. In 2014, FFG accounted for its investment in a2MC using the equity method. In 2015, following a failed takeover attempt and the resignation of FFG's CEO from the board of a2MC, FFG reclassified its investment as available-for-sale and recognized a fair value gain of A$53.1 million. Another example is Walgreens Boots Alliance, Inc. (WBG) which owned 5.2% of AmerisourceBergen (AB) in 2015 and designated one member of AB's board of directors. In 2013 the two companies announced various agreements and arrangements, including a ten-year pharmaceutical distribution agreement. Further, WGB had the right to purchase a minority equity position in AB (which it exercised in 2016) and gain associated representation on AB's board of directors in certain circumstances. In 2015, WGB accounted for its equity investment as available-for-sale (see Walgreens Boots Alliance, Inc. Annual Report 2015, note 7).

[11] See Hansen and Lott (1995) and Clayton and Jorgensen (2005).

[12] See Shleifer and Vishny (1986), Aghion and Tirole (1997), Burkart, Gromb, and Panunzi (1997), and Cronqvist and Fahlenbrach (2009), among others.

financial statements are similarly distorted. Consider the case of two-sided cross holdings, when one firm records the value of its investment in another firm, this value includes the other firm's investment in its own equity securities. Thus, the aggregate market values of all shares outstanding exceeding the aggregate intrinsic value of all firms and the aggregate value of all future dividends.

We note that these value distortions may arise for firms with direct, as well as indirect cross holdings. A firm can own shares in another firm indirectly, through equity ownership of an intermediate firm. To illustrate this point, consider a three firm network where firm H has one-sided equity ownership in firm F, firm F has one-sided equity ownership in firm G, and firm G has one-sided equity ownership in Firm H. Although none of these three firms have direct two-sided equity ownership, the circular ownership structure causes each firm's valuation to depend on the performance of the two other firms.

We also illustrate the effects of corporate equity ownership on market-to-book (MB) and price-to-earnings (PE) ratios. When we allow for equity investments, we find that MB ratios are distorted away from unity. These findings provide a theoretical perspective on Fama and French (1992, 1993, 2015), who suggest that MB ratios capture firms' underlying risk. We show that corporate equity investments alter earnings and book values, thus articulating an analytical explanation for the observed empirical relation between MB ratios and stock returns. Moreover, prior empirical literature discusses the effects of equity market concentration and cross holdings on market prices and informativeness of accounting information (French and Poterba 1991, Alford et al. 1993). We demonstrate how unconsolidated equity positions alter the relation between earnings and prices.

Lastly, we discuss linear information dynamics in a setting with multiple firms. We propose linear information models that permit formal analyses of inter-firm information transfers. Prior empirical literature examines intra-industry information transfers (Baginski 1987, Foster 1981, Han, Wild and Ramesh 1989, Han and Wild 1990), and market and analysts' reaction to peer firms' disclosures (Freeman and Tse 1992, Ramnath 2002, Shroff, Verdi and Yost 2017). Our model offers theoretical foundations to these studies, as we provide a theoretical benchmark for assessing inter-firm information transfers.

We derive a closed form solution for a linear information model where a firm directly incorporates information about another firm. Moreover, we derive a closed form solution for firms with cross holdings, that is, a model where firms indirectly incorporate information about their investees. We show that in the presence of cross-firm equity ownership, the implied stock prices incorporate information about investees even in the absence of inter-firm information transfers.

Our contribution is twofold. First, we present an accounting-based valuation and a linear information model to value multiple firms jointly. Second, we demonstrate that corporate equity investments may distort accounting-based valuation. We focus on the periods following the initial equity investment decision and analytically demonstrate how equity ownership of other firms may subsequently alter firms' valuation. Thus, we provide a benchmark for these firms' value net of benefits or synergies that were unpriced at the date of the initial equity investment.[13]

The chapter proceeds as follows. Section 3.2 describes the model and formalizes the valuation of firms with corporate equity investments. We also discuss the implications of cross holdings for empirical research and for financial ratios. Section 3.3 presents a linear information framework for multiple firms and discusses the effects of inter-firm information transfers and cross holdings on firms' valuation. We conclude and discuss future research in Section 3.4. All variables are defined in Appendix 3.5.1. Appendices 3.5.2-3.5.4 expand an example due to Lundholm (1995) to illustrate corporate equity ownership and the implication of the accounting treatments for financial ratios. Appendices 3.5.5-3.5.6 discuss valuation using the general linear information model and provide guidance for empirical applications.

[13] We assume that the firm acquires its corporate equity positions at fair value. The share price at the time of the acquisition incorporates all expected future abnormal earnings.

3.2 A Valuation Model with Corporate Equity Ownership

Ohlson (1995) presents a valuation model for companies that engage exclusively in operating activities. Conceptually, these companies can increase their production capacity or improve production processes by purchasing additional productive assets. Thus, future abnormal earnings are correlated with current abnormal earnings and, future return on assets (ROA) are similar to past ROA. FO (1995) suggest an investment channel through which companies invest in risk-free (government) bonds. By construction, this investment channel does not generate future abnormal earnings.

Extending Ohlson (1995) and FO (1995), we introduce the possibility that companies purchase equity in other firms. Each firm may invest in a productive asset, a risk-free bond, or a risky equity security issued by another firm. The returns from these equity investments depend on the nature of the investment and the performance of the investee firms over time. The investments we consider are one-sided or two-sided cross holdings that are either direct or indirect.

Ohlson (1995) and FO (1995) show that accounting-based valuation equals book value and expected discounted future abnormal earnings. Since we consider the value of a firm that owns shares in another firm, we take into consideration both the investor's and its investees' book values and future abnormal earnings.[14]

3.2.1 Formal Model of Cross Holdings

We model an economy with two firms denoted by $i = \{j, k\}, \forall\, j \neq k$,[15] operating for multiple periods $t = 0,1,2, ...$ Both firms are traded in a competitive stock market, where the

[14] Appendix 3.5.2 illustrate the central features of firms' equity investments. As a benchmark, we first present a single firm setting without equity investments from Lundholm (1995). Next, we present two firms where only one of the firms has equity investment, an ownership stake in the other firm. Lastly, we present the case of two-sided cross holdings, where both firms have equity investments, ownership stakes in each other. Appendix 3.5.2 demonstrates how equity ownership affects book values and earnings.

[15] The model can be extended and solved for $n > 2$ firms, that is, $i = 1,2,.., n$.

ex-dividend market price of firm i at date t (end of the period) is given by p_t^i, and $p_t = \begin{vmatrix} p_t^j \\ p_t^k \end{vmatrix}$ denotes the 2-dimensional price vector. Each firm engages in operating, financing and investing activates. We follow FO (1995) and assume firms disclose accounting information about their operational and financial activities. Moreover, we assume firms disclose accounting information concerning their corporate equity investments.

We focus on firms' valuation in the periods following an investment decision. For ease of exposition, we treat the ownership structure as exogenously given and constant over time.[16] Firm j's percentage ownership in firm k is represented by $\phi_{j,k}$, and $\phi_j = |\phi_{j,j} \quad \phi_{j,k}|$ denotes the vector of firm j's ownership structure.[17] We normalize $\phi_{j,j} = 0$ to eliminate self-ownership and $0 \leq \phi_{j,k} < 1$ to prohibit short selling and leveraged positions.

We augment FO's (1995) specification to account for corporate equity investments: the firm's book value includes the market value of the firm's equity investments and the firm's earnings include the cash flow generated by these investments. Thus, the following conditions hold $\forall i, \forall t$:

(3.1) $B_t^j = FA_t^j + OA_t^j + \phi_j p_t = FA_t^j + OA_t^j + \phi_{j,k} * p_t^k$

(3.2) $x_t^j = i_t^j + ox_t^j + \phi_{j,k} * d_t^k$

Equation (3.1) denotes firm j's total book value at date t. Firm j's book value of equity $\left(B_t^j\right)$ is the sum of the firm's total financial assets net of financial obligations $\left(FA_t^j\right)$, its total operating assets net of operating liabilities $\left(OA_t^j\right)$, and the current market value of firm j's equity investment in firm k, $\left(\phi_{j,k} * p_t^k\right)$. Equation (3.2) describes the firm's earnings for the period $(t-1, t)$. Firm j's earnings $\left(x_t^j\right)$ comprise of interest revenue from financing activities

[16] This constraint does not have any implications for the investee's liquidity. In particular, we impose no constraints on the liquidity of the investee's stocks.
[17] Without loss of generality, we use firm j as a representative firm.

net of interest expenses $\left(i_t^j\right)$, operating earnings $\left(ox_t^j\right)$, and its claim to the dividends paid by firm k at the end of the period $\left(d_t^k\right)$.

In addition to Equations (3.1) and (3.2) we assume the present value relation, where firm's market value, V_t^j, equals the present value of expected dividends (PVED) at time t:

(3.3) $\mathrm{V}_t^j = \sum_{\tau=t+1}^{\infty} E_t \left[\frac{d_\tau^j}{(1+r)^{\tau-t}}\right]$

Accounting Relations

We now present three accounting relations: Clean Surplus Relation, Financial Assets Relation and Operating Assets Relation. We use these accounting relations to derive firms' valuation.

(i) *Clean Surplus Relation* (CSR)

As in Ohlson (1995), we assume the *Clean Surplus Relation* (CSR) holds:

(CSR) $B_t^j = B_{t-1}^j + x_t^j - d_t^j$

CSR merely states that the book value at time t equals the book value at time $(t-1)$, plus the earnings generated over the period $(t-1, t)$, minus dividends paid by the firm to its shareholders $\left(d_t^j\right)$. Thus, book value increases with earnings and decreases with dividends paid.

Using the present value relation (PVED) we can value the firm based on CSR. We start by defining abnormal earnings for the firm as: $x_t^{a,j} \triangleq x_t^j - r * B_{t-1}^j$. The risk-free rate is denoted by r, which, for simplicity, we assume is constant over time. CSR can be written as: $B_t^j = (1+r)B_{t-1}^j + x_t^{a,j} - d_t^j$. Rearranging, we get:

(3.4) $d_t^j = (1+r)B_{t-1}^j - B_t^j + x_t^{a,j}$

Substituting d_t^j in (PVED) and with appropriate transversality conditions, we get that the firm's value is given by:

(3.5) $V_t^j = B_t^j + \sum_{\tau=t+1}^{\infty} E_t\left[\frac{x_\tau^{a,j}}{(1+r)^{\tau-t}}\right], \forall i,\ \forall t$

Equation (3.5) states that firm j's value at date t equals the sum of firm j's book value and discounted future abnormal earnings. We use Equation (3.5) to simultaneously solve for both firms' market values. Since the firms are permitted to hold equity stock in each other, we solve a system of equations to extract each firm's individual value. To do so, we first define the following variables: $V_t = \begin{vmatrix} V_t^j \\ V_t^k \end{vmatrix}$ is the $[2 \times 1]$-vector of the firms' market values at time t and $B_t = \begin{vmatrix} B_t^j \\ B_t^k \end{vmatrix}$ is the $[2 \times 1]$-vector of the firms' book values at time t. $FA_t = \begin{vmatrix} FA_t^j \\ FA_t^k \end{vmatrix}$ and $OA_t = \begin{vmatrix} OA_t^j \\ OA_t^k \end{vmatrix}$ are the $[2 \times 1]$-vectors of the firms' stock of financial assets and stock of operating assets at time t, respectively. $X_{t+1}^a = \begin{vmatrix} \sum_{\tau=t+1}^{\infty} E_t\left[\frac{x_\tau^{a,j}}{(1+r)^{\tau-t}}\right] \\ \sum_{\tau=t+1}^{\infty} E_t\left[\frac{x_\tau^{a,k}}{(1+r)^{\tau-t}}\right] \end{vmatrix}$ is the $[2 \times 1]$-vector of the firms' discounted abnormal earnings from $t+1$ to ∞. Lastly, ϕ denotes the $[2 \times 2]$ matrix of equity ownership percentage (i.e. ownership structure): $\phi = |\phi_j, \phi_k| = \begin{vmatrix} 0 & \phi_{j,k} \\ \phi_{k,j} & 0 \end{vmatrix}$.

Given Equation (3.5), the firms' market values can be expressed as: $V_t = B_t + X_{t+1}^a$. Substituting from Equation (3.1) we get: $V_t = FA_t + OA_t + \phi p_t + X_{t+1}^a$. Assuming efficient capital markets, where market prices fully reflect the firms' values, implies: $p_t = V_t$, hence:

$$V_t = FA_t + OA_t + \phi V_t + X_{t+1}^a$$

$$[I - \phi]V_t = FA_t + OA_t + X_{t+1}^a$$

where I is the $[2 \times 2]$ identity matrix $I = \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}$. Thus, the firms' values are: [18]

(3.6) $V_t = |I - \phi|^{-1}|FA_t + OA_t| + |I - \phi|^{-1}X^a_{t+1}$

(ii) Financial Asset Relation (FAR)

In FO (1995) each firm has a stock of financial assets generated through the accumulation of cash from operating actives and earnings re-invested in risk-free bonds. We extend FO (1995) and model an economy where each firm can hold shares of other firms in addition to investing in risk-free bonds. Corporate equity investments differ from financing activities as the former permits firms to invest their earnings in a risky asset, while the later allows firms to reinvest their earnings in a risk-free asset. The firm's income from its equity investments are the dividends paid by the investees and the market returns on the corporate equity. Moreover, income generated by equity investments are cash based (dividends received from investees) as well as non-cash based, in the form of unrealized capital gains (losses). We define the following cash-based items to account for all cash-based income:

(3.7) $i^j_t = r * LA^j_{t-1}$

(3.8) $LA^j_t = LA^j_{t-1}(1 + r) + \left(c^j_t - d^j_t\right) + \phi_{j,k} * d^k_t$

Equation (3.7) defines the firm's income from financing activities, where LA^j_{t-1} represents the liquid assets invested in the risk-free bonds at the beginning of period t. This income is a cash flow, as in each period the firm reinvests its total liquid assets, LA^j_t, in a bond that pays risk-free interest, r. Equation (3.8) denotes the evolution of total liquid assets over

[18] We assume the firms' equity investments are independent. I and ϕ are square matrices and $|I - \phi|$ is a full rank matrix, hence, its inverse matrix $|I - \phi|^{-1}$ exists such that: $|I - \phi|^{-1}|I - \phi| = I$. Note that for the case of two firms $\{j, k\}$, $|I - \phi| = \begin{vmatrix} 1 & -\phi_{j,k} \\ -\phi_{k,j} & 1 \end{vmatrix}$ and $|I - \phi|^{-1} = \begin{vmatrix} \frac{1}{1-\phi_{j,k}\phi_{k,j}} & \frac{\phi_{j,k}}{1-\phi_{j,k}\phi_{k,j}} \\ \frac{\phi_{k,j}}{1-\phi_{j,k}\phi_{k,j}} & \frac{1}{1-\phi_{j,k}\phi_{k,j}} \end{vmatrix}$.

time. Total liquid assets increase with cash flow realized from operating activities net of investment in those activities, c_t^j, and with dividends paid from the investee, d_t^k. The liquid assets decrease with the dividend paid to shareholders, d_t^j.

In our model, the financial assets account accumulates income generated by both financing activities and equity investments. Interest is earned on the liquid assets during the period $(t-1, t)$ and dividends are declared and paid at the end of the period. In addition, as in FO (1995), the financial assets account includes the cash generated by operating actives. Hence, financial assets increase with cash from operating activities, returns on liquid asset (equivalent to a savings account) and the capital gains on investment assets (investee's equity).[19] The following equation denotes the *Financial Asset Relation* (FAR):

(FAR) $$FA_t^j = FA_{t-1}^j + r * LA_{t-1}^j - \left(d_t^j - c_t^j\right) + \phi_{j,k} * \left(p_t^k + d_t^k - p_{t-1}^k\right)$$

We note that equity investments alter FAR relative to FO (1995). When equity investments are introduced, financial assets accumulate cash dividends paid by the investee as well as the unrealized capital gains (losses) over time.[20]

We can now express the firm's valuation using FAR. We start by observing that Equation (3.8) can be simplified using backward induction. Assuming that the initial stock of financial assets equals the initial stock of liquid assets, $LA_0^j = FA_0^j$, we can rewrite Equation (3.8) as:

(3.9) $$LA_t^j = FA_0^j(1+r)^t + \sum_{\tau=1}^{t}(1+r)^{t-\tau}\left(c_\tau^j - d_\tau^j + \phi_{j,k} * d_\tau^k\right).$$

Substituting LA_t^j in FAR and re-arranging, we get:

$$d_t^j = FA_{t-1}^j - FA_t^j + rFA_0^j(1+r)^{t-1} + r\sum_{\tau=1}^{t-1}(1+r)^{t-1-\tau}\left(c_\tau^j - d_\tau^j + \phi_{j,k} * d_\tau^k\right) + c_t^j + \phi_{j,k} * \left(p_t^k + d_t^k - p_{t-1}^k\right)$$

[19] Partitioning the financial assets into liquid assets and equity ownership is required for tractability of the financing activities' earnings and the unrealized changes in the investees' value.
[20] Both US GAAP and IFRS generally permit recognition of capital gains in the income statement.

The current dividend, d_t^j, depends on the values of past dividends, d_τ^j. [21] This is a dynamic process, we use backwards induction to get:

(3.10) $d_t^j = FA_{t-1}^j(1+r) - FA_t^j + c_t^j - r\phi_{j,k}\sum_{\tau=1}^{t-1}(p_\tau^k - p_{\tau-1}^k) + \phi_{j,k} * (p_t^k + d_t^k - p_{t-1}^k)$

Using (PVED) and the transversality condition, the firm's valuation can be represented as:

(3.11) $V_t^j = FA_t^j + \sum_{\tau=t+1}^{\infty} E_t\left[\frac{c_\tau^j}{(1+r)^{\tau-t}}\right] + \phi_{j,k}\sum_{\tau=t+1}^{\infty} E_t\left[\frac{d_\tau^k}{(1+r)^{\tau-t}}\right],\ \forall i, \forall t$

The firm's value equals the sum of its financial assets, discounted future abnormal cash flows from operating activities and discounted future dividends paid by its investee.

We can use Equation (3.11) to define the valuation of all firms. First, we define $C_{t+1} = \begin{vmatrix} \sum_{\tau=t+1}^{\infty} E_t\left[\frac{c_\tau^j}{(1+r)^{\tau-t}}\right] \\ \sum_{\tau=t+1}^{\infty} E_t\left[\frac{c_\tau^k}{(1+r)^{\tau-t}}\right] \end{vmatrix}$ as the $[2 \times 1]$-vector of the firms' discounted cash flows from operating activities from time $t+1$ to ∞, and $D_{t+1} = \begin{vmatrix} \sum_{\tau=t+1}^{\infty} E_t\left[\frac{d_\tau^j}{(1+r)^{\tau-t}}\right] \\ \sum_{\tau=t+1}^{\infty} E_t\left[\frac{d_\tau^k}{(1+r)^{\tau-t}}\right] \end{vmatrix}$ as the $[2 \times 1]$-vector of the firms' discounted dividends paid by all firms from $t+1$ to ∞. We extrapolate Equation (3.11) for all firms:

$$V_t = FA_t + C_{t+1} + \phi D_{t+1}$$

Using the (PVED) identify ($V_t = D_{t+1}$) and rearranging, we get:

(3.12) $V_t = |I - \phi|^{-1} FA_t + |I - \phi|^{-1} C_{t+1}$

(iii) Operating Asset Relation (OAR)

Following FO (1995), we define the *Operating Asset Relation* (OAR) as:

[21] The current dividend is a function of prior dividends paid. Current dividends depend on the stock of liquid assets, which decreases with prior dividends paid.

(OAR) $OA_t^j = OA_{t-1}^j + ox_t^j - c_t^j$

OAR characterizes the evolution of firm j's operating assets. Each period the firm chooses whether to reinvest or realize its operating earnings. Reinvesting the earnings increases the operating assets, which potentially increases future operating earnings. Realizing the earnings increases the liquid assets, which increases future interest revenues.

We value the firm based on OAR. We start by defining abnormal operating earnings for firm j at time t as: $ox_t^{a,j} \triangleq ox_t^j - rOA_{t-1}^j$. Hence OAR can be written as:

$$OA_t^j = (1+r)OA_{t-1}^j + ox_t^{a,j} - c_t^j.$$

Rearranging, we get:

(3.13) $c_t^j = (1+r)OA_{t-1}^j - OA_t^j + ox_t^{a,j}$

Using Equation (3.13) we calculate the firm's present value of cash flows:

(3.14) $\sum_{\tau=t+1}^{\infty} E_t\left[\frac{c_\tau^j}{(1+r)^{\tau-t}}\right] = OA_t^j + \sum_{\tau=t+1}^{\infty} E_t\left[\frac{ox_\tau^{a,j}}{(1+r)^{\tau-t}}\right], \forall i, \forall t$

And add FA_t^j to both sides of Equation (3.14) and get:

(3.15) $\sum_{\tau=t+1}^{\infty} E_t\left[\frac{c_\tau^j}{(1+r)^{\tau-t}}\right] + FA_t^j = OA_t^j + FA_t^j + \sum_{\tau=t+1}^{\infty} E_t\left[\frac{ox_\tau^{a,j}}{(1+r)^{\tau-t}}\right], \forall i, \forall t$

Next, we can augment Equation (3.15) for all firms as:

$$C_{t+1} + FA_t = OA_t + FA_t + OX_{t+1}^a$$

Where $OX_{t+1}^a = \begin{Vmatrix} \sum_{\tau=t+1}^{\infty} E_t\left[\frac{ox_\tau^{a,1}}{(1+r)^{\tau-t}}\right] \\ \sum_{\tau=t+1}^{\infty} E_t\left[\frac{ox_\tau^{a,2}}{(1+r)^{\tau-t}}\right] \end{Vmatrix}$ is the $[2 \times 1]$-vector of the firms' discounted abnormal operating earnings from $t+1$ to ∞.

Lastly, from FAR we know that: $[I - \phi]V_t = FA_t + C_{t+1}$, hence, we get:

(3.16) $V_t = |I - \phi|^{-1}|FA_t + OA_t| + |I - \phi|^{-1}OX_{t+1}^a$

Proposition I:

Given Equations (3.1)-(3.3) and (3.7)-(3.8), assuming efficient capital markets and assuming the three accounting relations, firms' market prices are given by the following equivalent expressions:

(a) $p_t = |I - \phi|^{-1}|FA_t + OA_t| + |I - \phi|^{-1}X_{t+1}^a$

(b)$p_t = |I - \phi|^{-1}FA_t + |I - \phi|^{-1}C_{t+1}$

(c)$p_t = |I - \phi|^{-1}|FA_t + OA_t| + |I - \phi|^{-1}OX_{t+1}^a$

First, the above proposition extends Proposition 1 in FO (1995, page 698), which is the special case of our setting without corporate equity ownerships, i.e., $\phi = \underline{0}$. The two propositions coincide since when $|I - \phi|^{-1} = I$, the other firm's accounting information is not needed for valuation.

Second, Proposition I naturally extends to cases with $n > 2$ firms. As long as capital markets are efficient, the market value is consistent with all three accounting relations, similar to FO (1995). The same price prevails regardless of the underlying accounting relations, as the firm's book values and abnormal earnings capture the firms' underlying economics.

3.2.2 Implication for Empirical Research: The Case of Cross Holdings

Proposition I permits studying the effects of corporate equity investments on prices. In this section, we demonstrate the empirical application of Proposition I and show that not accounting for cross holdings may lead to biased estimation due to omission of correlated variables.

We start by using Proposition I to price two firms with similar operating activities but different equity investment stakes.[22] Both firms, H and F, are traded in a competitive stock

[22] We consider two firms to be similar if their operating actives are the same, but their equity investments differ. Assume two firms that operate in the same industry and have access to identical production technology. Assume one firm, Firm H, holds all its operating assets directly and a second firm, Firm F, that holds some of its operating asset indirectly, by owing equity in firm H. These two firms are similar as their underlying economics are the same.

market. Firm H does not have corporate equity investments, while Firm F owns $\varphi \in (0,1)$ of Firm H. The ownership structure is denoted by $\phi = |\phi_H, \phi_F| = \begin{vmatrix} 0 & 0 \\ \varphi & 0 \end{vmatrix}$.

Under CSR the firms' prices are given be:[23]

$$p_t^H = FA_t^H + OA_t^H + \sum_{\tau=t+1}^{\infty} E_t \left[\frac{x_\tau^{a,H}}{(1+r)^{\tau-t}} \right]$$

$$p_t^F = FA_t^F + OA_t^F + \varphi FA_t^H + \varphi OA_t^H + \sum_{\tau=t+1}^{\infty} E_t \left[\frac{x_\tau^{a,F} + \varphi x_\tau^{a,H}}{(1+r)^{\tau-t}} \right]$$

Note that Firm H is unaffected by the corporate equity investments of Firm F. Firm H's price is identical to the valuation presented in Ohlson (1995), as $B_t^H = FA_t^H + OA_t^H$. Nonetheless, Firm F's valuation is altered by its equity ownership, its stock of financial asset incorporates capital gains (losses) on its investee, Firm H. Specifically, from Equation (3.10), we get:

$$FA_t^H = FA_{t-1}^H(1+r) + c_t^H - d_t^H$$

$$FA_t^F = FA_{t-1}^F(1+r) + c_t^F - d_t^F - r\varphi * \sum_{\tau=1}^{t-1}(p_\tau^H - p_{\tau-1}^H) + \varphi * (p_t^H + d_t^H - p_{t-1}^H)$$

Using backwards induction, we can express the stock of financial assets as follows:

$$FA_t^H = FA_0^H(1+r)^t + \sum_{\tau=1}^{t}(c_\tau^H - d_\tau^H)(1+r)^{t-\tau}$$

$$FA_t^F = FA_0^F(1+r)^t + \sum_{\tau=1}^{t}(c_\tau^F - d_\tau^F + \varphi * d_\tau^H)(1+r)^{t-\tau} + \varphi \sum_{\tau=1}^{t}(p_\tau^H - p_{\tau-1}^H)$$

Thus, the firms' prices are given by:

$$p_t^H = FA_0^H(1+r)^t + \sum_{\tau=1}^{t}(c_\tau^H - d_\tau^H)(1+r)^{t-\tau} + OA_t^H + \sum_{\tau=t+1}^{\infty} E_t \left[\frac{x_\tau^{a,H}}{(1+r)^{\tau-t}} \right]$$

$$p_t^F = (FA_0^F + \varphi FA_0^H)(1+r)^t + \sum_{\tau=1}^{t}(c_\tau^F - d_\tau^F + \varphi c_\tau^H)(1+r)^{t-\tau} + \varphi \sum_{\tau=1}^{t}(p_\tau^H - p_{\tau-1}^H) + OA_t^F + \varphi OA_t^H + \sum_{\tau=t+1}^{\infty} E_t \left[\frac{x_\tau^{a,F} + \varphi x_\tau^{a,H}}{(1+r)^{\tau-t}} \right]$$

[23] Where $|I - \phi|^{-1} = \begin{vmatrix} 1 & 0 \\ \varphi & 1 \end{vmatrix}$.

Firm F's financial assets include capital gains (losses) on its investee, while its price also includes a fraction of the investee's financial assets, operating assets and operating cash flows. This implies that even under fair-value accounting, the value of a firm with equity investments may differ from a similar firm that does not have equity investments. Corporate equity investments permit firms to incorporate unrealized profits and changes in market expectations into their current assets. As such, these investments are also expected to affect the volatility of firms' prices. Furthermore, the evolution of the financial assets of a firm with equity investments differs from that of a firm without equity investments. Since financial assets differ, cash flows are also likely to differ and thus, induce different prices in practice.

Proposition II:

The following holds for an economy with two similar firms:

(a) Consider two firms denoted by j *and* k. *Without loss of generality, we set* $\phi_{j,k} > 0$ *and* $\phi_{k,j} = 0$. *Thus, firm* j *owns a fraction of firm* k *as one-sided cross holding. The firms' prices are given by* p_t^j *and* p_t^k.

(b) Consider two firms denoted by $\hat{j}$ *and* $\hat{k}$. *Both firms do not have corporate equity investments, thus,* $\phi_{\hat{j},\hat{k}} = \phi_{\hat{k},\hat{j}} = 0$. *The firms' prices are given by:* $\widehat{p_t^j}$ *and* $\widehat{p_t^k}$.

Given (a) and (b), $p_t^j \neq \widehat{p_t^j}$

Proposition II states that equity investments alter a firm's value. The value of a given firm without investments activities is different from the value of an identical firm that owns part of its operating assets and operating activities through an equity investment, i.e. equity ownership of an identical firm. Since market prices incorporate expectations about future performance, equity ownership permits the integration of these expectations into the current value of a holding firm.

Consider next the case of two-sided cross holdings, where two identical firms, Firm F and Firm G, both have equity investments. Firm F owns $\varphi \in (0,1)$ of Firm G, and Firm G owns $\gamma \in (0,1)$ of Firm F: $\phi = |\phi_G, \phi_F| = \begin{vmatrix} 0 & \gamma \\ \varphi & 0 \end{vmatrix}$. Under CSR the Firms' prices are given by:[24]

$$p_t^F = \frac{FA_t^F + OA_t^F + \varphi FA_t^G + \varphi OA_t^G}{1-\gamma\varphi} + \frac{1}{1-\gamma\varphi} \sum_{\tau=t+1}^{\infty} E_t \left[\frac{x_\tau^{\alpha,F} + \varphi x_\tau^{\alpha,G}}{(1+r)^{\tau-t}} \right]$$

$$p_t^G = \frac{FA_t^G + OA_t^G + \gamma FA_t^F + \gamma OA_t^F}{1-\gamma\varphi} + \frac{1}{1-\gamma\varphi} \sum_{\tau=t+1}^{\infty} E_t \left[\frac{x_\tau^{\alpha,G} + \gamma x_\tau^{\alpha,F}}{(1+r)^{\tau-t}} \right]$$

The valuations of both firms are distorted relative to the valuations given by Ohlson (1995) and FO (1995). Two-sided cross holdings mechanically alter the valuation of the firms by $\frac{1}{1-\varphi\gamma}$, a *value amplifier* that depends on the ownership structure. The two-sided cross holdings create a dependency between the firms, as the value of Firm G depends on the percentage ownership of Firm F and vice-versa.

Note that Firm F did not change its operating activities, financing activities or investments relative to the case of one-sided cross holding. The two-sided cross holdings imply a circular holding structures, leading to a greater dependency between the firms. The value of Firm F became more sensitive to the firm and its investee's (Firm G) initial book values and to the expected flows of abnormal earnings.

Corollary I: *Given an economy with two similar firms, the following holds:*

(a) Consider two firms denoted by j and k. Without loss of generality we set $\phi_{j,k} > 0$ and $\phi_{k,j} = 0$. Thus, firm j owns a fraction of firm k as one-sided cross holding. The firms' prices are given by p_t^j and p_t^k.

(b) Consider two firms denoted by $\hat{j}$ and $\hat{k}$. We set $\phi_{\hat{j},\hat{k}} > 0$ and $\phi_{\hat{k},\hat{j}} > 0$, thus, the firms' own equity in each other as two-sided cross holdings. The firms' prices are given by: $\widehat{p_t^j}$, $\widehat{p_t^k}$.

Given (a) and (b), $\widehat{p_t^j} = \frac{1}{1-\phi_{\hat{j},\hat{k}} * \phi_{\hat{k},\hat{j}}} p_t^j$.

[24] Where $|I - \phi|^{-1} = \begin{vmatrix} \frac{1}{1-\gamma\varphi} & \frac{\gamma}{1-\gamma\varphi} \\ \frac{\varphi}{1-\gamma\varphi} & \frac{1}{1-\gamma\varphi} \end{vmatrix}$.

Corollary I states that the firm's value depends on the equity investments of its investee. The price of a given firm that has equity investment as two-sided cross holding appear distorted relative to the price of an identical firm that has the same equity investment as one-sided cross holdings. Thus, the corporate equity investments of the investee may alter the price of a given firm, as two-sided ownership structure induces double counting into both firms' valuations. Moreover, the price adjustment depends on the percentage ownership of both the investing firm and its investee.

Figure 3.6.1 provides an illustration of Corollary I, demonstrating the potential effect of cross holdings on the firm’s value. Consider two firms with operating assets worth 100. Assume that these firms exchange shares, thus creating a circular ownership structure. Figure 3.6.1 shows how each firm’s value increases with the percentage of (symmetric) ownership. That is, the more shares the two firms swap, the higher are their individual values, while their underlying economics (operating assets) does not change.

Corollary II:

Given an economy with three similar firms, the following holds:

(a) Consider three firms denoted by j, k and h, where $\phi_{j,h} = 0$, $\phi_{j,k} > 0$; $\phi_{k,h} > 0$, $\phi_{k,j} = 0$ and $\phi_{h,k} = \phi_{h,j} = 0$. Thus, firm j owns a fraction of firm k as one-sided cross holding, firm k owns a fraction of firm h as one-sided cross holding, and firm h does not have any cross holdings. The firms' prices are given by: p_t^j, p_t^k, p_t^h.

(b) Consider three firms denoted by $\hat{j}$, $\hat{k}$ and $\hat{h}$. Set $\phi_{\hat{j},\hat{h}} = 0$, $\phi_{\hat{j},\hat{k}} > 0$ and $\phi_{\hat{k},\hat{h}} > 0$, $\phi_{\hat{k},\hat{j}} = 0$. Thus, firm $\hat{j}$ owns a fraction of firm $\hat{k}$ and firm $\hat{k}$ owns a fraction of firm $\hat{h}$. Firm $\hat{h}$ is an intermediate firm as $\phi_{\hat{h},\hat{j}} > 0$, $\phi_{\hat{h},\hat{k}} = 0$. The ownership structure of firm $\hat{h}$ creates a circular ownership between firm $\hat{j}$ and firm $\hat{k}$. Thus, the ownership structure is such that firms $\hat{j}$ and $\hat{k}$ have indirect two-sided cross holdings. The firms' prices are given by: $\widehat{p_t^j}$, $\widehat{p_t^k}$, $\widehat{p_t^h}$

Given (a) and (b):

$$\widehat{p_t^j} = \frac{1}{1-\phi_{\hat{h},\hat{j}}*\phi_{\hat{j},\hat{k}}*\phi_{\hat{k},\hat{h}}} p_t^j$$

$$\widehat{p_t^k} = \frac{1}{1-\phi_{\hat{h},\hat{j}}*\phi_{\hat{j},\hat{k}}*\phi_{\hat{k},\hat{h}}} p_t^k + \frac{\phi_{\hat{k},\hat{h}}*\phi_{\hat{h},\hat{j}}}{1-\phi_{\hat{h},\hat{j}}*\phi_{\hat{j},\hat{k}}*\phi_{\hat{k},\hat{h}}} * \left(FA_t^{\hat{j}} + OA_t^{\hat{j}} + \sum_{\tau=t+1}^{\infty} E_t \left[\frac{x_\tau^{a,\hat{j}}}{(1+r)^{\tau-t}} \right] \right)$$

We know from Corollary I that two-sided cross holdings alter the firms' prices. Corollary II states that prices also change when the two-sided cross holdings are indirect. Indirect cross holdings arise when firms own shares in each other through an intermediate firm (see Figure 3.6.2). The circular ownership structure modifies the valuations of all firms, causing each firm's price to depend on the performance and investing activities of the two other firms. Their market values may be inflated or deflated depending on initial book values and expected abnormal earnings flows.

Corollary II shows that upon the creation of a circular ownership structure (moving from (a) to (b)), the firms' prices change depending on their location relative to the intermediate firm. Put differently, the price of the firm that is furthest from the intermediate firm in terms of the ownership chain,[25] firm j, is multiplied by the value amplifier, $\frac{1}{1-\phi_{\hat{h},\hat{j}}*\phi_{\hat{j},\hat{k}}*\phi_{\hat{k},\hat{h}}}$.[26] The value of the firm that is closest to the intermediate firm in terms of the ownership chain, firm k, which initially owns a fraction of the intermediate firm as one-sided cross holding, is multiplied by the same value amplifier. However, once the intermediate firm purchases shares in firm j, firm k has indirect ownership in firm j, thus its "revised" market value also incorporates a fraction of firm j's assets and future abnormal earnings.

Overall, cross holding is expected to increase the inter-dependencies of firms and may alter their price volatility. Cross holdings may influence price volatility for two reasons. First, market prices are incorporated into current values, thus, the price of a firm with equity investments contains market expectations about the future stock market performance of its investees. Second, direct or indirect two-sided cross holdings induce a mechanical amplification of the firms' price. This implies that the price of a firm with two-sided cross

[25] The ownership is through the equity investment in firm k.
[26] Note that the value amplifier is bigger than 1.

holding is likely more sensitive to changes in the firm's own performance as well as its investees' performances.

Given that prices are affected by the ownership structure, we next discuss a possible empirical application of Proposition I and Corollaries I and II. An empirical estimation of the price functions would take the following form:[27]

(3.17) $p_t^H = \alpha_1^H * FA_t^H + \alpha_2^H * OA_t^H + \alpha_5^H * x_{t+1}^{a,H}$

(3.18) $p_t^F = \alpha_1^F * FA_t^F + \alpha_2^F * OA_t^F + \alpha_3^F * FA_t^H + \alpha_4^F * OA_t^H + \alpha_5^F * x_{t+1}^{a,F} + \alpha_6^F * x_{t+1}^{a,H}$

(3.19) $p_t^G = \alpha_1^G * FA_t^G + \alpha_2^G * OA_t^G + \alpha_3^G * FA_t^K + \alpha_4^G * OA_t^K + \alpha_5^G * x_\tau^{\alpha,G} + \alpha_6^G * x_\tau^{\alpha,K}$

Where p_t^H, p_t^F and p_t^G represent the price of a firm with no corporate equity investment (Firm H), a firm with one-sided cross holding (Firm F owns shares in Firm H) and a firm with two-sided cross holdings (Firm G owns shares in Firm K and vice versa), respectively. Current prices and current book values are observable, while future expected abnormal earnings could be estimated or inferred from analysts' forecasts (see Penman and Sougiannis 1998, Francis, Olsson, and Oswald 2000).

Regression specification that fails to account for firms' equity ownership may yield biased coefficient estimates. A common practice in empirical-archival accounting research involves specifications similar to Equation (3.17). A regression based on Equation (3.17) has omitted correlated variables when used to study a firm with corporate equity investments, such as Firm F or Firm G. The correct specification should include the book values and the abnormal earnings of the firm's investees. Moreover, when firms are connected through a network of inter-company ownerships, the coefficients are scaled by the ownership structure. Thus, we expect different coefficients on the book values and abnormal earnings of firms with

[27] The empirical estimation assumes linear information dynamics (LID). We further discuss LID in section 3.3 and in Appendices 3.5.5 and 3.5.6.

two-sided cross holdings, with one-sided cross holding, and without corporate equity ownership.

3.2.3 Price and Book Values: The Effect of Cross Holdings on Financial Ratios

Prior literature establishes that in the absence of future abnormal earnings, book values equal market values (FO (1995)). Penman (1992) shows that MB ratios can be expressed as: $\frac{P_t}{B_t} = 1 + \beta * ROE$, where $ROE = \frac{x_t}{B_t}$ denotes return on equity, and the β coefficient captures the relation between the MB ratio and ROE. Penman (1992) explains that excess earnings are isomorphic to book rate of return. This implies that the values of the β-coefficient should appropriately impound earnings (growth) beyond the level implied by book values, into market prices.

In Appendix 3.5.4 we illustrate the effects of cross holdings on MB and ROE ratios. First, we show that MB ratios are distorted away from unity when firms have corporate equity investments. Assuming firms purchase productive assets with positive expected cash flows, the MB ratio appear biased downwards for firms that use the fair value method. This distortion arises since book value incorporates expected capital gains (losses).

Second, we demonstrate that the way earnings from equity investments are reflected in MB and ROE ratios changes with the accounting treatment (fair value method or equity method). Thus, for the predicated relationship between MB ratios and ROE to hold, β must vary with the firm's corporate equity ownership and accounting treatment. Intuitively, since the book value is modified when a firm has equity investments and since the modification depends on the accounting treatment, so is the implied β.

Our findings provide an additional theoretical perspective on Fama and French (1992, 1993, 2015), who view MB ratios as risk factors, capturing firms' underlying risk. Furthermore, Fama and French (1995) demonstrate that common factors in stock returns mirror common factors in earnings. Our analysis shows that corporate equity investments alter earnings and book values, thus articulating an analytical explanation for the observed empirical relation between MB ratios and stock returns. Moreover, as MB ratios are affected by cross holdings, we offer an alternative reason for the observed MB ratios variation across firms that is, in our setting, independent from risk.

Prior empirical literature explores the effects of equity market concentration and cross holdings on market prices and informativeness of accounting information. French and Poterba (1991) investigate the discrepancy of price-earnings ratios between Japan and the US. They argue that some international differences may be attributable to the more prominent inter-corporate equity holdings in Japan relative to the US, causing double counting of equity. Harris, Lang and Mőller (1994) compare Germany and the US and find that the association between price and earnings in Germany is comparable to the US, but that German accounting data exhibit increasing explanatory power in the level of consolidation. Their findings are consistent with Alford et al. (1993) documenting that for non-US firms, unconsolidated earnings are less value relevant than consolidated earnings.

Our accounting-based valuation for firms with corporate equity investments provides explanations consistent with the above empirical findings. We model the double counting that may arise due to cross holdings and provide theoretical foundations to the observed increase in earnings informativeness with the degree of consolidation. Overall, our analysis demonstrates how unconsolidated equity positions may alter the relation between earnings and prices.

3.3 Uncertainty and Linear Information Dynamics

The pricing models in Ohlson (1995) and FO (1995) focus on expected abnormal earnings. Bernard (1995) notes that these models shift attention from analyzing price behavior to forecasting abnormal earnings behavior, and that this approach of estimating fundamental value using prices' information independency is in line with fundamental analysis. Ohlson (1995) assume that current accounting variables are sufficient statistics of future accounting information and use linear information dynamics to derive a relation between the firm's current accounting numbers and its equity market value.

We extend FO (1995) by considering linear information dynamics (LID) for multiple firms and showing that each firm's value can be derived when its augmented LID incorporates information about peer firms. We focus on operating activities and assume that abnormal operating earnings and book values form part of the sufficient statistics representing relevant information (FO 1995). Our model differs from prior literature in two ways. First, we present a LID that incorporates accounting information for multiple firms and allow for inter-firm information transfers. Second, in our setting, we account for cross holdings such that book values include equity investments.

Proposition I demonstrates a relation between the firm's valuation and future accounting figures. As future accounting variables are uncertain, we describe the evolution of these uncertain variables over time using LID assumptions. We assume that accounting variables follow a dynamic process based on prior accounting variables. For tractability, the model follows a linear Markovian structure, as in FO (1995).

We begin by presenting an inter-firm information dynamic model for multiple firms and showing that a unique closed-form solution exists. We next focus on a simplified information model, suppressing inter-firm information transfers and demonstrating that a closed-form solution exists where the presence of two-sided cross holdings biases the valuation compared to the benchmarks of one-sided cross holding and no equity ownership.

3.3.1 Inter-Firm Information Transfers: Multiple Firms

Single-firm accounting-based valuation models commonly assume that the firm's current accounting information form a sufficient statistic of relevant information. Nevertheless, in a multiple firm setting, information from peer firms may form part of the value relevant information set. Hence, we suggest the following linear information dynamics for $i = \{1,2,3 \dots n\}$ firms, $\forall t$. Without loss of generality, we set firm j to be a representative firm.

(3.20a) $\widetilde{ox}_{t+1}^{a,j} = \omega_{11}{}^{j} * ox_t^{a,j} + \omega_{12}{}^{j} * OA_t^j + \omega_{13}{}^{j} * OX_t + \omega_{14}{}^{j} * OA_t + \nu_{1,t}{}^{j} + \tilde{\varepsilon}_{1,t+1}^{j}$

(3.20b) $\widetilde{OA}_{t+1}^{j} = \omega_{22}{}^{j} * OA_t^j + \omega_{24}{}^{j} * OA_t + \nu_{2,t}{}^{j} + \tilde{\varepsilon}_{2,t+1}^{j}$

(3.20c) $\tilde{\nu}_{1,t+1}{}^{j} = \beta_1{}^{j} * \nu_{1,t} + \tilde{\varepsilon}_{3,t+1}^{j}$

(3.20d) $\tilde{\nu}_{2,t+1}{}^{j} = \beta_2{}^{j} * \nu_{2,t} + \tilde{\varepsilon}_{4,t+1}^{j}$

The information system described by the four equations in (3.20) denotes the evolution of four random variables over time. This specification differs from prior literature as we assume firm j's future abnormal operating earnings, operating assets and other information depends on its own current information as well as on all other firms' current information.

Equation (3.20a) states that firm *j*'s abnormal operating earnings at time $t+1$ depends on its abnormal operating earnings and operating assets at time t. The abnormal operating earnings at time $t+1$ also depend on the abnormal operating earnings and operating assets of the other firms, as well as on other information, where $OX_t = \begin{vmatrix} ox_t^{a,1} \\ ox_t^{a,2} \\ \vdots \\ ox_t^{a,n} \end{vmatrix}$ denotes the $[n \times 1]$-vector of all firms' abnormal operating earnings; $OA_t = \begin{vmatrix} OA_t^1 \\ OA_t^2 \\ \vdots \\ OA_t^n \end{vmatrix}$ is the $[n \times 1]$-vector of all firms' operating assets and $\nu_{1,t} = \begin{vmatrix} \nu_{1,t}^1 \\ \nu_{1,t}^2 \\ \vdots \\ \nu_{1,t}^n \end{vmatrix}$ is the $[n \times 1]$-vectors of all firms' other information. Similarly, Equation (3.20b) defines the relation between firm *j*'s operating assets at time $t+1$

and its operating assets at time t, all other firms' operating assets at time t and on other information, where $\nu_{2,t} = \begin{vmatrix} \nu_{2,t}^1 \\ \nu_{2,t}^2 \\ \vdots \\ \nu_{2,t}^n \end{vmatrix}$ is the second $[n \times 1]$-vector of all firms' other information.

Our linear information model includes two random processes denoted by Equations (3.20c)-(3.20d). These random processes represent other information, thus permitting the abnormal operating earnings and stock of operating asset to incorporate additional sources of information about all firms (e.g. industry specific information, market-wide information). Finally, the information system includes random terms: $\{\tilde{\varepsilon}_{1,t+1}^j,\ \tilde{\varepsilon}_{2,t+1}^j,\ \tilde{\varepsilon}_{3,t+1}^j,\ \tilde{\varepsilon}_{4,t+1}^j\}$. These terms represent idiosyncratic shocks and are independent and identically distributed, with mean zero.

We note that ${\omega_{11}}^j$, ${\omega_{12}}^j$, ${\omega_{22}}^j$ are scalars capturing firm *j*'s responsiveness to its own current abnormal operating earnings and operating assets. Moreover, since we allow firm j to incorporate information about its $n-1$ counterpart firms' operating process and other information, ${\omega_{13}}^j$, ${\omega_{14}}^j$, ${\omega_{24}}^j$, ${\beta_1}^j$ and ${\beta_2}^j$ are $[1 \times n]$ vectors capturing the responsiveness of the firm j to these sources of information.[28]

Overall, the above information system permits the earnings and the operating assets of firm j to be influenced by other firms' operating activities and information. The linear information model described by Equations (3.20) is consistent with the notion that firms operating in the same industry or economy are often influenced by each other. We note that even in the absence of cross holdings, each firm's linear information model may incorporate information from other related firms, whether these are competing firms, firms operating within the same industry or the same country. A firm's informational environment includes

[28] The j-th element in ${\omega_{13}}^j$, ${\omega_{14}}^j$ and ${\omega_{24}}^j$ is zero, as firm j already accounts for its own current abnormal operating earnings and operating assets information through coefficients ${\omega_{11}}^j, {\omega_{12}}^j$, and ${\omega_{22}}^j$.

outside information sources in addition to its own operations. Hence, investors may assign weights on other firms' operations even in the absence of corporate equity ownership.

3.3.2 Linear Information Dynamics and Firm Valuation: The Case of Two Firms

For ease of exposition, we consider only two firms, $i = \{j, k\}, \forall\, j \neq k$. We further assume that the firms do not have cross holdings. The following information system denote the linear information dynamics for firm $j \neq k$, $\forall t$:

(3.21a) $\widetilde{ox}_{t+1}^{a,j} = \omega_{11}{}^{j} * ox_t^{a,j} + \omega_{12}{}^{j} * OA_t^j + \omega_{13}{}^{j} * ox_t^{a,k} + \omega_{14}{}^{j} * OA_t^k + \nu_{1,t}^j + \tilde{\varepsilon}_{1,t+1}^j$

(3.21b) $\widetilde{OA}_{t+1}^j = \omega_{22}{}^{j} * OA_t^j + \omega_{24}{}^{j} * OA_t^k + \nu_{2,t}^j + \tilde{\varepsilon}_{2,t+1}^j$

(3.21c) $\tilde{\nu}_{1,t+1}^j = \beta_{11}{}^{j} * \nu_{1,t}^j + \beta_{12}{}^{j} * \nu_{1,t}^k + \tilde{\varepsilon}_{3,t+1}^j$

(3.21d) $\tilde{\nu}_{2,t+1}^j = \beta_{21}{}^{j} * \nu_{2,t}^j + \beta_{22}{}^{j} * \nu_{2,t}^k + \tilde{\varepsilon}_{4,t+1}^j$

Next, we consider the firm's goodwill, that is the difference between the market price of the firm's equity and the firm's book value: $g_t^j = P_t^j - B_t^j, \forall j$. Given Equation (3.16) and Proposition I, it follows that $g_t^j = \sum_{\tau=t+1}^{\infty} E_t\left[\frac{ox_\tau^{a,j}}{(1+r)^{\tau-t}}\right]$.

We assume that abnormal operating assets and operating assets' book value form part of the sufficient statistic representing investor information. We conjecture and find that firm j's goodwill has the following structure:[29]

$g_t^j = \alpha_1^j * ox_t^{a,j} + \alpha_2^j * ox_t^{a,k} + \alpha_3^j * OA_t^j + \alpha_4^j * OA_t^k + \alpha_5^j * \nu_{1,t}^j + \alpha_6^j * \nu_{1,t}^k + \alpha_7^j * \nu_{2,t}^j +$

$\gamma_8^j * \nu_{2,t}^k$

Where:

$$\alpha_1^j = \frac{\omega_{11}{}^{j}\left(R - \omega_{11}{}^{k}\right) + \omega_{13}{}^{j}\omega_{13}{}^{k}}{\delta_1^j}$$

[29] See solution and a generalization to n firms in Appendix 3.5.5.

$$\alpha_2^j = \frac{1}{\delta_1^j}\frac{{\omega_{13}}^j R}{(R - {\omega_{11}}^k)}$$

$$\alpha_3^j = (1 + \alpha_1^j)\frac{(R - {\omega_{22}}^k){\omega_{12}}^j + {\omega_{14}}^j {\omega_{24}}^k}{\delta_2^j} + \alpha_2^j \frac{(R - {\omega_{22}}^k){\omega_{14}}^k + {\omega_{12}}^k {\omega_{24}}^k}{\delta_2^j})$$

$$\alpha_4^j = (1 + \alpha_1^j)\frac{(R - {\omega_{22}}^j){\omega_{14}}^j + {\omega_{12}}^j {\omega_{24}}^j}{\delta_2^j} + \alpha_2^j \frac{(R - {\omega_{22}}^j){\omega_{12}}^k + {\omega_{14}}^k {\omega_{24}}^j}{\delta_2^j}$$

$$\alpha_5^j = (1 + \alpha_1^j)\frac{R - {\beta_{11}}^k}{\delta_3^j} + \alpha_2^j \frac{{\beta_{12}}^k}{\delta_3^j}$$

$$\alpha_6^j = (1 + \alpha_1^j)\frac{{\beta_{12}}^j}{\delta_3^j} + \alpha_2^j \frac{R - {\beta_{11}}^j}{\delta_3^j}$$

$$\alpha_7^j = \alpha_3^j \frac{R - {\beta_{21}}^k}{\delta_4^j} + \alpha_4^j \frac{{\beta_{22}}^k}{\delta_4^j}$$

$$\alpha_8^j = \alpha_3^j \frac{{\beta_{22}}^j}{\delta_4^j} + \alpha_4^j \frac{R - {\beta_{21}}^j}{\delta_4^j}$$

And:

$R = 1 + r$

$\delta_1^j = (R - {\omega_{11}}^j)(R - {\omega_{11}}^k) - {\omega_{13}}^j {\omega_{13}}^k$

$\delta_2^j = (R - {\omega_{22}}^k)(R - {\omega_{22}}^j) - {\omega_{24}}^k {\omega_{24}}^j$

$\delta_3^j = (R - {\beta_{11}}^j)(R - {\beta_{11}}^k) - {\beta_{12}}^j {\beta_{12}}^k$

$\delta_4^j = (R - {\beta_{21}}^j)(R - {\beta_{21}}^k) - {\beta_{22}}^k {\beta_{22}}^j$

Hence, the valuation function can be expressed as:

$p_t^j = B_t^j + \alpha_1^j * ox_t^{a,j} + \alpha_2^j * ox_t^{a,k} + \alpha_3^j * OA_t^j + \alpha_4^j * OA_t^k + \alpha_5^j * \nu_{1,t}^j + \alpha_6^j * \nu_{1,t}^k + \alpha_7^j * \nu_{2,t}^j + \alpha_8^j * \nu_{2,t}^k, \forall i, \forall t.$

Note that solving for the pricing model coefficients is equivalent to solving: $E_t[y(\tilde{x}_{t+1})] = Ay(x_t)$

where

$$y(\tilde{x}_{t+1}) = \begin{vmatrix} \widetilde{ox}_{t+1}^{a,j} \\ \widetilde{ox}_{t+1}^{a,k} \\ \widetilde{OA}_{t+1}^{j} \\ \widetilde{OA}_{t+1}^{k} \\ \tilde{v}_{1,t+1}{}^{j} \\ \tilde{v}_{1,t+1}{}^{k} \\ \tilde{v}_{2,t+1}{}^{j} \\ \tilde{v}_{2,t+1}{}^{k} \end{vmatrix}; \; y(x_t) = \begin{vmatrix} ox_t^{a,j} \\ ox_t^{ak} \\ OA_t^{j} \\ OA_t^{K} \\ v_{1,t}{}^{j} \\ v_{1,t}{}^{k} \\ v_{2,t}{}^{j} \\ v_{2,t}{}^{k} \end{vmatrix};$$

$$A = \begin{vmatrix} \omega_{11}{}^{j} & \omega_{12}{}^{j} & \omega_{13}{}^{j} & \omega_{14}{}^{j} & 1 & 0 & 0 & 0 \\ \omega_{13}{}^{k} & \omega_{14}{}^{k} & \omega_{11}{}^{k} & \omega_{12}{}^{k} & 0 & 1 & 0 & 0 \\ 0 & \omega_{22}{}^{j} & 0 & \omega_{24}{}^{j} & 0 & 0 & 1 & 0 \\ 0 & \omega_{24}{}^{k} & 0 & \omega_{22}{}^{k} & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & \beta_{11}{}^{j} & \beta_{12}{}^{j} & 0 & 0 \\ 0 & 0 & 0 & 0 & \beta_{12}{}^{k} & \beta_{11}{}^{k} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{21}{}^{j} & \beta_{22}{}^{j} \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{22}{}^{k} & \beta_{21}{}^{k} \end{vmatrix};$$

A unique solution exists if: $\det|A| \neq 0$. Thus, we require:[30]

$$\frac{\omega_{11}{}^{j}}{\omega_{13}{}^{j}} \neq \frac{\omega_{13}{}^{k}}{\omega_{11}{}^{k}}; \frac{\omega_{22}{}^{j}}{\omega_{24}{}^{j}} \neq \frac{\omega_{24}{}^{k}}{\omega_{22}{}^{k}}; \frac{\beta_{11}{}^{j}}{\beta_{12}{}^{j}} \neq \frac{\beta_{12}{}^{k}}{\beta_{11}{}^{k}}; \frac{\beta_{21}{}^{j}}{\beta_{22}{}^{j}} \neq \frac{\beta_{22}{}^{k}}{\beta_{21}{}^{k}}$$

The unique solution is defined using the ratio of each firm's responsiveness to its own information and to the other firm's information (i.e. $\frac{\omega_{11}{}^{j}}{\omega_{13}{}^{j}}$). A unique solution exists when the firm's responsiveness ratio differs from the invers responsiveness ratio of the other firm, that is, when the firms react to information differently. If the firms process and respond to information in the same way, with the same relative magnitude, then the information components, the information sources become indistinguishable.

[30] To also ensure decreasing persistent effect of abnormal earnings, sufficient conditions would constrain the evolution of abnormal earnings over time such that as $t \to \infty$, the coefficient on abnormal earnings approaches zero: $-1 < \{\omega_{11}, \omega_{13}\} < 1$. Note that both the weights assigned to the firm's own abnormal earnings and other firms' abnormal earnings are constrained. The firm's abnormal earnings process is influenced by the other firms, which in turn, are also influenced by the firm's abnormal earnings, hence, to limit the circular effect, both ω_{11} and ω_{13} need to be constrained.

We note that for a finite time period $\tau > 0$ and if and only if A [nxn] has n independent eigenvectors, the following holds:$E_t[y(\tilde{x}_{t+\tau})] = A^\tau y(x_t) = V\lambda^\tau V^{-1}$

where λ is the matrix of eigenvalues and V is the eigenvectors matrix.

3.3.3 Linear Information Dynamics and Firm Valuation: Cross Holdings

We consider an economy with only two firms, $i = \{j, k\}, \forall\, j \neq k$, and for ease of exposition, we suppress the inter-firm information transfer. We first consider a simplified case where the firms do not have corporate equity ownership:

(3.22a) $\widetilde{ox}^{a,j}_{t+1} = \omega_{11}{}^j * ox^{a,j}_t + \omega_{12}{}^j * OA^j_t + \nu^j_{1,t} + \tilde{\varepsilon}^j_{1,t+1}$

(3.22b) $\widetilde{OA}^j_{t+1} = \omega_{22}{}^j * OA^j_t + \nu^j_{2,t} + \tilde{\varepsilon}^j_{2,t+1}$

(3.22c) $\tilde{\nu}^j_{1,t+1} = \beta_{11}{}^j * \nu^j_{1,t} + \tilde{\varepsilon}^j_{3,t+1}$

(3.22d) $\tilde{\nu}^j_{2,t+1} = \beta_{21}{}^j * \nu^j_{2,t} + \tilde{\varepsilon}^j_{4,t+1}$

Equations (3.22a)-(3.22d) are identical to FO (1995, page 702), and as in FO (1995), we assume that abnormal operating assets and operating assets' book value form part of the sufficient statistic representing investor information. Thus, we conjecture and find that Firm j's goodwill has the following structure:[31] $g^j_t = \alpha_1{}^j * ox^{a,j}_t + \alpha_3{}^j * OA^j_t + \alpha_5{}^j \nu^j_{1,t} + \alpha_7{}^j \nu^j_{2,t}$

where $\alpha_1 = \frac{\omega_{11}{}^j}{(R-\omega_{11}{}^j)}$; $\alpha_2 = \frac{R*\omega_{12}{}^j}{(R-\omega_{11}{}^j)(R-\omega_{22}{}^j)}$; $\alpha_3 = \frac{R}{(R-\beta_{11}{}^j)(R-\omega_{11}{}^j)}$; and

$\alpha_4 = \frac{R*\omega_{12}}{(R-\beta_{21}{}^j)(R-\omega_{11}{}^j)(R-\omega_{22}{}^j)}$

Hence, the valuation function can be expressed per individual firm as:

$p^j_t = B^j_t + \alpha_1{}^j * ox^{a,j}_t + \alpha_3{}^j * OA^j_t + \alpha_5{}^j \nu^j_{1,t} + \alpha_7{}^j \nu^j_{2,t}, \forall i \in, \forall t.$

This result is identical to FO (1995), where $B^j_t = FA^j_t + OA^j_t$.

[31] See solution in Appendix 3.5.5.

We next outline the extension of FO (1995) to a setting with multiple firms with cross holdings. For simplicity, we assume all firms, $i = \{1, 2, 3 \dots \dots n\}$, are symmetric with the same linear information dynamics, such that we can conjecture and verify prices with the same response coefficients, $(\alpha_1,\ \alpha_2,\ \alpha_3,\ \alpha_4)$ for all firms. As a benchmark, we present the pricing model for multiple firms in the absence of cross holdings:

$$p_t = B_t + \alpha_1 * OX_t + \alpha_2 * OA_t + \alpha_3 * \nu_{1,t} + \alpha_4 * \nu_{2,t}$$

We next allow for cross holdings such that: $B_t^j = FA_t^j + OA_t^j + \phi_j * p_t$ and the pricing model needs to be adjusted. Thus follows Proposition III.

Proposition III

For an economy with multiple firms that have financing activities, operating activities and corporate equity investments, the firms 'pricing function is denoted by:

$$p_t = |I - \phi|^{-1} \left| FA_t + \alpha_1 * OX_t + (1 + \alpha_2) * OA_t + \alpha_3 * \nu_{1,t} + \alpha_4 * \nu_{2,t} \right|$$

Proposition III presents the firms' market values as a function of current accounting information and current other information. Proposition III demonstrates that cross holdings may distort values and that the value distortion occurs when pricing is based on OAR and linear information dynamics. Although we make similar assumption to FO (1995) regarding the linear information model, our result differs as our pricing model is multiplied by the amplification factor, the $[n \times n]$ matrix $|I - \phi|^{-1}$, which modifies the pricing coefficients. Furthermore, the equity ownership itself introduces inter-firm information transfers, as firms' prices incorporate information about their investees.

We note that our pricing model can be extended to express market returns. Return specification has been prevalent in accounting research (see Easton and Harris 1991, Clubb 1996, among others) and our proposed pricing model permits exploring cross-sectional variation in firms' stock returns. In particular, one empirical implication of Proposition III is that the estimated coefficients of a pricing model based on standard linear information dynamics are altered by cross holdings, even when fair value accounting is used.

In Appendix 3.5.6 we further discuss the empirical application of accounting-based valuation in the presence of inter-firm information transfers. We also propose a new approach to cross-sectional studies in settings where firms file their financial statements at different time periods or at different frequencies. Our approach provides a roadmap to valuing firms that face different disclosure requirements. For example, we consider the valuation of public European firms that are not required to file their financial statements as often as public US firms; or private European firms that are not required to file financial statements as often as public firms. Our analysis suggests that different disclosure policies may alter the pricing coefficients, implying that empirical research should consider the role of information disclosure dynamics in firms' valuation by external financial statements users.

3.4 Conclusion

Extending the accounting-based valuation model to allow for corporate equity ownership, we find that the ownership structure distort accounting-based valuation coefficients. The presence of cross holdings alters the accounting-based valuation of firms, which modifies the predicted relation between intrinsic values and firm fundamentals. This distortion arises for both direct and indirect cross holdings.

Moreover, we demonstrate how cross holdings serve as an indirect channel for incorporating information about investees in a linear dynamic information model. We also study inter-firm information transfers for multiple firms and given different reporting schedules.

Overall, we provide an analytical framework to examine different forms of interactions among firms, such as minority interest stakes and information transfers. We present an additional motivation for firms to own corporate equity and have more complex ownership structures.

A critical assumption in our model is that firms clearly disclose information about their investments in other firms' equity. Nevertheless, firms may not fully disclose the details of their corporate equity ownership, such that direct and indirect equity investments may be unknown to outsiders. In the US, all investing firms are required to disclose equity ownership that exceeds the 5 percent threshold of the investee's equity on Form 13D to the US Securities and Exchange Commission. Thus, some corporate equity ownerships are not publicly disclosed, especially when an investment is accounted for using the fair value method. Nevertheless, given our findings, knowing the details of each of these equity investments can be crucial for correctly assessing firm values. In summary, our model presumes that investors have accounting information concerning all firms' equity investments, but we acknowledge that this assumption requires that investors can observe and process ownership information for multiple firms.

Future analytical research could use our approach to formally develop models of the returns-earnings relation in the presence of intra-industry information transfers (IIIT). Specifically, one could envision that other non-accounting information sources, at the two extremes, are either firm-specific or common within an industry. In the latter case, common non-accounting information sources might serve a role conceptually somewhat similar to cross holdings. Empirical-archival research into IIIT might benefit from a more rigorous analytical foundation to articulate when other information is predicted to be substitutes or complements to accounting information.

The presence of corporate equity ownership has other implications that future empirical-archival accounting research might address. First, corporate equity ownership may affect the perception of dividends payments. When a firm reports dividends per share or dividend payout ratios (dividends in percentage of earnings), some of these dividends flow back to the firm through its investees. Second, corporate equity ownership may affect perceived liquidity as common liquidity ratios in prior literature do not correct for cross holdings. Third, while accounting-based valuation models consider an all equity firm, most firms do have debt. A leveraged investee firm can be at risk of liquidation. In the presence of corporate equity ownership, however, the investing firm faces incentives to prop up a financially distressed investee that is close to liquidation. This, in turn, might affect optimal corporate governance and executive compensation. Finally, equity investments may raise corporate governance challenges associated with rent extraction through tunneling. In conclusion, we note that the strength of the accounting-based valuation model is its generality, while at the same time this means that these models do not directly incorporate any of the above-mentioned avenues for future research.

3.5 Appendices

APPENDIX 3.5.1

Variable Definitions

n	Number of firms in the economy
i	Firm indicator
t	Time indicator
r	Risk-free interest rate
p_t^j	Ex-dividend market price of firm j at date t
p_t	$[n \times 1]$ vector of the n firms' prices at date t
$\phi_{j,k}$	Firm j's percentage ownership in firm k
ϕ_j	$[n \times 1]$ ownership structure vector of firm j
ϕ	$[n \times n]$ matrix of equity ownership percentage (i.e. the ownership structure)
B_t^j	Firm j's book value of equity at date t
B_t	$[n \times 1]$ vector of the n firms' book values at date t
FA_t^j	Firm j's total financial assets net of financial obligations at date t
FA_t	$[n \times 1]$-vectors of the n firms' stock of financial assets at date t
OA_t^j	Firm j's total operating assets net of operating liabilities at date t
OA_t	$[n \times 1]$-vectors of the n firms' stock of operating assets at date t
x_t^j	Firm j's earnings at date t
$x_t^{a,j}$	Firm j's abnormal earnings at date t
X_{t+1}^a	$[n \times 1]$-vector of the n firms' discounted abnormal earnings from $t+1$ to ∞
i_t^j	Firm j's interest revenue from financing activities net of interest expenses at date t
ox_t^j	Firm j's operating earnings at date t
$ox_t^{a,j}$	Firm j's abnormal operating earnings at date t
OX_{t+1}^a	$[n \times 1]$-vector of the n firms' discounted abnormal operating earnings from $t+1$ to ∞
d_t^j	Dividends paid by firm j at date t
D_{t+1}	$[n \times 1]$-vector of the n firms' discounted dividends paid by all firms from $t+1$ to ∞
$\mathrm{V_t^j}$	Firm j's market value at date t
V_t	$[n \times 1]$-vector of the firms' market values at date t
I	$[n \times n]$ identity matrix

LA_t^j	Firm j's liquid assets invested in risk-free bonds at date t
c_t^j	Firm j's cash flow realized from operating activities net of investment in those activities at date t
C_{t+1}	$[n \times 1]$-vector of the n firms' discounted cash flows from operating activities from $t+1$ to ∞
g_t^j	Firm j's goodwill at date t
g_t	$[n \times 1]$-vector of the n firms' goodwill at time t
$\nu_{1,t}^j, \nu_{2,t}^j$	Firm j's other information at date t
$\nu_{1,t}, \nu_{2,t}$	$[n \times 1]$-vectors of the n firms' other information at date t
$\tilde{\varepsilon}_{t+1}^j$	Idiosyncratic shocks to Firm j's information model. These random shocks are independent and identically distributed, with mean zero.

APPENDIX 3.5.2

Illustration of Two Firms with Cross Holdings Using the Fair Value Method

Under the fair value method, the initial investment is an asset on the investing firm's balance sheet. When the investee's price appreciates (depreciates) the firm's assets account increases against an unrealized holding gain (loss) in the equity account. When the investee pays dividends, the investing firm records an increase in cash and revenues. Any profit or loss generated by the investee is unrecorded by the investing firm.

In this appendix, we rely heavily on Lundholm's (1995) example of the FO (1995) model to demonstrate how corporate equity investments may alter book values and earnings when the investment is accountant for using the fair value method. Lundholm (1995) illustrates a firm's payouts from productive assets and financial assets. As in Lundholm (1995), we first consider a single firm, firm H, operating over 3 periods.

Firm H begins at time $t = 0$ with a capital contribution of 100. The firm immediately uses its entire capital to purchase productive assets that earn risk-free interest (r), on the assets and an uncertain amount at $t = 2$, $(\tilde{z})$. The firm liquidates some of its assets at the interim date, $t = 1$, to pay an interim dividend (d). In addition, the firm pays a liquidating dividend at $t = 2$.[32] These amounts are summarized in Panel A of Table 3.7.1, which presents book values (B_t^H), earnings (x_t^H) and dividends (d_t^H) for each date $(t = 0, 1, 2)$ for firm H. This Panel is identical to a single firm case in Lundholm (1995, page 754).

Illustration: Two firms with cross holdings

Building on Lundholm's (1995) single firm example, we now consider an economy with two firms, firm H and firm F. Both firms have three sources of income from productive assets, financial assets, and investment assets.

[32] It is common to report dividends net of capital contribution and to represent prices immediately following any dividend payments at each date.

We assume the firms' equity trade in an efficient capital market. Both firms begin at $t = 0$ with a 100 capital contribution. As in the previous example, firm H uses its entire capital of 100 to purchase a productive asset that yields risk-free interest (r) on their book value, as well as an uncertain amount at time $t = 2$ $(\tilde{z})$. Firm F allocates its capital between purchasing a similar productive asset and purchasing 20% of Firm H, whose initial market price is given by $p^H = 100$. Hence, firm F invests 80 into a productive asset and 20 into firm H's equity. We assume that the initial purchase of Firm H's equity affects neither firm's equity values.[33] Both firms liquidate some of their assets at $t = 1$ to pay an interim dividend (d), as well as a liquidating dividend at $t = 2$. Any dividends received earn risk-free interest of (r).

Firm H's book values, earnings and dividends remain as previously presented in Table 3.7.1 Panel A. We assume that firm F has no influence over firm H's operations or activities. Hence, firm F accounts for its equity holdings using the fair value method, where firm F's assets are comprised of its productive asset, the market price of firm H's equity and the dividends paid by firm H. Firm F's earnings incorporate the dividends paid out by Firm H as well as changes in Firm H's market price. Table 3.7.1 Panel B presents the book values, earnings, and dividends for Firm F.

The market prices can be derived by discounting future dividends. In Table 3.7.1 Panel C we present the book values, earnings, and dividends for firm F, given firm H's market prices (see market prices below). It appears that firm F's book values and liquidating dividends are higher (lower) than firm H's, when the expectations and the realizations of $\tilde{z}$ are positive (negative). Nevertheless, the level of income generated by the productive asset might depend on the initial investment level such that $z^H > z^F$. Moreover, reported earnings differ between the companies since firm F's earnings incorporate expected future capital gains. Particularly, $x_1^F > x_1^H$ when expectations about $\tilde{z}$ increases over time. The patterns illustrated in Table 3.7.1

[33] Note that firm H does not issue new equity. Moreover, Firm H is unaffected by the identity of its equity holders. Similarly, firm F dose not issue new equity in order to finance the purchase of firm H's equity.

are consistent with the Modigliani-Miller irrelevance of dividend policy. As discussed in Lundholm (1995), a dollar increase in the current dividend policy decreases the current price by exactly one dollar, i.e., $\left(\frac{\partial p_t}{\partial d_t} = -1\right)$, and the future expected earnings decrease by an amount equal to the interest that would have been earned on that dollar, i.e., $\left(\frac{\partial E_t[X_{t+1}]}{\partial d_t} = -r\right)$. See also Clubb (2013) for further discussion on dividend displacement.

Next, we consider the case of two-sided cross holdings. Consider two identical firms denoted by F and G. Both firms begin at $t = 0$ with a capital contribution of 100 and use 80% of their initial capital to purchase productive assets. As before, these productive assets earn risk-free interest (r) on their book value and an uncertain amount at $t = 2$ ($\tilde{z}$). With the remaining capital, each firm purchases 20% of the other firm, where the initial price is $p = 100$. Both firms use the *fair value method* to account for their equity investments. Both firms liquidate some of their assets at $t = 1$ to pay an interim dividend (d) and pay a liquidating dividend at $t = 2$. These amounts are summarized in Table 3.7.1 Panel D for firm G (representative firm).

The liquidating dividend paid by firm G at $t = 2$, encompasses the return on the productive assets owned by firm G as well as the capital gains made on its equity investment in the other firm (firm F). In this case, capital gains are the sum of 20.83% of firm f's income from productive assets (z^F) and an additional 4.16% of firm G's income from its own productive assets (z^G). Essentially, it appears as if firm G invests more than 80% of its initial capital in productive assets, since it holds an equity investment which includes an indirect ownership stake in its own productive assets. Ceteris paribus, when the realization of $\tilde{z}$ is positive (negative), the liquidating dividend of a firm with two-sided cross holdings is higher (lower) than the liquidating dividend of a firm with one-sided cross holding, solely due to the accounting treatment of the circular ownership structure.

Market Prices

To calculate the market prices at the end of each period, we apply discounted dividend valuation. These prices only differ at the intermediate date t=1.

Firm H – No equity ownership

$$p_0^H = 100 + E_0\left[\frac{z^H}{(1+r)^2}\right] = 100$$
$$p_1^H = (1+r) * 100 - d_1^H + E_1[\frac{z^H}{1+r}]$$
$$p_2^H = 0$$

Firm F – One-sided equity ownership

$$p_0^F = 100 + E_0\left[\frac{z^F + 20\% * z^H}{(1+r)^2}\right] = 100$$
$$p_1^F = (1+r) * 100 - d_1^F + E_1\left[\frac{z^F + 20\% * z^H}{1+r}\right]$$
$$p_2^F = 0$$

Firm G – Two-sided equity ownership

$$p_0^G = 100 + E_0\left[\frac{z^G + 20\% * z^F}{(1-20\%) * (1+20\%) * (1+r)^2}\right] = 100$$
$$p_1^G = (1+r) * 100 - d_1^G + E_1\left[\frac{z^G + 20\% * z^F}{(1-20\%) * (1+20\%) * (1+r)}\right]$$
$$p_2^G = 0$$

APPENDIX 3.5.3

Illustration of Two Firms with Cross Holdings Using the Equity Method

Under the equity method the initial investment is an asset on the investing firm's balance sheet. When the investee's market price appreciates (depreciates), the firm's assets account is unaffected. When the investee pays dividends, the investing firm records an increase in cash against a reduction in the value of the investment. Any profit (loss) generated by the investee is recorded as an increase (decrease) in the firm's assets account and revenues from investment.

The distinction between the fair value method and the equity method is as follows. If the investing firm has substantial control over the investee, meaning, it influences the operational and financial decisions of the investee, the equity method is the applicable treatment. Nevertheless, if the investing firm states that it lacks significant influence over an investee, then the fair value method can be used.

We build on Lundholm (1995) to illustrate the book values, earnings and dividends of firms that account for their corporate equity investments using the equity method. Similar to Appendix 3.5.2, we consider an economy with two firms, firm H and firm F. We assume that both firms are traded in an efficient capital market, and that each firm can engage in operating activities, financing activities and corporate equity ownership.

The firms begin at $t = 0$ with a 100 capital contribution. Firm H uses its entire capital of 100 to purchase productive assets that pay the risk-free interest rate (r) on their book value and an uncertain amount at time $t = 2$ ($\tilde{z}$). Firm F allocates its capital between purchasing a similar productive asset and purchasing 20% of firm H whose initial market price is given by $p^H = 100$. Hence, firm F invests 80 into a productive asset, and 20 into firm H's equity. As in Appendix 3.5.2, we assume that the initial purchase of firm H's equity does not affect firm H's nor firm F's value. Both firms liquidate some of their assets at $t = 1$ to pay a n interim dividend (d) and pay a liquidating dividend at $t = 2$.

Assume firm F has control over firm H such that firm F accounts for its equity holdings using the equity method. Firm F's assets are comprised of its productive assets and the historical cost of firm H's equity. Note that the dividends paid by firm H do not affect firm F's assets. The firms' book values, earnings and dividends, are summarized in Table 3.7.2 below.

Panel A of Table 3.7.2 repeats Lundholm's (1995, page 547) example to facilitate comparison with firm H, the benchmark case of no equity investments. Panel B of Table 3.7.2 presents the book values, earnings and dividends of firm F. Firm F's earnings incorporate the dividends paid by firm H and a portion of firm H's earnings. However, under the equity *method*, the net effect of receiving dividends from an investee on earnings is zero (recall that for public limited liability firms, dividends are paid out of retained earnings account). The book values, earnings and dividends of the firms are similar at $t = 0, 1$. Nonetheless, we note that the firms may pay different dividends, which in turn may affect their earnings in the subsequent period. At $t = 2$, firm F's liquidating earnings and dividends differ from those of firm H, as it includes 20% of firm H's income from the productive asset.

Next, we consider the case of two-sided cross holdings between two identical firms, firm F and firm G. Both firms begin at $t = 0$ with a 100 capital contribution and use 80% of their initial capital to purchase productive assets that earn a risk-free interest (r) on their book value and an uncertain amount at $t = 2$ ($\tilde{z}$). With the remaining capital, each firm purchases 20% of the other firm, where $p = 100$. Both firms declare to have influence over the activities of their investee, thus they use the equity *method* to account for their investments. Both firms liquidate some of their assets at $t = 1$ to pay a dividend (d) and pay a liquidating dividend at $t = 2$. These amounts are summarized in Panel C of Table 3.7.2 for the representative firm (firm G).

The liquidating dividend paid by firm G encompasses the return on the productive assets owned by firm G, as well as the earnings generated by the equity investment in firm F.

These earnings are the sum of 20.83% of the investee's income from productive assets (z^F) and an additional 4.16% of firm G's income from productive assets (z^G). Essentially, it appears as if firm G invests more than 80% of its initial capital in productive assets since it invests in a financial asset which includes ownership stake in its own productive assets. Ceteris paribus, firm G's liquidating dividend is higher (lower) than Firm F's liquidating dividend when the realization of $\tilde{z}$ is positive (negative), solely due to the accounting treatment of the two-sided cross holdings.

APPENDIX 3.5.4

Market-to-Book and Return-on-Equity Ratios

Penman (1992) showed that market-to-book ratios (MB) can be expressed as: $\frac{P_t}{B_t} = 1 + \beta * ROE$, where $ROE = \frac{x_t}{B_t}$ denotes the return on equity, and the coefficient β denotes the relation between the MB ratio and the ROE.

Using Lundholm's (1995) example of the FO (1995) model,[34] we illustrate the MB and ROE ratios for firms with different equity investments: firm H (no investments), firm F (one-sided cross holding) and firm G (two-sided cross holdings) over two periods: $t = 0, 1$. Note that MB ratios for the terminal date $t = 2$, is undefined (both numerator and denominator are zero).

To compare the fair *value method* and the *equity method*, we assume that the interim dividends are the same across accounting treatments. This assumption allows studying how book values and earnings differ between the two accounting methods for any dividend policy, d_1.

Table 3.7.3 present the MB ratios for the three firms and across the two accounting methods. Table 3.7.3 demonstrates how the accounting treatment may alter the MB ratios. We note that the ownership structure does not affect MB ratios in the special case where firms purchase productive assets that are expected to generate zero future cash flows, i.e., ($E[\tilde{z}] = 0$). We focus our discussion on firms with operating assets that generate non-zero expected cash flows.

Comparing the MB ratios for the different accounting methods, we observe that the MB ratios of a firm with corporate equity investments (firm F or firm G) accounted for using

[34] A summary of the effect of using the fair value method on book values, earnings, and dividends, is given in Table 3.7.1 in Appendix 3.5.2. In Appendix 3.5.3 we return to Lundholm's (1995) example of the FO (1995) model to illustrate the effect of using the equity method on book values, earnings, and dividends. A summary of the example is given in Table 3.7.2 in Appendix 3.5.3.

the fair value method, has a higher (lower) denominator, as its book values incorporate expected capital gains (losses). Nevertheless, a firm that applies the equity method may have higher (lower) numerators as prices incorporate the expected income (loss) of its investees' operating assets. Hence, the numerator may be higher for firms that use the equity method relative to firms that use the fair value method. Assuming that on average firms purchase productive assets that are expected to generate positive cash flows ($E[\tilde{z}] > 0$), it appears that MB ratios of firms that use the fair value method are biased downwards, while the BM ratios of firms that use the equity method are biased upwards.

Table 3.7.4 illustrates how the accounting treatment may alter the firm's ROE. In the first period, when all firms earn only the risk-free rate on their operating assets, the expected ROE is equal across firms and accounting treatments. In the second period, the expected ROE incorporates returns on operating assets as well as expected income from corporate equity ownership. Thus, the expected ROE of firms with equity investments (firm F or firm G) changes with the accounting method. Moreover, we observe that if $E[\tilde{z}]$ is the same for all firm and is proportional to the initial level of investment in operating assets, the ROE under the equity method is unaffected by equity investments and is constant across firms.

Nonetheless, the ROE of a firm with corporate equity investments accounted for using the fair value method, has a higher (lower) denominator, as its book values incorporate expected capital gains (losses). Assuming that on average firms purchase productive assets that are expected to generate positive cash flows ($E[\tilde{z}] > 0$), it appears that the ROE of firms that use the fair value method are biased downwards, while the ROE of firms that use the equity method are unaffected by the corporate equity ownership.

Penman (1992) explains that excess earnings are isomorphic to book rate of return. This implies that the values of β-coefficients should appropriately impound earnings (growth) beyond the level implied by the book values, into the market price. However, Tables 3.3 and 3.4 show that the manner by which earnings from equity investments are captured by the MB ratio and ROE, varies with the accounting method. Thus, for the relationship between MB ratios and ROE to hold, β must change with the firm's corporate equity investments and accounting treatments.

We note that for the equity method, the implied β should be constant across ownership structures. Under the equity method, the book value is unaffected by the equity investments and profit (loss) from investees are recorded only when realized at $t = 2$. Thus, ROE and the implied β are the same for firms with and without corporate equity investments. However, under the fair value method, book value increases (decreases) with the expected profit (loss) of the investees' operating activities. Thus, as the expected profit (loss) from the operating activities of the investees' increases, the implied β decreases (increases). Thus, although the underlying economic activity is unchanged by the equity investments, the MB ratios, ROEs and implied βs are altered by the presence of corporate equity investments. As such, the relation between MB ratios and ROE may not be isomorphic.

Theorem A-I:

Under the equity method, when considering the relation between MB ratios and ROE, the implied coefficient on ROE, β, is constant across ownership structures.

Theorem A-II:

Under the fair value method, when considering the relation between MB ratios and ROE, the implied coefficient on ROE, β, is distorted for firms that own corporate equity. Given $E[\tilde{z}] > 0$, for firms that own corporate equity, β is lower than for firms that do not have corporate equity.

Theorem A-III:

Given $E[\tilde{z}] > 0$, for firms that own corporate equity, the implied β is higher for firms that use the equity method than for firms that use the fair value method: $\beta_{EM} > \beta_{FVM}$.

APPENDIX 3.5.5

Linear Information Dynamics

From Proposition I we know:

$$p_t = |I - \phi|^{-1}|FA_t + OA_t| + |I - \phi|^{-1}OX^a_{t+1}$$

Following FO (1995) we develop a model in which future abnormal operating earnings depends on current accounting and non-accounting information. We begin by defining goodwill as: $g_t = p_t - B_t$, where $g_t = \begin{vmatrix} g_t^1 \\ g_t^2 \\ \vdots \\ g_t^n \end{vmatrix}$ is the $[n \times 1]$-vector of all firms' goodwill at time t.

Hence, for any firm $i = \{1,2,3 \dots n\}$, goodwill can be expressed as:

$$g_t^j = \sum_{\tau=t+1}^{T\to\infty} E_t\left[\frac{ox_\tau^{a,j}}{(1+r)^{\tau-t}}\right]$$

$$g_{t+1}^j = \sum_{\tau=t+2}^{T\to\infty} E_{t+1}\left[\frac{ox_\tau^{a,j}}{(1+r)^{\tau-t-1}}\right]$$

Note that under the fair value method goodwill is unaffected by the initial equity investment.

Next, we multiply goodwill by $R = (1+r)$: $R * g_t^j = (1+r)\sum_{\tau=t+1}^{T\to\infty}\frac{ox_\tau^{a,j}}{(1+r)^{\tau-t}}$, and rearrange:

(3.23) $R * g_t^j = E_t[ox_{t+1}^{a,j}] + E_t[g_{t+1}^j]$

To keep the model tractable, the model follows a linear Markovian structure. We start with FO (1995) and assume the following linear information model (identical to Equations (3.22)) $\forall i,\ \forall t$:

(3.22a) $\widetilde{ox}_{t+1}^{a,j} = \omega_{11}{}^j * ox_t^{a,j} + \omega_{12}{}^j * OA_t^j + \nu_{1,t}^j + \tilde{\varepsilon}_{1,t+1}^j$

(3.22b) $\widetilde{OA}_{t+1}^j = \omega_{22}{}^j * OA_t^j + \nu_{2,t}^j + \tilde{\varepsilon}_{2,t+1}^j$

(3.22c) $\tilde{v}_{1,t+1}^{j} = \beta_{11}{}^{j} * v_{1,t}^{j} + \tilde{\varepsilon}_{3,t+1}^{j}$

(3.22d) $\tilde{v}_{2,t+1}^{j} = \beta_{21}{}^{j} * v_{2,t}^{j} + \tilde{\varepsilon}_{4,t+1}^{j}$

We conjecture a linear price model: $g_t^j = \alpha_1{}^j * ox_t^{a,j} + \alpha_3{}^j * OA_t^j + \alpha_5{}^j * v_{1,t}^j + \alpha_7{}^j * v_{2,t}^j$

Substituting into Equation (3.23):

$R\alpha_1{}^j * ox_t^{a,j} + R\alpha_3{}^j * OA_t^j + R\alpha_5{}^j * v_{1,t}^j + R\alpha_7{}^j * v_{2,t}^j = (1 + \alpha_1{}^j)\omega_{11}{}^j * ox_t^{a,j} +$

$(\omega_{12}{}^j + \alpha_1{}^j\omega_{12}{}^j + \alpha_3{}^j\omega_{22}{}^j) * OA_t^j + (1 + \alpha_1{}^j + \alpha_5{}^j\beta_{11}{}^j) * v_{1,t}^j + (\alpha_3{}^j + \alpha_7{}^j\beta_{21}{}^j) *$

$v_{2,t}^j$

Isolating the coefficient and rearranging, we get:

$$\alpha_1{}^j = \frac{\omega_{11}{}^j}{(R - \omega_{11}{}^j)}$$

$$\alpha_3{}^j = \frac{R\omega_{12}{}^j}{(R - \omega_{11}{}^j)(R - \omega_{22}{}^j)}$$

$$\alpha_5{}^j = \frac{R}{(R - \beta_{11}{}^j)(R - \omega_{11}{}^j)}$$

$$\alpha_7{}^j = \frac{R\omega_{12}{}^j}{(R - \beta_{21}{}^j)(R - \omega_{11}{}^j)(R - \omega_{22}{}^j)}$$

Next, given Proposition I, we can write the conjectured price for all firms as:

$$p_t = [I - \phi]^{-1}\{FA_t + OA_t\} + [I - \phi]^{-1}g_t$$

Rearranging we get:

$$p_t = |I - \phi|^{-1}\left|FA_t + \alpha_1 * OX_t + |I + \alpha_3| * OA_t + \alpha_5 * v_{1,t} + \alpha_7 * v_{2,t}\right|$$

Where $v_{1,t}$ and $v_{2,t}$ are the

If we assume constant pricing coefficients across firms, that is $\alpha_1{}^j$, $\alpha_3{}^j$, $\alpha_5{}^j$, $\alpha_7{}^j$ are the same for all firms, then $\alpha_1 = \alpha_1{}^j * I$, $\alpha_3 = \alpha_3{}^j * I$, $\alpha_5 = \alpha_5{}^j * I$ and $\alpha_7 = \alpha_7{}^j * I$, where $\alpha_1{}^j$, $\alpha_3{}^j$, $\alpha_5{}^j$, $\alpha_7{}^j$ are scalars. Nonetheless, given the linear information model specified in Equations (3.22), the pricing coefficients could vary among firms which implies $\alpha_1,\ \alpha_3, \alpha_5$ and α_7 are $[n \times n]$ diagonal matrices, where each diagonal denotes the individual firms' pricing coefficients.

Solving for the assumed information dynamic presented in Equations (3.22), we get a closed form solution, identical to FO (1995). For unique solution to exists, the following condition should hold: ${\omega_{11}}^i {\omega_{13}}^i \neq 0$, $\forall i$. We remind the reader that for convergence of the linear information system, the following condition should hold:

(i) $-1 < {\beta_{11}}^i < 1, -1 < {\beta_{21}}^i < 1,\ \forall i$

(ii) $0 \leq {\omega_{11}}^i < 1, \forall i$

Furthermore, the following conditions are necessary to restrict long-run growth or decay of the operating assets (condition (iii)) and to rule out aggressive accounting (condition (iv)):

(iii) $1 \leq {\omega_{22}}^i < R, \forall i$

(iv) $0 \leq {\omega_{12}}^i, \forall i$

These assumptions and the solution characteristics are discussed in FO (1995), pages 703–704 and pages 722–723.

General Linear Information Dynamic

Consider now the more general linear information dynamics allowing for inter-firm information transfers (identical to Equations (3.20)), $\forall i,\ \forall t$:

(3.20a) $\widetilde{ox}_{t+1}^{a,j} = {\omega_{11}}^j * ox_t^{a,j} + {\omega_{12}}^j * OA_t^j + {\omega_{13}}^j * OX_t + {\omega_{14}}^j * OA_t + {\nu_{1,t}}^j + \tilde{\varepsilon}_{1,t+1}^j$

(3.20b) $\widetilde{OA}_{t+1}^j = {\omega_{22}}^j * OA_t^j + {\omega_{24}}^j * OA_t + {\nu_{2,t}}^j + \tilde{\varepsilon}_{2,t+1}^j$

(3.20c) ${\tilde{\nu}_{1,t+1}}^j = {\beta_1}^j * \nu_{1,t} + \tilde{\varepsilon}_{3,t+1}^j$

(3.20d) ${\tilde{\nu}_{2,t+1}}^j = {\beta_2}^j * \nu_{2,t} + \tilde{\varepsilon}_{4,t+1}^j$

where ${\omega_{11}}^j, {\omega_{12}}^j,\ {\omega_{22}}^j$ are scalars capturing firm *j*'s responsiveness to its own current abnormal operating earnings and operating assets. We allow firm j to incorporate information about the operating process of other firms, as well as its counterpart firms' other information. Thus, ${\omega_{13}}^j$, ${\omega_{14}}^j$, ${\omega_{24}}^j$, ${\beta_1}^j$ and ${\beta_2}^j$ are the $[1 \times n]$ vectors capturing theresponsiveness of the firm to these sources of information. Note that for ${\omega_{13}}^j$, ${\omega_{14}}^j$, ${\omega_{24}}^j$, the j-th element in each vector is zero, as the firm already accounts for its own current abnormal operating earnings and operating assets information by assigning the weights ${\omega_{11}}^j, {\omega_{12}}^j, {\omega_{22}}^j$.

Next, consider the general linear information dynamics for the entire economy:

$$\widetilde{OX}_{t+1} = \Omega_{11} * OX_t + \Omega_{12} * OA_t + \Omega_{13} * OX_t + \Omega_{14} * OA_t + \nu_{1,t} + \varepsilon_{1,t+1}$$

$$\widetilde{OA}_{t+1} = \Omega_{22} * OA_t + \Omega_{24} * OA_t + \nu_{2,t} + \varepsilon_{2,t+1}$$

$$\tilde{\nu}_{1,t+1} = \mathrm{B}_1 * \nu_{1,t} + \varepsilon_{3,t+1}$$

$$\tilde{\nu}_{2,t+1} = \mathrm{B}_2 * \nu_{2,t} + \varepsilon_{4,t+1}$$

Where $\Omega_{11} = |{\omega_{11}}^1\ {\omega_{11}}^2 \ldots {\omega_{11}}^n|$ is a $[n \times n]$-diagonal matrix of the firms' response coefficient to their current abnormal earnings in the abnormal earnings process. Similarly, $\Omega_{12} = |{\omega_{12}}^1\ {\omega_{12}}^2 \ldots {\omega_{12}}^n|$ and $\Omega_{22} = |{\omega_{22}}^1\ {\omega_{22}}^2 \ldots {\omega_{22}}^n|$ are the diagonal matrices of the firms' response coefficient to their current operating assets in the abnormal operating earnings process and the operating assets process, respectively.

In this general case we assume the firm's linear information dynamics regarding its operating activities incorporates information about other firms' operating abnormal earnings and operating assets. Accordingly, we define $\Omega_{13} = |{\omega_{13}}^1\ {\omega_{13}}^2 \ldots {\omega_{13}}^n|$ as the $[n \times n]$ matrix of response coefficients of each firm to its counterpart firms' current abnormal operating earnings. Note that for each firm, the response coefficient for its own current abnormal operating earnings is given by Ω_{11}, hence, the elements on the diagonal of Ω_{13} equal zero. We also define $\Omega_{14} = |{\omega_{14}}^1\ {\omega_{14}}^2 \ldots {\omega_{14}}^n|$ and $\Omega_{24} = |{\omega_{24}}^1\ {\omega_{24}}^2 \ldots {\omega_{24}}^n|$ as the matrices of the firms' response coefficients to other firms' current operating assets in the abnormal operating earnings process and in the operating assets process, respectively. The elements on the diagonal of Ω_{14} and Ω_{24} equal zero,

We also assume the firms' other information incorporates the remaining $\mathrm{n}-1$ firms' other information. Hence, we define $\mathrm{B}_1 = \left|\beta_1{}^1 \ \ \beta_1{}^2 \dots \beta_1{}^n\right|$ and $\mathrm{B}_2 = \left|\beta_2{}^1 \ \ \beta_2{}^2 \dots \beta_1{}^n\right|$ as the $[n \times n]$ matrices of response coefficients of each firm to its own and to all firms' other information. Lastly, $\varepsilon_{l,t+1}, l = 1,\ 2,\ 3,\ 4$ denotes the $[n \times 1]$ vector of idiosyncratic shocks at time $t+1$, i.i.d with mean zero.

We conjecture the following linear price model:

$$g_t = \mathrm{A}_1 * OX_t + \mathrm{A}_2 * OX_t + \mathrm{A}_3 * OA_t + \mathrm{A}_4 * OA_t + \mathrm{A}_5 * \nu_{1,t} + \mathrm{A}_6 * \nu_{2,t}$$

Where $\mathrm{A}_1 = |\alpha_1{}^1\, \alpha_1{}^2\ \dots \alpha_1{}^n|$ and $\mathrm{A}_3 = |\alpha_3{}^1\, \alpha_3{}^2\ \dots \alpha_3{}^n|$ are $[n \times n]$ diagonal matrices of the firms' pricing coefficient for their own current abnormal earnings and current operating assets, respectively. $\mathrm{A}_2 = |\alpha_2{}^1\, \alpha_2{}^2\ \dots \alpha_2{}^n|$ and $\mathrm{A}_4 = |\alpha_4{}^1\, \alpha_4{}^2\ \dots \alpha_4{}^n|$, are $[n \times n]$ matrices of the pricing coefficients for all firms' current abnormal operating earnings and current assets, respectively. Note that each firm's pricing coefficients for its own current abnormal operating earnings operating assets are given by A_1 and A_3, hence, the elements on the diagonals of both A_2 and A_4 matrices equal zero. Finally, $\mathrm{A}_5 = |\alpha_5{}^1\, \alpha_5{}^2\ \dots \alpha_5{}^n|$ and $\mathrm{A}_6 = |\alpha_6{}^1\, \alpha_6{}^2\ \dots \alpha_6{}^n|$ denotes the $[n \times n]$ matrices of the pricing coefficients assigned to other information.

Substituting into Equation (3.23):

$$R * \mathrm{A}_1 * OX_t + R * \mathrm{A}_2 * OX_t + R * \mathrm{A}_3 * OA_t + R * \mathrm{A}_4 * OA_t + R * \mathrm{A}_5 * \nu_{1,t} + R * \mathrm{A}_6 * \nu_{2,t} = |I + \mathrm{A}_1|\Omega_{11} * OX_t + \left||I + \mathrm{A}_1|\Omega_{12} + \mathrm{A}_3 * \Omega_{22}\right| * OA_t + ||I + \mathrm{A}_1|\Omega_{13} + \mathrm{A}_2 * \Omega_{11} + \mathrm{A}_2\Omega_{13}| * OX_t + \left||I + \mathrm{A}_1|\Omega_{14} + \mathrm{A}_3 * \Omega_{24} + \mathrm{A}_2\Omega_{12} + \mathrm{A}_2\Omega_{14} + \mathrm{A}_4 * \Omega_{22} + \mathrm{A}_4 * \Omega_{24}\right| * OA_t + |I + \mathrm{A}_1 + \mathrm{A}_2 + \mathrm{A}_5\mathrm{B}_1|\nu_{1,t} + |\mathrm{A}_3 + \mathrm{A}_4 + \mathrm{A}_6\mathrm{B}_2|\nu_{2,t}$$

Isolating the coefficient and rearranging, we get:

$$\mathrm{A}_1 = |R * I - \Omega_{11}|^{-1}\Omega_{11}$$

$$\mathrm{A}_2 = |R * I - \Omega_{11} - \Omega_{13}|^{-1}\big||I + |R * I - \Omega_{11}|^{-1}\Omega_{11}| * \Omega_{13}\big|$$

$$\mathrm{A}_3 = |R * I - \Omega_{22}|^{-1}\big||I + |R * I - \Omega_{11}|^{-1}\Omega_{11}| * \Omega_{12}\big|$$

$$\mathrm{A}_4 = |R * I - \Omega_{22} - \Omega_{24}|^{-1}\big||I + \mathrm{A}_1| * \Omega_{14} + \mathrm{A}_2 * |\Omega_{12} + \Omega_{14}| + \mathrm{A}_3 * \Omega_{24}\big|$$

$$\mathrm{A}_5 = |R - \mathrm{B}_1|^{-1}|I + \mathrm{A}_1 + \mathrm{A}_2|$$

$$\mathrm{A}_6 = |R - \mathrm{B}_2|^{-1}|\mathrm{A}_3 + \mathrm{A}_4|$$

Assuming firms' corporate equity investments are independent, the following matrices are invertible: $|R * I - \Omega_{11}|$, $|R * I - \Omega_{22}|$, $|R * I - \Omega_{11} - \Omega_{13}|$, $|R * I - \Omega_{22} - \Omega_{24}|$, $|R - \mathrm{B}_1|$ and $|R - \mathrm{B}_2|$.

Solving for the pricing model coefficients is equivalent to solving: $E_t[y(\tilde{x}_{t+1})] = Ay(x_t)$.

where: $y(\tilde{x}_{t+1}) = \begin{vmatrix} OX_{t+1} \\ OA_{t+1} \\ \nu_{1,t+1} \\ \nu_{2,t+1} \end{vmatrix}$; $y(x_t) = \begin{vmatrix} OX_t \\ OA_t \\ \nu_{1,t} \\ \nu_{2,t} \end{vmatrix}$; $A = \begin{vmatrix} \Omega & I \\ 0 & \mathrm{B} \end{vmatrix}$

We note that some restrictions should be placed on the information generating processes in order to derive a unique solution. Specifically, we require $\det|A| \neq 0$, where A is the $[4n \times 4n]$ "response coefficients" matrix for all firms. This implies the following conditions for the response coefficients of abnormal operating earnings and operating assets, $|\Omega|$, and response coefficients of other information, $|\mathrm{B}|$: $\det|\Omega| \neq 0$ and $\det|\mathrm{B}| \neq 0$.

Using Proposition I and the conjectured pricing model, we get:

(3.24) $p_t = |I - \phi|^{-1}\big|FA_t + \mathrm{A}_1 * OX_t + \mathrm{A}_2 * OX_t + |I + \mathrm{A}_3 * I| * OA_t + \mathrm{A}_4 * OA_t + \mathrm{A}_5 * \nu_{1,t} + \mathrm{A}_6 * \nu_{2,t}\big|$

Note that without cross holdings, that is $\phi = \underline{0}$, the pricing model of firms with inter-industry information transfers is:

(3.25) $p_t = B_t + \mathrm{A}_1 * OX_t + \mathrm{A}_2 * OX_t + \mathrm{A}_3 * OA_t + \mathrm{A}_4 * OA_t + \mathrm{A}_5 * \nu_{1,t} + \mathrm{A}_6 * \nu_{2,t}$

Overall, we see that when allowing for cross holdings, the amplification factor appears in a pricing model that is based on standard linear information dynamics as well as in a more general linear information dynamics that includes inter-firm information transfers. Furthermore, from Equation (3.25) we observe that even in the absence of equity investments, the response coefficients demonstrate inter-firms dependencies, as a firm's earnings and operating assets evolve along with other firms' earnings and operating assets.

We leave a discussion of the asymptotic properties of the general information dynamics for future research, as the convergence of the system depends on the interactions between the weights assigned to each firm's own accounting variable and the weights assigned to its counterpart firms' accounting variables. To further investigate this, one would like to consider, among other issues, strategic behavior by firms, response to complementary or substitute products and industry-wide information.

<u>*General Linear Information Dynamic: The Case of Two Firms*</u>

We consider a simplified two firm economy, $i = \{j, k\}, \forall\, j \neq k$, and present the firms' valuation.

The linear information system for the two firms is given by:

(3.26a) $\widetilde{ox}_{t+1}^{a,j} = {\omega_{11}}^j * ox_t^{a,j} + {\omega_{12}}^j * OA_t^j + {\omega_{13}}^j * ox_t^{a,k} + {\omega_{14}}^j * OA_t^k + {\nu_{1,t}}^j + \varepsilon_{1,t+1}^j$

(3.26b) $\widetilde{ox}_{t+1}^{a,k} = {\omega_{11}}^k * ox_t^{a,k} + {\omega_{12}}^k * OA_t^k + {\omega_{13}}^k * ox_t^{a,j} + {\omega_{14}}^k * OA_t^j + {\nu_{1,t}}^k + \varepsilon_{1,t+1}^k$

(3.26c) $\widetilde{OA}_{t+1}^j = {\omega_{22}}^j * OA_t^j + {\omega_{24}}^j * OA_t^k + {\nu_{2,t}}^j + \varepsilon_{2,t+1}^j$

(3.26d) $\widetilde{OA}_{t+1}^k = {\omega_{22}}^k * OA_t^k + {\omega_{24}}^k * OA_t^j + {\nu_{2,t}}^k + \varepsilon_{2,t+1}^k$

(3.26e) ${\tilde{\nu}_{1,t+1}}^j = {\beta_{11}}^j * {\nu_{1,t}}^j + {\beta_{12}}^j * {\nu_{1,t}}^k + \varepsilon_{3,t+1}^j$

(26f) ${\tilde{\nu}_{1,t+1}}^k = {\beta_{11}}^k * {\nu_{1,t}}^k + {\beta_{12}}^k * {\nu_{1,t}}^j + \varepsilon_{3,t+1}^k$

(3.26g) ${\tilde{\nu}_{2,t+1}}^j = {\beta_{21}}^j * {\nu_{2,t}}^j + {\beta_{22}}^j * {\nu_{2,t}}^k + \varepsilon_{4,t+1}^j$

(3.26h) ${\tilde{\nu}_{2,t+1}}^k = {\beta_{21}}^k * {\nu_{2,t}}^k + {\beta_{22}}^k * {\nu_{2,t}}^j + \varepsilon_{4,t+1}^k$

We conjecture a linear price model: $g_t^j = \alpha_1^j * ox_t^{a,j} + \alpha_2^j * ox_t^{a,k} + \alpha_3^j * OA_t^j + \alpha_4^j * OA_t^k + \alpha_5^j * \nu_{1,t}^j + \alpha_6^j * \nu_{1,t}^k + \alpha_7^j * \nu_{2,t}^j + \alpha_8^j * \nu_{2,t}^k$

Substituting into Equation (3.23) and rearranging we get:

$$R\alpha_1^j * ox_t^{a,j} + R\alpha_2^j * ox_t^{a,k} + R\alpha_3^j * OA_t^j + R\alpha_4^j * OA_t^k + R\alpha_5^j,* \nu_{1,t}^j + R\alpha_6^j * \nu_{1,t}^k + R\alpha_7^j * \nu_{2,t}^j + R\gamma_8 * \nu_{2,t}^k = ((1+\alpha_1^j){\omega_{11}}^j + \alpha_2^j{\omega_{13}}^k) * ox_t^{a,j} + ({\omega_{12}}^j(1+\alpha_1^j) + \alpha_2^j{\omega_{14}}^k + \alpha_3^j{\omega_{22}}^j + \alpha_4^j{\omega_{24}}^k) * OA_t^j + ({\omega_{13}}^j(1+\alpha_1^j) + \alpha_2^j{\omega_{11}}^k) * ox_t^{a,k} + ({\omega_{14}}^j(1+\alpha_1^j) + \alpha_2^j{\omega_{12}}^k + \alpha_3^j{\omega_{24}}^j + \alpha_4^j{\omega_{22}}^k) * OA_t^k + ((1+\alpha_1^j) + \alpha_5^j,{\beta_{11}}^j + \alpha_6^j{\beta_{12}}^k){\nu_{1,t}}^j + (\alpha_2^j + \alpha_5^j,{\beta_{12}}^j + \alpha_6^j{\beta_{11}}^k){\nu_{1,t}}^k + (\alpha_3^j + \alpha_7^j{\beta_{21}}^j + \alpha_8^j{\beta_{22}}^k){\nu_{2,t}}^j + (\alpha_4^j + \alpha_7^j{\beta_{22}}^j + \alpha_8^j{\beta_{21}}^k){\nu_{2,t}}^k)$$

Solving for $\alpha_1^j, \alpha_2^j, \alpha_3^j, \alpha_4^j, \alpha_5^j, \alpha_6^j, \alpha_7^j, \alpha_8^j$:

$$\alpha_1^j = \frac{{\omega_{11}}^j(R-{\omega_{11}}^k)+{\omega_{13}}^j{\omega_{13}}^k}{(R-{\omega_{11}}^j)(R-{\omega_{11}}^k)-{\omega_{13}}^j{\omega_{13}}^k}$$

$$\alpha_2^j = \frac{R{\omega_{13}}^j}{(R-{\omega_{11}}^j)(R-{\omega_{11}}^k)-{\omega_{13}}^j{\omega_{13}}^k}$$

$$\alpha_3^j = (1+\alpha_1^j)\frac{{\omega_{12}}^j(R-{\omega_{22}}^k)+{\omega_{14}}^j{\omega_{24}}^k}{(R-{\omega_{22}}^k)(R-{\omega_{22}}^j)-{\omega_{24}}^k{\omega_{24}}^j} + \alpha_2^j\frac{{\omega_{14}}^k(R-{\omega_{22}}^k)+{\omega_{12}}^k{\omega_{24}}^k}{(R-{\omega_{22}}^k)(R-{\omega_{22}}^j)-{\omega_{24}}^k{\omega_{24}}^j})$$

$$\alpha_4^j = (1+\alpha_1^j)\frac{{\omega_{14}}^j(R-{\omega_{22}}^j)+{\omega_{12}}^j{\omega_{24}}^j}{(R-{\omega_{22}}^k)(R-{\omega_{22}}^j)-{\omega_{24}}^k{\omega_{24}}^j} + \alpha_2^j\frac{{\omega_{12}}^k(R-{\omega_{22}}^j)+{\omega_{14}}^k{\omega_{24}}^j}{(R-{\omega_{22}}^k)(R-{\omega_{22}}^j)-{\omega_{24}}^k{\omega_{24}}^j}$$

$$\alpha_5^j = (1+\alpha_1^j)\frac{(R-{\beta_{11}}^k)}{(R-{\beta_{11}}^j)(R-{\beta_{11}}^k)-{\beta_{12}}^j{\beta_{12}}^k} + \alpha_2^j\frac{{\beta_{12}}^k}{(R-{\beta_{11}}^j)(R-{\beta_{11}}^k)-{\beta_{12}}^j{\beta_{12}}^k}$$

$$\alpha_6^j = (1+\alpha_1^j)\frac{{\beta_{12}}^j}{(R-{\beta_{11}}^j)(R-{\beta_{11}}^k)-{\beta_{12}}^j{\beta_{12}}^k} + \alpha_2^j\frac{R-{\beta_{11}}^j}{(R-{\beta_{11}}^j)(R-{\beta_{11}}^k)-{\beta_{12}}^j{\beta_{12}}^k}$$

$$\alpha_7^j = \alpha_3^j\frac{(R-{\beta_{21}}^k)}{(R-{\beta_{21}}^j)(R-{\beta_{21}}^k)-{\beta_{22}}^k{\beta_{22}}^j} + \alpha_4^j\frac{{\beta_{22}}^k}{(R-{\beta_{21}}^j)(R-{\beta_{21}}^k)-{\beta_{22}}^k{\beta_{22}}^j}$$

$$\alpha_8^j = \alpha_3^j\frac{{\beta_{22}}^j}{(R-{\beta_{21}}^j)(R-{\beta_{21}}^k)-{\beta_{22}}^k{\beta_{22}}^j} + \alpha_4^j\frac{(R-{\beta_{21}}^j)}{(R-{\beta_{21}}^j)(R-{\beta_{21}}^k)-{\beta_{22}}^k{\beta_{22}}^j}$$

We can present the solution as:

$$\alpha_1^j = \frac{{\omega_{11}}^j(R-{\omega_{11}}^k)+{\omega_{13}}^j{\omega_{13}}^k}{\delta_1^j}$$

$$\alpha_2^j = \frac{R\omega_{13}{}^j}{\delta_1^j}$$

$$\alpha_3^j = \left(1+\alpha_1^j\right)\frac{(R-\omega_{22}{}^k)\omega_{12}{}^j+\omega_{14}{}^j\omega_{24}{}^k}{\delta_2^j} + \alpha_2^j\frac{(R-\omega_{22}{}^k)\omega_{14}{}^k+\omega_{12}{}^k\omega_{24}{}^k}{\delta_2^j}$$

$$\alpha_4^j = \left(1+\alpha_1^j\right)\frac{(R-\omega_{22}{}^j)\omega_{14}{}^j+\omega_{12}{}^j\omega_{24}{}^j}{\delta_2^j} + \alpha_2^j\frac{(R-\omega_{22}{}^j)\omega_{12}{}^k+\omega_{14}{}^k\omega_{24}{}^j}{\delta_2^j}$$

$$\alpha_5^j = \left(1+\alpha_1^j\right)\frac{R-\beta_{11}{}^k}{\delta_3^j} + \alpha_2^j\frac{\beta_{12}{}^k}{\delta_3^j}$$

$$\alpha_6^j = \left(1+\alpha_1^j\right)\frac{\beta_{12}{}^j}{\delta_3^j} + \alpha_2^j\frac{R-\beta_{11}{}^j}{\delta_3^j}$$

$$\alpha_7^j = \alpha_3^j\frac{R-\beta_{21}{}^k}{\delta_4^j} + \alpha_4^j\frac{\beta_{22}{}^k}{\delta_4^j}$$

$$\alpha_8^j = \alpha_3^j\frac{\beta_{22}{}^j}{\delta_4^j} + \alpha_4^j\frac{R-\beta_{21}{}^j}{\delta_4^j}$$

Where:

$$\delta_1^j = \left(R-\omega_{11}{}^j\right)\left(R-\omega_{11}{}^k\right) - \omega_{13}{}^j\omega_{13}{}^k$$

$$\delta_2^j = \left(R-\omega_{22}{}^k\right)\left(R-\omega_{22}{}^j\right) - \omega_{24}{}^k\omega_{24}{}^j$$

$$\delta_3^j = \left(R-\beta_{11}{}^j\right)\left(R-\beta_{11}{}^k\right) - \beta_{12}{}^j\beta_{12}{}^k$$

$$\delta_4^j = \left(R-\beta_{21}{}^j\right)\left(R-\beta_{21}{}^k\right) - \beta_{22}{}^k\beta_{22}{}^j$$

Note that the pricing coefficients can all be expressed as a linear combination of α_1^j and α_2^j.

For a closed form solution to exist, we require: $\delta_1^j, \delta_2^j, \delta_3^j, \delta_4^j \neq 0$.

A unique solution exists if and only if: $\det|A| \neq 0$. Thus, we also require:

$$\omega_{13}{}^j\omega_{13}{}^k \neq \omega_{11}{}^j\omega_{11}{}^k$$

$$\omega_{22}{}^j\omega_{22}{}^k \neq \omega_{24}{}^j\omega_{24}{}^k$$

$$\beta_{12}{}^j\beta_{12}{}^k \neq \beta_{11}{}^j\beta_{11}{}^k$$

$$\beta_{22}{}^j\beta_{22}{}^k \neq \beta_{21}{}^j\beta_{21}{}^k$$

The valuation function can be expressed as:

$$p_t^j = B_t^j + \alpha_1^j * ox_t^{a,j} + \alpha_2^j * ox_t^{a,k} + \alpha_3^j * OA_t^j + \alpha_4^j * OA_t^k + \alpha_5^j * \nu_{1,t}^j + \alpha_6^j * \nu_{1,t}^k + \alpha_7^j * \nu_{2,t}^j + \alpha_8^j * \nu_{2,t}^k$$

APPENDIX 3.5.6

Linear Information Dynamics – Empirical Application

In Appendix 3.5.5 we consider the baseline case where firms file their financial statements at the same time. However, reporting periods and reporting frequencies differ across firms. This may pose some challenges for empirical research studying inter-firms or intra-industry information transfers. In this appendix we provide guidance regarding the empirical application of two cases: (i) Firms with different reporting frequencies (ii) Firms with misaligned reporting periods.

First, consider a public European firm that file its financial statements semi-annually and a private European firm that files its financial statements annually; or consider Singapore, where lager public firms (above S$75 million in market capitalization) are required to report quarterly, while smaller public firms are required to report semi-annually (see Kajuter, Klassmann, and Nienhaus 2018). These are two examples where firms may operate in the same country or even in the same industry, nevertheless, have different reporting frequencies. We note that the variation in reporting frequency may be voluntary or mandatory following a policy change (Butler, Kraft, and Weiss 2007, Fu, Kraft, and Zhang 2012, Kraft, Vashishtha, and Venkatachalam 2018).

Moreover, firms operating in different countries may also have different reporting frequencies. A public US firm is required to file its financial statements quarterly, while a public UK firm is required to report semi-annually. The US firm discloses information to external users more frequently than the UK firm. Hence, external users may update their information set based on the US firm's disclosures more often. This implies that the valuation function may be altered compared to the benchmark case of two firms that report at the same time and every period.

Second, firms file their financial statements at the different times. For example, consider two UK firms that report semi-annually, where one firm files its financial statements at the end of March and September, while the other firm files its financial statements at the end of June and December. In this setting, external users may update their information set in a staggered manner, based on one firm disclosure at a time. Furthermore, Kamp (2002) documents that firms' typical fiscal year-ends vary across countries. For example, the most common fiscal year end is end of March in Japan, end of June in Australia, and end of December in US. Thus, the information flow between firms and across countries is misaligned such that the valuation function may be altered relative to the benchmark case where all firms report at the same time period. Our approach differs from Ohlson (1979) as we consider the reliability of the disclosed information and its relevance to both reporting and non-reporting firms.

We demonstrate the solution for these two cases of misaligned information flows using a simplified two-firm economy. First, we illustrate the empirical specification of the benchmark case. Second, we discuss the solution for two firms with different reporting frequencies. Lastly, we demonstrate the valuation of two firms with the same reporting frequency but misaligned reporting periods. A crucial, simplifying assumption in our analysis is that the true information generating process is independent of the reporting frequency and disclosure timing.[35] Thus, we assume that the firms' linear information dynamics remain constant over time and across reporting schedules.

Two Firms with the Same Reporting Frequency and the Same Reporting Period

Consider an economy with two firms, $i = \{j, k\}, \forall\, j \neq k$. We set $u = 2t$ and assume that the underlying information process is quarterly, as in Equations (3.26), and that both firms file their financial statements in every period u. For external users, the information set in each period is complete as they observe the financial statements of both firms and may update the information set every quarter based on all disclosed information. Equations (3.27) denotes the

[35] We acknowledge that Oyer (1998) considers a contracting setting where this assumption does not hold.

firms' information system based on the information observed by external users. For simplicity we also assume there is no other information.

(3.27a) $E_u\left[ox_{u+1}^{a,j}\right] = \omega_{11}{}^{j} * ox_u^{a,j} + \omega_{12}{}^{j} * OA_u^j + \omega_{13}{}^{j} * ox_u^{a,k} + \omega_{14}{}^{j} * OA_u^k$

(3.27b) $E_u\left[ox_{u+1}^{a,k}\right] = \omega_{11}{}^{k} * ox_u^{a,k} + \omega_{12}{}^{k} * OA_u^k + \omega_{13}{}^{k} * ox_u^{a,j} + \omega_{14}{}^{k} * OA_u^j$

We conjecture a linear price model for both firms:

(3.28a) $g_u^j = \alpha_{11}^j * ox_u^{a,j} + \alpha_{12}^j * ox_u^{a,k} + \alpha_{13}^j * OA_u^j + \alpha_{14}^j * OA_u^k$

(3.28b) $g_u^k = \alpha_{11}^k * ox_u^{a,k} + \alpha_{12}^k * ox_u^{a,j} + \alpha_{13}^k * OA_u^k + \alpha_{14}^k * OA_u^j$

Solving for firm j (representative firm) we get:

$$\alpha_{11}^j = \frac{\omega_{11}{}^{j}(R-\omega_{11}{}^{k})+\omega_{13}{}^{j}\omega_{13}{}^{k}}{(R-\omega_{11}{}^{j})(R-\omega_{11}{}^{k})-\omega_{13}{}^{j}\omega_{13}{}^{k}}$$

$$\alpha_{12}^j = \frac{R\omega_{13}{}^{j}}{(R-\omega_{11}{}^{j})(R-\omega_{11}{}^{k})-\omega_{13}{}^{j}\omega_{13}{}^{k}}$$

$$\alpha_{13}^j = \left(1+\alpha_{11}^j\right)\frac{\omega_{12}{}^{j}(R-\omega_{22}{}^{k})+\omega_{14}{}^{j}\omega_{24}{}^{k}}{(R-\omega_{22}{}^{k})(R-\omega_{22}{}^{j})-\omega_{24}{}^{j}\omega_{24}{}^{k}} + \alpha_{12}^j\frac{\omega_{14}{}^{k}(R-\omega_{22}{}^{k})+\omega_{24}{}^{k}\omega_{12}{}^{k}}{(R-\omega_{22}{}^{k})(R-\omega_{22}{}^{j})-\omega_{24}{}^{j}\omega_{24}{}^{k}}$$

$$\alpha_{14}^j = \left(1+\alpha_{11}^j\right)\frac{\omega_{14}{}^{j}(R-\omega_{22}{}^{j})+\omega_{24}{}^{j}\omega_{12}{}^{j}}{(R-\omega_{22}{}^{k})(R-\omega_{22}{}^{j})-\omega_{24}{}^{j}\omega_{24}{}^{k}} + \alpha_{12}^j\frac{\omega_{12}{}^{k}(R-\omega_{22}{}^{j})+\omega_{14}{}^{k}\omega_{24}{}^{j}}{((R-\omega_{22}{}^{k})(R-\omega_{22}{}^{j})-\omega_{24}{}^{j}\omega_{24}{}^{k}}$$

The pricing coefficient are consistent with Appendix 3.5.5.

1. Two Firms with Different Reporting Frequency

Consider an economy with two firms, $i = \{j, k\}, \forall\, j \neq k$, where firm j discloses information every period (that is at time $u, u+1$, $u+2$, $u+3$, and so on) and firm k discloses information every other period (that is at time $u+1, u+3, u+5$, and so on). Thus, the firms provide new information to the market at different frequencies.

For external users, the information set in odd periods is complete, as they may use the disclosed financial information of both firms to update their information set. Nevertheless, in even periods external users' information set is incomplete, they may update the information set based only on firm j's disclosed information. Thus, in each even period the information set can only be updated using one firm's disclosure.

We assume that external users may update the information set based on observed information as well as on estimations of firm $k's$ financial information. Put differently, for the firm that discloses less frequently, external users will generate a predication of the firm's financial information using the partial information set.

The following denotes the firms' information system based on the information disclosed to external users. Equations (3.29) denotes the expected information set for even periods where the information set is partial:

(3.29a) $E_u\left[ox_{u+1}^{a,j}\right] = \widehat{\omega_{11}}^{j} * ox_u^{a,j} + \widehat{\omega_{12}}^{j} * OA_u^j + \widehat{\omega_{13}}^{j} * \widehat{ox}_u^{a,k} + \widehat{\omega_{14}}^{j} * \widehat{OA}_u^k$

(3.29b) $E_u\left[ox_{u+1}^{a,k}\right] = \overline{\omega_{11}}^{k} * \widehat{ox}_u^{a,k} + \overline{\omega_{12}}^{k} * \widehat{OA}_u^k + \overline{\omega_{13}}^{k} * ox_u^{a,j} + \overline{\omega_{14}}^{k} * OA_u^j$

(3.29c) $E_u\left[OA_{u+1}^j\right] = \widehat{\omega_{22}}^{j} * OA_u^j + \widehat{\omega_{24}}^{j} * \widehat{OA}_u^k$

(3.29d) $E_u\left[OA_{u+1}^k\right] = \overline{\omega_{22}}^{k} * \widehat{OA}_u^k + \overline{\omega_{24}}^{k} * OA_u^j$

Equations (3.30) denotes the expected information set for odd periods where the information set is complete:

(3.30a) $E_{u-1}\left[ox_u^{a,j}\right] = \omega_{11}{}^{j} * ox_{u-1}^{a,j} + \omega_{21}{}^{j} * OA_{u-1}^j + \omega_{13}{}^{j} * ox_{u-1}^{a,k} + \omega_{14}{}^{j} * OA_{u-1}^k$

(3.30b) $E_{u-1}\left[\widehat{ox}_u^{a,k}\right] = \omega_{11}{}^{k} * ox_{u-1}^{a,k} + \omega_{12}{}^{k} * OA_{u-1}^k + \omega_{13}{}^{k} * ox_{u-1}^{a,j} + \omega_{14}{}^{k} * OA_{u-1}^j$

(3.30c) $E_{u-1}\left[OA_u^j\right] = \omega_{22}{}^{j} * OA_{u-1}^j + \omega_{24}{}^{j} * OA_{u-1}^k$

(3.30d) $E_{u-1}\left[\widehat{OA}_u^k\right] = \omega_{22}{}^{k} * OA_{u-1}^k + \omega_{24}{}^{k} * OA_{u-1}^j$

We note that the underlying data generating process may differ from the estimated data and use a different notation for the estimated information generating processes.[36] Accordingly, $\{\widehat{\omega_{11}}, \widehat{\omega_{12}}, \widehat{\omega_{13}}, \widehat{\omega_{14}}\}$ represent the response coefficients for periods where the

[36] In this analysis, we make two assumptions. First, we take as given that the market can use the currently disclosed accounting information from one firm to form an updated expectation about the other firm's non-disclosed current accounting information. The assumption of linear information model makes this estimate calculatable. Second, we presume that pricing function continues to be linear and rely on the (i) most current (observed) accounting information from the disclosing firms as well as (ii) the updated expectation about the accounting information of the non-disclosing firm. This second assumption is a reasonable heuristic that allows us to establish that the resulting pricing coefficients differ relative to the benchmark case where information is disclosed by both firms in all periods, and that the pricing coefficients vary with the information set.

information set includes estimation of the other firms' financial information, while $\{\overline{\omega_{11}}, \overline{\omega_{12}}, \overline{\omega_{13}}, \overline{\omega_{14}}\}$ are the response coefficients for periods where the information set includes estimation of the firm k's own financial information (investors' expectations about the undisclosed information). In this case, the only estimated information relates to firm k in even periods. Hence, we use $\{\widehat{\omega_{11}}, \widehat{\omega_{12}}, \widehat{\omega_{13}}, \widehat{\omega_{14}}\}$ in Equations (3.29a) and (3.29c), and $\{\overline{\omega_{11}}, \overline{\omega_{12}}, \overline{\omega_{13}}, \overline{\omega_{14}}\}$ in Equations (3.29b) and (3.29d).

Given that the information set differs between odd and even periods, we conjecture a linear price model for even (g_u) and odd (g_{u+1}) periods both firms:

(3.31a) $g_u^j = \alpha_{11}^j * ox_u^{a,j} + \alpha_{12}^j * \widehat{ox}_u^{a,k} + \alpha_{13}^j * OA_u^j + \alpha_{14}^j * \widehat{OA}_u^k$

(3.31b) $g_{u+1}^j = \alpha_{21}^j * ox_{u+1}^{a,j} + \alpha_{22}^j * ox_{u+1}^{a,k} + \alpha_{23}^j * OA_{u+1}^j + \alpha_{24}^j * OA_{u+1}^k$

(3.31c) $g_u^k = \alpha_{11}^k * \widehat{ox}_u^{a,k} + \alpha_{12}^k * ox_u^{a,j} + \alpha_{13}^k * \widehat{OA}_u^k + \alpha_{14}^k * OA_u^j$

(3.31d) $g_{u+1}^k = \alpha_{21}^k * ox_{u+1}^{a,k} + \alpha_{22}^k * ox_{u+1}^{a,j} + \alpha_{23}^k * OA_{u+1}^k + \alpha_{24}^k * OA_{u+1}^j$

The partial information sets imply that pricing coefficient should be solved as a system for periods with partial and full information sets. That is, solving a simultaneous system of the linear pricing model for even (g_u) and odd (g_{u+1}) periods. We solve the pricing coefficients by substituting Equations (3.30)-(3.32) into Equation (3.23), using firm j as a representative firm: $\begin{cases} R * g_u^j = E_u[ox_{u+1}^{a,j}] + E_u[g_{u+1}^j] \\ R * g_{u+1}^j = E_{u+1}[ox_{u+2}^{a,j}] + E_{u+1}[g_{u+2}^j] \end{cases}$

Solving the simultaneous system yields a closed form solution for firm *j* (representative firm):

Even Periods		Odd Periods	
$\boldsymbol{\alpha_{11}^j}$	$\frac{\omega_{13}{}^j \overline{\omega_{13}}{}^k}{\lambda_1} + (1 + \alpha_{21}^j) \frac{\omega_{11}{}^k \widehat{\omega_{13}}{}^j \overline{\omega_{13}}{}^k + \widehat{\omega_{11}}{}^j (R^2 - \omega_{11}{}^k \overline{\omega_{11}}{}^k)}{R\lambda_1}$	$\boldsymbol{\alpha_{21}^j}$	$\left[\left(R + \widehat{\omega_{11}}{}^j\right)\overline{\omega_{11}}{}^k - \widehat{\omega_{13}}{}^j \overline{\omega_{13}}{}^k\right] * \frac{\omega_{13}{}^j \omega_{13}{}^k - \omega_{11}{}^j \omega_{11}{}^k}{\lambda_2} + R^2 \frac{(R + \widehat{\omega_{11}}{}^j)\omega_{11}{}^j + R^2 \widehat{\omega_{13}}{}^j \omega_{13}{}^k}{\lambda_2}$
$\boldsymbol{\alpha_{12}^j}$	$\frac{\overline{\omega_{11}}{}^k \omega_{13}{}^j}{\lambda_1} + (1 + \alpha_{21}^j) \widehat{\omega_{13}}{}^j \frac{\widehat{\omega_{11}}{}^j \overline{\omega_{11}}{}^k + (R^2 - \omega_{13}{}^j \overline{\omega_{13}}{}^k)}{R\lambda_1}$	$\boldsymbol{\alpha_{22}^j}$	$\frac{R\omega_{13}{}^j}{\lambda_1} + (1 + \alpha_{21}^j) \frac{\widehat{\omega_{11}}{}^j \omega_{13}{}^j + \omega_{11}{}^k \widehat{\omega_{13}}{}^j}{\lambda_1}$

$\boldsymbol{\alpha_{13}^{j}}$	$\left[\left(1+\alpha_{11}^{j}\right)\omega_{21}^{j}+\alpha_{12}^{j}\omega_{14}^{k}\right]*\frac{R\widehat{\omega_{22}}^{j}+\omega_{22}^{k}\left(\widehat{\omega_{24}}^{j}\overline{\omega_{24}}^{k}-\widehat{\omega_{22}}^{j}\overline{\omega_{22}}^{k}\right)}{\lambda_3}+\omega_{24}^{k}\left[\left(1+\alpha_{11}^{j}\right)\omega_{14}^{j}+\alpha_{12}^{j}\omega_{12}^{k}\right]*\frac{R+\widehat{\omega_{22}}^{j}\overline{\omega_{22}}^{k}-\widehat{\omega_{24}}^{j}\overline{\omega_{24}}^{k}}{\lambda_3}+\left[\left(1+\alpha_{21}^{j}\right)\widehat{\omega_{12}}^{j}+\alpha_{22}^{j}\overline{\omega_{14}}^{k}\right]*\frac{R-\omega_{22}^{k}\overline{\omega_{22}}^{k}-\widehat{\omega_{24}}^{j}\omega_{24}^{k}}{\lambda_3}+\left[\left(1+\alpha_{21}^{j}\right)\widehat{\omega_{14}}^{j}+\alpha_{22}^{j}\overline{\omega_{12}}^{k}\right]*\frac{\widehat{\omega_{22}}^{j}\omega_{24}^{k}+\omega_{22}^{k}\overline{\omega_{24}}^{k}}{\lambda_3}$	$\boldsymbol{\alpha_{23}^{j}}$	$\left[\left(1+\alpha_{11}^{j}\right)\omega_{21}^{j}+\alpha_{12}^{j}\omega_{14}^{k}+\alpha_{13}^{j}\omega_{22}^{j}\right]*\frac{R-\omega_{22}^{k}\overline{\omega_{22}}^{k}}{R\lambda_4}+\left[\left(1+\alpha_{11}^{j}\right)\omega_{14}^{j}+\alpha_{12}^{j}\omega_{12}^{k}+\alpha_{13}^{j}\omega_{24}^{j}\right]\frac{\overline{\omega_{22}}^{k}\omega_{24}^{k}}{R\lambda_4}+\left[\left(1+\alpha_{21}^{j}\right)\widehat{\omega_{14}}^{j}+\alpha_{22}^{j}\overline{\omega_{12}}^{k}\right]\frac{\omega_{24}^{k}}{R\lambda_4}$
$\boldsymbol{\alpha_{14}^{j}}$	$\left[\left(1+\alpha_{11}^{j}\right)\omega_{21}^{j}+\alpha_{12}^{j}\omega_{14}^{k}\right]\frac{\widehat{\omega_{24}}^{j}}{\lambda_4}+\left[\left(1+\alpha_{11}^{j}\right)\omega_{14}^{j}+\alpha_{12}^{j}\omega_{12}^{k}\right]\frac{\overline{\omega_{22}}^{k}}{\lambda_4}+\alpha_{13}^{j}\frac{\omega_{22}^{j}\widehat{\omega_{24}}^{j}+\overline{\omega_{22}}^{k}\omega_{24}^{j}}{\lambda_4}+\left[\left(1+\alpha_{21}^{j}\right)\widehat{\omega_{14}}^{j}+\alpha_{22}^{j}\overline{\omega_{12}}^{k}\right]\frac{1}{\lambda_4}$	$\boldsymbol{\alpha_{24}^{j}}$	$\left[\left(1+\alpha_{11}^{j}\right)\omega_{21}^{j}+\alpha_{12}^{j}\omega_{14}^{k}+\alpha_{13}^{j}\omega_{22}^{j}\right]\frac{\omega_{22}^{k}\widehat{\omega_{24}}^{j}}{R\lambda_4}+\left[\left(1+\alpha_{11}^{j}\right)\omega_{14}^{j}+\alpha_{12}^{j}\omega_{12}^{k}+\alpha_{13}^{j}\omega_{24}^{j}\right]\frac{R-\widehat{\omega_{24}}^{j}\omega_{24}^{k}}{R\lambda_4}+\left[\left(1+\alpha_{21}^{j}\right)\widehat{\omega_{14}}^{j}+\alpha_{22}^{j}\overline{\omega_{12}}^{k}\right]\frac{\omega_{22}^{k}}{R\lambda_4}$

Where:

$$\lambda_1=\left(R^2-\omega_{11}^{k}\overline{\omega_{11}}^{k}-\omega_{13}^{j}\overline{\omega_{13}}^{k}\right)$$

$$\lambda_2=\left(R^2-\widehat{\omega_{13}}^{j}\omega_{13}^{k}-\omega_{11}^{j}\widehat{\omega_{11}}^{j}\right)\left(R^2-\omega_{13}^{j}\overline{\omega_{13}}^{k}-\omega_{11}^{k}\overline{\omega_{11}}^{k}\right)-\left(\widehat{\omega_{11}}^{j}\omega_{13}^{j}+\omega_{11}^{k}\widehat{\omega_{13}}^{j}\right)$$

$$\lambda_3=R\left(R-\omega_{22}^{j}\widehat{\omega_{22}}^{j}-\omega_{22}^{k}\overline{\omega_{22}}^{k}-\widehat{\omega_{24}}^{j}\omega_{24}^{k}-\omega_{24}^{j}\overline{\omega_{24}}^{k}\right)+\left(\omega_{22}^{j}\omega_{22}^{k}-\omega_{24}^{j}\omega_{24}^{k}\right)\left(\widehat{\omega_{22}}^{j}\overline{\omega_{22}}^{k}-\widehat{\omega_{24}}^{j}\overline{\omega_{24}}^{k}\right)$$

$$\lambda_4=\left(R-\omega_{22}^{k}\overline{\omega_{22}}^{k}-\widehat{\omega_{24}}^{j}\omega_{24}^{k}\right)$$

The solution suggests that the pricing coefficients oscillate. Thus, empirical estimation of pooled cross-sectional data should employ full interaction models. Our analysis suggests that all pricing coefficients may be altered as the information set swings between periods with full disclosures $\{\alpha_{11}^{j},\alpha_{12}^{j},\alpha_{13}^{j},\alpha_{14}^{j}\}$ and periods with partial disclosures $\{\alpha_{21}^{j},\alpha_{22}^{j},\alpha_{23}^{j},\alpha_{24}^{j}\}$. These results provide a theoretical framework to the findings of Arif and De George (2018)

We also note that the pricing coefficients of both firms may be altered, regardless of their disclosure policy. As evident from Equation (3.31a) and Equation (3.31c), in even periods the prices impound information based on the expected abnormal operating earnings and operating assets of firm k as well as on firm j's disclosed information. In odd periods (Equation (3.31b) and Equation (3.31d)), the prices incorporate information disclosed by both firms. Although firm j discloses information more frequently than firm k, firm j's pricing coefficients may still vary from even to odd periods as its prices incorporate the disclosed information by firm k in odd periods and expectations regarding firm k's performances in even periods.

2. Two Firms with the Same Reporting Frequency and Misaligned Reporting Period

Consider an economy with two firms, $i = \{j, k\}, \forall\, j \neq k$. We set $u = 2t$ such that firm j discloses information in even periods (at time u, $u + 2$, $u + 4$, and so on) and firm k discloses information in odd periods (at time $u + 1$, $u + 3$, $u + 5$, and so on). We assume the underlying information process is quarterly, as in Equations (3.26). Nevertheless, given that firms reporting periods are misaligned, external users may only observe one firm's financial information in each period.[37]

For external users, the information set in each period is incomplete, as they may update the information set based only on disclosed information. Thus, in each period the information set can only be updated using one firm's disclosure. Nevertheless, we assume that external observers use the partial information set and based on an estimation, update the information set also for the firm that does not disclose financial information. The following denotes the firms' information system based on the information disclosed to external users. Equations (3.32) denotes the expected information set for even periods:

(3.32a) $E_u\left[\widehat{ox}_{u+1}^{a,j}\right] = \widehat{\omega_{11}}^{j} * ox_u^{a,j} + \widehat{\omega_{12}}^{j} * OA_u^{j} + \widehat{\omega_{13}}^{j} * \widehat{ox}_u^{a,k} + \widehat{\omega_{14}}^{j} * \widehat{OA}_u^{k}$

(3.32b) $E_u\left[ox_{u+1}^{a,k}\right] = \overline{\omega_{11}}^{k} * \widehat{ox}_u^{a,k} + \overline{\omega_{12}}^{k} * \widehat{OA}_u^{k} + \overline{\omega_{13}}^{k} * ox_u^{a,j} + \overline{\omega_{14}}^{k} * OA_u^{j}$

(3.32c) $E_u\left[\widehat{OA}_{u+1}^{j}\right] = \widehat{\omega_{22}}^{j} * OA_u^{j} + \widehat{\omega_{24}}^{j} * \widehat{OA}_u^{k}$

(3.32d) $E_u\left[OA_{u+1}^{k}\right] = \overline{\omega_{22}}^{k} * \widehat{OA}_u^{k} + \overline{\omega_{24}}^{k} * OA_u^{j}$

[37] Again, see the discussion and caveats in the previous footnote.

Equations (3.33) denotes the expected information set for odd periods:

(3.33a) $E_{u-1}\left[ox_u^{a,j}\right] = \overline{\omega_{11}}^j * \widehat{ox}_{u-1}^{a,j} + \overline{\omega_{21}}^j * \widehat{OA}_{u-1}^j + \overline{\omega_{13}}^j * ox_{u-1}^{a,k} + \overline{\omega_{14}}^j * OA_{u-1}^k$

(3.33b) $E_{u-1}\left[\widehat{ox}_u^{a,k}\right] = \widehat{\omega_{11}}^k * ox_{u-1}^{a,k} + \widehat{\omega_{12}}^k * OA_{u-1}^k + \widehat{\omega_{13}}^k * \widehat{ox}_{u-1}^{a,j} + \widehat{\omega_{14}}^k * \widehat{OA}_{u-1}^j$

(3.33c) $E_{u-1}\left[OA_u^j\right] = \overline{\omega_{22}}^j * \widehat{OA}_{u-1}^j + \overline{\omega_{24}}^j * OA_{u-1}^k$

(3.33d) $E_{u-1}\left[\widehat{OA}_u^k\right] = \widehat{\omega_{22}}^k * OA_{u-1}^k + \widehat{\omega_{24}}^k * \widehat{OA}_{u-1}^j$

The information sets denoted by Equations (3.32) and Equations (3.33) are the expected information generating process based on firms' observed information, where the values for periods in which a firm does not disclose are estimated based on the partial information set.

Again, we note that the underlying data generating process may differ from the observed data and use a different notation for the estimated information generating processes, where $\{\widehat{\omega_{11}}, \widehat{\omega_{12}}, \widehat{\omega_{13}}, \widehat{\omega_{14}}\}$ are the response coefficients for period where the information set includes estimation of the other firm's financial information (investors' expectations about firm k's undisclosed information) and where $\{\overline{\omega_{11}}, \overline{\omega_{12}}, \overline{\omega_{13}}, \overline{\omega_{14}}\}$ are the response coefficients for periods where the information set includes estimation of the firm's own financial information (investors' expectations about firm j's undisclosed information).

We conjecture a linear price model for even (g_u) and odd (g_{u+1}) periods:

(3.32a) $g_u^j = \alpha_{11}^j * ox_u^{a,j} + \alpha_{12}^j * \widehat{ox}_u^{a,k} + \alpha_{13}^j * OA_u^j + \alpha_{14}^j * \widehat{OA}_u^k$

(3.32b) $g_{u+1}^j = \alpha_{21}^j * \widehat{ox}_{u+1}^{a,j} + \alpha_{22}^j * ox_{u+1}^{a,k} + \alpha_{23}^j * \widehat{OA}_{u+1}^j + \alpha_{24}^j * OA_{u+1}^k$

(3.32c) $g_u^k = \alpha_{11}^k * \widehat{ox}_u^{a,k} + \alpha_{12}^k * ox_u^{a,j} + \alpha_{13}^k * \widehat{OA}_u^k + \alpha_{14}^k * OA_u^j$

(3.32d) $g_{u+1}^k = \alpha_{21}^k * ox_{u+1}^{a,k} + \alpha_{22}^k * \widehat{ox}_{u+1}^{a,j} + \alpha_{23}^k * OA_{u+1}^k + \alpha_{24}^k * \widehat{OA}_{u+1}^j$

We solve the pricing coefficients for even and odd periods by substituting Equations (3.30)-(3.32) into Equation (3.23), using firm j as a representative firm:

$$\begin{cases} R * g_u^j = E_u\left[\widehat{ox}_{u+1}^{a,j}\right] + E_u\left[g_{u+1}^j\right] \\ R * g_{u+1}^j = E_u\left[ox_{u+2}^{a,j}\right] + E_u\left[g_{u+2}^j\right] \end{cases}$$

The partial information sets imply that pricing coefficient should be solved as a system for periods where firm j discloses and periods where firm k does not disclose. A closed form solution exists, and this solution is similar to the solution outlined for two firms with different reporting frequency. As in the previous case, the theoretical pricing coefficients suggest that the pricing function is altered by the firms' disclosure policy. In each period prices incorporate new information disclosed by one firm only and the expectation regarding the abnormal operating earnings and operating assets of the other firm.

The assumed linear information dynamics with inter firm information transfers permits pricing firms in periods when they do not disclose information. As peer firms' disclosures are informative with regards to the firm's own operations, even in the absence of disclosure, external users are able to update their expectations about the non-disclosing firm. As such, our proposed approach allows pricing firms with misaligned reporting periods and different reporting frequencies. Our approach is also useful for valuation of private firms that rarely disclose financial information as well as private European firms that have lower disclosure requirements relative to public firms.

3.6 Figures

FIGURE 3.6.1

Cross Holdings and Firm Value

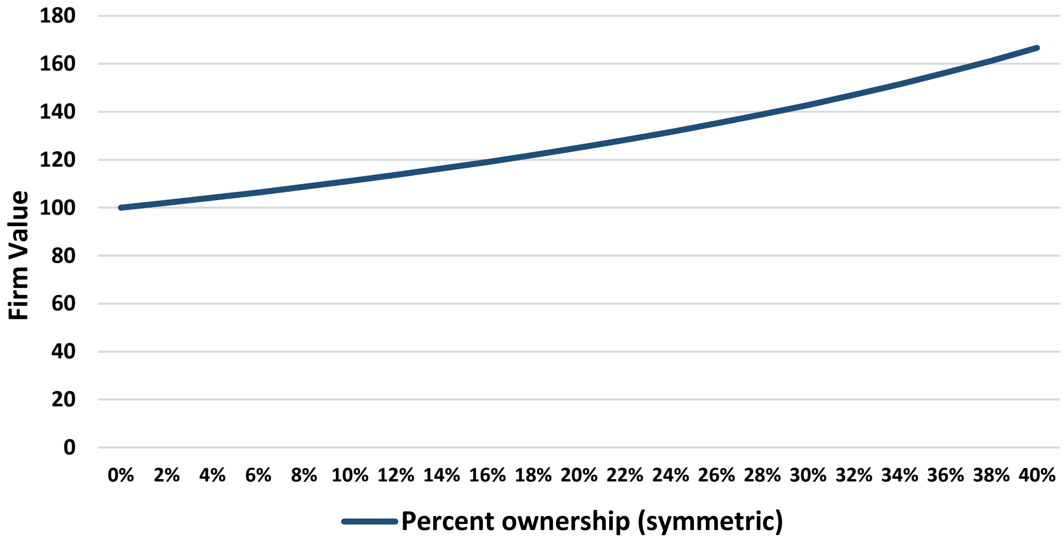
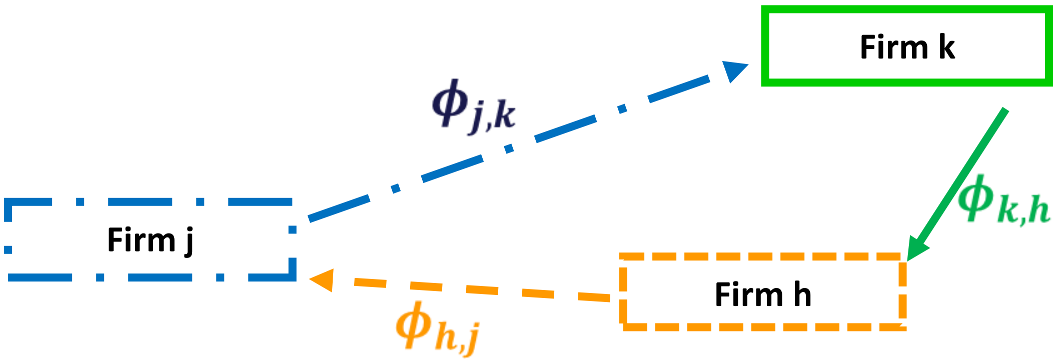


FIGURE 3.6.2

Circular Ownership Structure Illustration



3.7 Tables

TABLE 3.7.1

Two Firms - Fair Value Method

Panel A - Firm H without Equity Ownership (the source of this panel is Lundholm (1995))			
t	$\boldsymbol{B_t^H}$	$\boldsymbol{x_t^H}$	$\boldsymbol{d_t^H}$
0	*100*	*0*	*-100*
1	$(1+r)*100-d_1^H$	$r*100$	d_1^H
2	*0*	$r*[(1+r)*100-d_1^H]+z^H$	$(1+r)*[(1+r)*100-d_1^H]+z^H$
Panel B - Firm F Has Equity Ownership in Firm H;			
t	$\boldsymbol{B_t^F}$	$\boldsymbol{x_t^F}$	$\boldsymbol{d_t^F}$
0	$0.8*100+0.2*p_0^H$	*0*	*-100*
1	$(1+r)*0.8*100+0.2*(p_1^H+d_1^H)-d_1^F$	$r*0.8*100+0.2*(p_1^H+d_1^H-p_0^H)$	d_1^F
2	*0*	$r[(1+r)*0.8*100+0.2*d_1^H-d_1^F]+z^F+0.2*(p_2^H+d_2^H-p_1^H)$	$(1+r)[(1+r)*100-d_1^F]+z^F+0.2*(p_2^H+z^H)$
Panel C - Firm F Has One-sided Equity Ownership in Firm H; Market Prices			
t	$\boldsymbol{B_t^F}$	$\boldsymbol{x_t^F}$	$\boldsymbol{d_t^F}$
0	$100+0.2*\frac{E_0[z^H]}{(1+r)^2}$	*0*	*-100*
1	$(1+r)*100-d_1^F+0.2*\frac{E_1[z^H]}{1+r}$	$r*100+0.2*\left\{\frac{E_1[z^H]}{1+r}-\frac{E_0[z^H]}{(1+r)^2}\right\}$	d_1^F
2	*0*	$r[(1+r)*100-d_1^F]+z^F+0.2*\left\{z^H-\frac{E_1[z^H]}{1+r}\right\}$	$(1+r)[(1+r)*100-d_1^F]+z^F+0.2*z^H$
Panel D - Firms G and F Have Two-sided Symmetric Equity Ownership; Market Prices			
t	$\boldsymbol{B_t^G}$	$\boldsymbol{x_t^G}$	$\boldsymbol{d_t^G}$
0	$100+\frac{0.2}{0.96}*\frac{E_0[z^F+0.2*z^G]}{(1+r)^2}$	0	-100
1	$(1+r)*100-d_1^G+\frac{0.2}{0.96}*\frac{E_1[z^F+0.2*z^G]}{(1+r)}$	$r*100+\frac{0.2}{0.96}*\left\{\frac{E_1[z^F+0.2*z^G]}{(1+r)}-\frac{E_0[z^F+0.2*z^G]}{(1+r)^2}\right\}$	d_1^G
2	0	$r[(1+r)*100-d_1^G]+z^G+\frac{0.2}{0.96}*\left[z^F+0.2*z^G-\frac{E_1[z^F+0.2*z^G]}{(1+r)}\right]$	$(1+r)[(1+r)*100-d_1^G]+z^G+\frac{0.2}{0.96}*(z^F+0.2*z^G)$

TABLE 3.7.2

Two Firms -Equity Method

Panel A - Firm H: No Equity Ownership (the source of this panel is Lundholm (1995))			
t	B_t^A	x_t^A	d_t^A
0	100	0	-100
1	$(1+r)*100-d_1^A$	$r*100$	d_1^A
2	0	$r*[(1+r)*100-d_1^A]+z^A$	$(1+r)*[(1+r)*100-d_1^A]+z^A$
Panel B -Firm F: Equity Ownership in Firm H			
t	B_t^F	x_t^F	d_t^F
0	100	0	-100
1	$(1+r)*100-d_1^F$	$r*100$	d_1^F
2	0	$r[(1+r)*100-d_1^F]+z^F+20\%*z^H$	$(1+r)[(1+r)*100-d_1^F]+z^F+20\%*z^H$
Panel C -Firm G: Two-sided Symmetric Equity Ownership Between Firms F and G			
t	B_t^G	x_t^G	d_t^G
0	100	0	-100
1	$(1+r)*100-d_1^G$	$r*100$	d_1^G
2	0	$r[(1+r)*100-d_1^G]+\frac{z^G+20\%*z^F}{96\%}$	$(1+r)*[(1+r)*100-d_1^G]+\frac{z^G+20\%*z^F}{96\%}$

TABLE 3.7.3

Market-to-Book Ratios

t	Fair Value Method	Equity Method
Panel A – Firm H, No Corporate Equity Investments (P_t^H/B_t^H)		
t	**Fair Value Method**	**Equity Method**
0	$1+\frac{E_0[\frac{z^H}{(1+r)^2}]}{100}$	$1+\frac{E_0[\frac{z^H}{(1+r)^2}]}{100}$
1	$1+\frac{E_1[\frac{z^H}{1+r}]}{(1+r)*100-d_1^H}$	$1+\frac{E_1[\frac{z^H}{1+r}]}{(1+r)*100-d_1^H}$
Panel B - Firm F, One-sided Cross Holding (P_t^F/B_t^F)		
t	**Fair Value Method**	**Equity Method**
0	$1+\frac{E_0\left[\frac{z^F}{(1+r)^2}\right]}{100+0.2*E_0\left[\frac{z^H}{(1+r)^2}\right]}$	$1+\frac{E_0\left[\frac{z^F+0.2*z^H}{(1+r)^2}\right]}{100}$
1	$1+\frac{E_1\left[\frac{z^F}{1+r}\right]}{(1+r)*100-d_1^F+0.2*E_1\left[\frac{z^H}{1+r}\right]}$	$1+\frac{E_1\left[\frac{z^F+0.2*z^H}{1+r}\right]}{(1+r)*100-d_1^F}$
Panel C - Firm G, Two-sided Cross Holding (P_t^G/B_t^G)		
t	**Fair Value Method**	**Equity Method**
0	$1+\frac{E_0\left[\frac{z^G}{(1+r)^2}\right]}{100+\frac{0.2}{0.96}*\frac{E_0[z^F+0.2*z^G]}{(1+r)^2}}$	$1+\frac{1}{0.96}*\frac{E_0\left[\frac{z^G+0.2*z^F}{(1+r)^2}\right]}{100}$
1	$1+\frac{E_1\left[\frac{z^G}{(1+r)}\right]}{(1+r)*100-d_1^G+\frac{0.2}{0.96}*\frac{E_1[z^F+0.2*z^G]}{(1+r)}}$	$1+\frac{1}{0.96}*\frac{E_1\left[\frac{z^G+0.2*z^F}{(1+r)}\right]}{(1+r)*100-d_1^G}$

TABLE 3.7.4

Return on Equity

Panel A – Firm H, No corporate equity investments (X_{t+1}^{H}/B_{t}^{H})

t	Fair Value Method	Equity Method
0	r	r
1	$r+\frac{E_1[z^H]}{(1+r)*100-d_1^H}$	$r+\frac{E_1[z^H]}{(1+r)*100-d_1^H}$

Panel B - Firm F, One-sided cross holding (X_{t+1}^{F}/B_{t}^{F})

t	Fair Value Method	Equity Method
0	r	r
1	$r+\frac{E_1[z^F]}{(1+r)*100-d_1^F+0.2*E_1\left[\frac{z^H}{1+r}\right]}$	$r+\frac{E_1[z^F+0.2*z^H]}{(1+r)*100-d_1^F}$

Panel C - Firm G, Two-sided cross holdings (X_{t+1}^{G}/B_{t}^{G})

t	Fair Value Method	Equity Method
0	r	r
1	$r+\frac{E_1[z^G]}{(1+r)*100-d_1^G+\frac{0.2}{0.96}*\frac{E_1[z^F+0.2*z^G]}{(1+r)}}$	$r+\frac{1}{0.96}*\frac{E_1[z^G+0.2*z^F]}{(1+r)*100-d_1^G}$

Bibliography

Acemoglu, D., and Pischke, J. S. (1998). Why do firms train? Theory and evidence. *The Quarterly Journal of Economics*, 113(1), 79–119.

Acemoglu, D., and Pischke, J. S. (1999). The structure of wages and investment in general training. *Journal of Political Economy*, 107(3), 539–572.

Aghion, P., and Tirole, J. (1997). Formal and real authority in organizations. *Journal of Political Economy*, 105(1), 1–29.

Alexander, J. (1991). Do the merits matter? A study of settlements in securities class actions. *Stanford Law Review*, 43(3), 497–598.

Alford A., Jones J., Leftwich R., and Zmijewski, M. (1993). The relative informativeness of accounting disclosures in different countries. *Journal of Accounting Research*, 31(Supplement), 183–223.

Allen, J. W., and Phillips, G. M. (2000). Corporate equity ownership, strategic alliances and product market relationships. *Journal of Finance*, 55(6), 2791–2815.

Altman, E. (1968). Financial ratios, discriminate analysis and the prediction of corporate bankruptcy. *Journal of Finance*, 23(4), 589–609.

Arellano, M., and Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2), 277–297.

Arif, S., and De George, E. T. (2018). Does financial reporting frequency affect investors' reliance on alternative sources of information? Evidence from earnings information spillovers around the world. Working paper.

Armstrong, C. S., Barth, M. E., Jagolinzer, A. D., and Riedl, E. J. (2010). Market reaction to the adoption of IFRS in Europe. *The Accounting Review*, 85(1), 31–61.

Baginski, S. (1987). Intraindustry information transfer associated with management forecasts of earnings. *Journal of Accounting Research*, 25(2), 196–216.

Bai, J., Fairhurst, D. J., and Serfling, M. (2017). Employment protection, investment, and firm growth. Working paper.

Ball, R., Kothari, S. P., and Robin, A. (2000). The effect of international institutional factors on properties of accounting earnings. *Journal of Accounting and Economics*, 29(1), 1–51.

Bandyopadhyay, S. P., Hanna, J. D., and Richardson, G. (1994). Capital market effects of US-Canada GAAP differences. *Journal of Accounting Research*, 32(2), 262–277.

Barron, J. M., Berger, M. C. and Black, D. A. (1997). On-the-job training. Kalamazoo, Mich.: W. E. Upjohn Institute for Employment Research

Barth, M. E., Landsman, W. R., and Lang, M. H. (2008). International accounting standards and accounting quality. *Journal of Accounting Research*, 46(3), 467–498

Bartov, E., Givoly, D. and Hayn, C. (2002). The rewards to meeting or beating earnings expectations. *Journal of Accounting and Economics*, 33(2), 173–204.

Beatty, A., and Liao, S., (2017). Why do US multinationals voluntarily provide geographical employment disclosures? Working paper.

Becht, M. and Roell, A., (1999). Blockholdings in Europe: An international comparison. *European Economic Review*, 43, 1049–1056.

Bens, D. A., Nagar, V., and Wong, M. H. (2002). Real investment implications of employee stock option exercises. *Journal of Accounting Research*, 40(2), 359–393.

Benson, A. (2015). Do agents game their agents' behavior? Evidence from sales managers. *Journal of Labor Economics*, 33(4), 863–890.

Bernard, V. L. (1995). The Feltham-Ohlson framework: Implications for empiricists. *Contemporary Accounting Research*, 11(2), 733–747.

Bishop, J. H. (1997). What we know about employer-provided training: A review of the literature. *Research in Labor Economics*, 16, 19–87.

Blatter, M., Muehlemann, S., and Schenker, S. (2012). The costs of hiring skilled workers. *European Economic Review*, 56(1), 20–35.

Blatter, M., Muehlemann, S., Schenker, S., and Wolter, S. C. (2015). Hiring costs for skilled workers and the supply of firm-provided training. *Oxford Economic Papers*, 68(1), 238–257.

Blundell, R. W., and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115–143.

Boyer, M. (2014). Directors' and officers' insurance and shareholder protection. *Journal of Financial Perspectives*, 2(1), 107–128.

Boyer, M. M., and Stern, L. H. (2014). D&O insurance and IPO performance: What can we learn from insurers?. *Journal of Financial Intermediation,* 23(4), 504–540.

Brüggemann, U., Hitz, J. M., and Sellhorn, T. (2013). Intended and unintended consequences of mandatory IFRS adoption: A review of extant evidence and suggestions for future research. *European Accounting Review*, 22(1), 1–37.

Burgstahler, D., and Dichev, I. (1997). Earnings management to avoid earnings decreases and losses. *Journal of Accounting and Economics*, 24(1), 99–126.

Burkart, M., Gromb, D., and Panunzi, F. (1997). Large shareholders, monitoring, and the value of the firm. *The Quarterly Journal of Economics*, 112(3), 693–728.

Burnett, B. M., Gordon, E. A., Jorgensen, B. N., and Linthicum, C. L. (2015). Earnings quality: Evidence from Canadian firms' choice between IFRS and US GAAP. *Accounting Perspectives*, 14(3), 212–249.

Burnett, B. M., Jorgensen, B. N., and Pollard, T. J. (2017). The stock market reaction to losing or gaining foreign private issuer status. *Journal of Accounting and Public Policy*, 36(2), 101–118.

Butler, M., Kraft, A., and Weiss, I. S. (2007). The effect of reporting frequency on the timeliness of earnings: The cases of voluntary and mandatory interim reports. *Journal of Accounting and Economics*, 43(2), 181–217.

Canada Business Corporations Act (CBCA). (1985).

Cao, Z., and Narayanamoorthy, G. S. (2014). Accounting and litigation risk: Evidence from directors' and officers' insurance pricing. *Review of Accounting Studies,* 19(1), 1–42.

Cascio, W. F. (1993). Downsizing: What do we know? What have we learned? *The Academy of Management Executive*, 7(1), 95–104.

Caskey, J. (2014). The pricing effects of securities class action lawsuits and litigation insurance. *Journal of Law, Economics, and Organization,* 30(3), 493–532.

Chalmers, J. M. R., Dann, L.Y., and Harford, J. (2002). Managerial opportunism? Evidence from directors' and officers' insurance purchases. *The Journal of Finance*, 57(2), 609–636.

Chen, P., Mehrotra, V., Sivakumar, R., and Wayne, W. Y. (2001). Layoffs, shareholders' wealth, and corporate performance. *Journal of Empirical Finance* 8(2), 171–199.

Chen, Z., Li, O. Z., and Zou, H. (2016). Directors' and officers' liability insurance and the cost of equity. *Journal of Accounting and Economics*, 61(1), 100–120.

Christensen, H. B., Hail, L., and Leuz, C. (2013). Mandatory IFRS reporting and changes in enforcement. *Journal of Accounting and Economics*, 56(2), 147–177.

Chung, H. S. H., Hillegeist, S. A., and Wynn, J. P. (2015). Directors' and officers' legal liability insurance and audit pricing. *Journal of Accounting and Public Policy*, 34(6), 551–577.

Chung, H. S. H., and Wynn, J. P. (2008). Managerial legal liability coverage and earnings conservatism. *Journal of Accounting and Economics*, 46(1), 135–153.

Clayton, M. J., and Jorgensen, B. N. (2005). Optimal crossholding with externalities and strategic interactions. *The Journal of Business*, 78(4), 1505–1522

Clubb, C. D. (1996). Valuation and clean surplus accounting: Some implications of the Feltham and Ohlson model for the relative information content of earnings and cash flows. *Contemporary Accounting Research*, 13(1), 329–337.

Clubb, C. D. (2013). Information dynamics, dividend displacement, conservatism, and earnings measurement: a development of the Ohlson (1995) valuation framework. *Review of Accounting Studies*, 18(2), 360–385.

Cohen, D. A., Mashruwala, R., and Zach, T. (2010). The use of advertising activities to meet earnings benchmarks: Evidence from monthly data. *Review of Accounting Studies*, 15(4), 808–832.

Core, J. E. (1997). On the corporate demand for directors' and officers' insurance. *Journal of Risk and Insurance,* 64(1), 63–87.

Core, J. E. (2000). The directors' and officers' insurance premium: An outside assessment of the quality of corporate governance. *Journal of Law, Economics, and Organization*, 16(2), 449–477.

Cormier, D., and Magnan, M. L. (2016). The advent of IFRS in Canada: incidence on value relevance. *Journal of International Accounting Research*, 15(3), 113–130.

Cronqvist, H., and Fahlenbrach, R. (2009). Large shareholders and corporate policies. *Review of Financial Studies*, 22(10), 3941–3976.

Cummins, D. J. (1991). Statistical and financial models of insurance pricing and the insurance firm. *Journal of Risk and Insurance*, 58(2), 261–302.

Darrough, M. N. (1993). Disclosure policy and competition: Cournot vs. Bertrand. *The Accounting Review*, 68(3), 534–561.

Darrough, M. N., and Stoughton, N. M. (1990). Financial disclosure policy in an entry game. *Journal of Accounting and Economics*, 12(1-3), 219–243.

Daske, H., Luzi, H., Leuz, C., and Verdi, R. S. (2008). Mandatory IFRS reporting around the world: Early evidence on the economic consequences. *Journal of Accounting Research*, 46(5), 1085–1142.

De George, E. T., Ferguson, C. B., and Spear, N. A. (2013). How much does IFRS cost? IFRS adoption and audit fees. *The Accounting Review*, 88(2), 429–462.

De George, E. T., Li, X., and Shivakumar, L. (2016). A review of the IFRS adoption literature. *Review of Accounting Studies*, 21(3), 898–1004.

Dechow, P. M., Sloan, R., and Sweeney, A. (1995). Detecting earnings management. *The Accounting Review*, 70(2), 193–225.

Dechow, P. M., Sloan, R., and Sweeney, A. (1996). Causes and consequences of earnings manipulation: An analysis of firms subject to enforcement actions by the SEC. *Contemporary Accounting Research*, 13(1), 1–36.

Degeorge, F., Patel, J., and Zeckhauser, R. (1999). Earnings management to exceed thresholds. *The Journal of Business*, 72(1), 1–33.

Dierynck, B., Landsman, W. R., and Renders, A. (2012). Do managerial incentives drive cost behavior? Evidence about the role of the zero earnings benchmark for labor cost behavior in private Belgian firms. *The Accounting Review*, 87(4), 1219–1246.

Dolfin, S. (2006). An examination of firms' employment costs. *Applied Economics*, 38(8), 861–878.

Donelson, D. C., McInnis, J. M., and Mergenthaler, R. D. (2012). Rules-based accounting standards and litigation. *The Accounting Review*, 87(4), 1247–1279.

Donelson, D. C., McInnis, J., and Mergenthaler, R. D. (2016). Explaining rules-based characteristics in US GAAP: Theories and evidence. *Journal of Accounting Research*, 54(3), 827–861.

Dye, R. A. (1985). Disclosure of nonproprietary information. *Journal of Accounting Research*, 23(1), 123–145.

Dye, R. A. (1988). Earnings management in an overlapping generations model. *Journal of Accounting Research*, 26(2), 195–235.

Easton, P., and Harris, T. (1991). Earnings as an explanatory variable for returns. *Journal of Accounting Research*, 29(1), 19–36.

Edmans, A., Heinle, M. S., and Huang, C. (2016). The real costs of financial efficiency when some information is soft. *Review of Finance*, 20(6), 2151–2182.

Einhorn, E., and Ziv, A. (2012). Biased voluntary disclosure. *Review of Accounting Studies*, 17(2), 420–442.

Elayan, F. A., Swales, G. S., Maris, B. A., and Scott, J. R. (1998). Market reactions, characteristics, and the effectiveness of corporate layoffs. *Journal of Business Finance and Accounting* 25(3-4), 329–351.

Ernst and Young. (2012). US GAAP versus IFRS: The basics.

Ernst and Young. (2015). Financial reporting developments: Equity method investments.

Ernstberger, J., Link, B., Stich, M., and Vogler, O. (2017). The real effects of mandatory quarterly reporting. *The Accounting Review*, 92(5), 33–60.

Ewert, R., and Wagenhofer, A. (2005). Economic effects of tightening accounting standards to restrict earnings management. *The Accounting Review*, 80(4), 1101–1124.

Fama, E. F., and French, K. R. (1992). The cross-section of expected stock returns. *Journal of Finance*, 47(2), 427–465.

Fama, E. F., and French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33(1), 3–56.

Fama, E. F., and French, K. R. (1995). Size and book-to-market factors in earnings and returns. *The Journal of Finance*, 50(1), 131–155.

Fama, E. F., and French, K. R. (2015). A five-factor asset pricing model. *Journal of Financial Economics*, 116(1), 1–22.

Fama, E. F., and MacBeth, J. D. (1973). Risk, return, and equilibrium: Empirical tests. *Journal of Political Economy*, 81(3), 607–636.

Fedenia, M., Hodder, J. E., and Triantis, A. J. (1994). Cross holdings: Estimation issues, biases, and distortions. *Review of Financial Studies*, 7(1), 61–96.

Feltham, G. A., and Ohlson, J. A. (1995).Valuation and clean surplus accounting for operating and financial activities. *Contemporary Accounting Research*, 11(2), 689–731.

Feltham, G. A., and Ohlson, J. A. (1999). Residual earnings valuation with risk and stochastic interest rates. *The Accounting Review*, 74(2), 165–183.

Foster, G. 1981. Intra-industry information transfers associated with earnings release. *Journal of Accounting and Economics*, 3(3), 201–232.

Francis, J., Olsson, P., and Oswald, D. R. (2000). Comparing the accuracy and explainability of dividend, free cash flow, and abnormal earnings equity value estimates. *Journal of Accounting Research*, 38(1), 45–70.

Francis, J., Philbrick, D., and Schipper, K. (1994). Shareholder litigation and corporate disclosures. *Journal of Accounting Research*, 32(2), 137–164.

Freeman, R., and Tse, S. (1992). An earnings prediction approach to examining intercompany information transfers. *Journal of Accounting and Economics*, 15(4), 509–523.

French, K. R., and Poterba, J. M. (1991). Were Japanese stock prices too high? *Journal of Financial Economics*, 29(2), 337–363.

Fu, R., Kraft, A., and Zhang, H. (2012). Financial reporting frequency, information asymmetry, and the cost of equity. *Journal of Accounting and Economics*, 54(2), 132–149.

Ghaly, M., Dang, V. A., and Stathopoulos, K. (2017). Cash holdings and labor heterogeneity: The role of skilled labor. *The Review of Financial Studies*, 30(10), 3636–3668.

Gigler, F., Kanodia, C., Sapra, H., and Venugopalan, R. (2014). How frequent financial reporting can cause managerial short-termism: An analysis of the costs and benefits of increasing reporting frequency. *Journal of Accounting Research*, 52(2), 357–387

Gillan, S. L., and Panasian, C. A. (2015). On lawsuits, corporate governance, and directors' and officers' liability insurance. *Journal of Risk and Insurance*, 82(4), 793–822.

Graham, J. R., Harvey, C. R., and Rajgopal, S. (2005). The economic implications of corporate financial reporting. *Journal of Accounting and Economics*, 40(1), 3–73.

Griffith, S. J. (2006). Uncovering a gatekeeper: why the sec should mandate disclosure of details concerning directors' and officers' liability insurance policies. *University of Pennsylvania Law Review*, 154(5), 1147–1208.

Grossman, S. J. (1981). The informational role of warranties and private disclosure about product quality. *The Journal of Law and Economics*, 24(3), 461–483.

Gunny, K. A. (2010). The relation between earnings management using real activities manipulation and future performance: Evidence from meeting earnings benchmarks. *Contemporary Accounting Research*, 27(3), 855–888.

Hail, L., Leuz, C., and Wysocki, P. (2010). Global accounting convergence and the potential adoption of IFRS by the US (Part I): Conceptual underpinnings and economic analysis. *Accounting Horizons*, 24(3), 355–394.

Hall, C. M. (2016). Does ownership structure affect labor decisions? *The Accounting Review*, 91(6), 1671–1696.

Hallock, K. F. (1998). Layoffs, top executive pay, and firm performance. *American Economic Review*, 88(4), 711–723.

Hallock, K. F. (2006). Layoffs in Large US Firms from the Perspective of Senior Managers. In *Research in Personnel and Human Resources Management*, 25, 137–179. Emerald Group Publishing Limited.

Han, J. C. Y., and Wild, J. J. (1990). Unexpected earnings and intraindustry information transfers: Further evidence. *Journal of Accounting Research*, 28(1), 211–219.

Han, J. C. Y., Wild, J. J., and Ramesh. K. (1989). Managers' earnings forecasts and intra-industry information transfer. *Journal of Accounting and Economics*, 11(1), 3–33.

Hansen, R., and Lott, J. (1995). Profiting from induced changes in competitors' market values: The case of entry and entry deterrence. *The Journal of Industrial Economics*, 43(3), 261–276.

Harris, T. S., Lang, M., and Mőller, H. P. (1994). The value relevance of German accounting measures: An empirical analysis. *Journal of Accounting Research*, 32(2), 187–209.

Healy, P. M., and Palepu, K. G. (2001). Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature. *Journal of Accounting and Economics*, 31(1), 405–440.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica*, 47(1), 153–161.

Hermalin, B. E., and Weisbach, M. S. (2012). Information disclosure and corporate governance. *The Journal of Finance*, 67(1), 195–233.

Hillier, D., Marshall, A., McColgan, P., and Werema, S. (2007). Employee layoffs, shareholder wealth and firm performance: Evidence from the UK. *Journal of Business Finance and Accounting*, 34(3-4), 467–494.

Holderness, C. G. (1990). Liability insurers as corporate monitors. *International Review of Law and Economics*, 10(2), 115–129.

Holderness, C. G. (2009). The myth of diffuse ownership in the United States. *Review of Financial Studies*, 22(4), 1377–*1408.*

Holmstrom, B. (1979). Moral hazard and observability. *The Bell Journal of Economic*, 10(1), 74–91.

Institute of Chartered Accountants for England & Wales (ICAEW). (2007). EU Implementation of IFRS and the Fair Value Directive: Report for the European Commission. London, U.K.

Johnson, M. F., Kasznik, R., and Nelson, K. (2001). The impact of securities litigation reform on the disclosure of forward-looking information by high-technology firms. *Journal of Accounting Research*, 39(2), 297–327.

Jones, C. L., and Weingram, S. E. (2000). The determinants of 10b-5 litigation risk. Working paper, George Washington University.

Jones, J. (1991). Earnings management during import relief investigations. *Journal of Accounting Research*, 29(2), 193–228.

Joos, P. P., and Leung, E. (2013). Investor perceptions of potential IFRS adoption in the United States. *The Accounting Review*, 88(2), 577–609.

Jung, B., Lee, W. J., and Weber, D. P. (2014). Financial reporting quality and labor investment efficiency. *Contemporary Accounting Research*, 31(4), 1047–1076.

Kajuter, P., Klassmann, F., and Nienhaus, M. (2018). The effect of mandatory quarterly reporting on firm value. *The Accounting Review* (in press).

Kamp, B. (2002). Fiscal year-end choice: Determinants and dynamics. *The International Journal of Accounting*, 37(4), 421–427.

Kasznik, R., and Lev, B. (1995). To warn or not to warn management disclosures in the face of an earnings surprise. *The Accounting Review*, 70(1), 113–134.

Kasznik, R., and McNichols, M. (2002). Does meeting earnings expectations matter? Evidence from analyst forecast revisions and share prices. *Journal of Accounting Research*, 40(3), 727–759.

Kessler, A. S., and Lülfesmann, C. (2006). The theory of human capital revisited: On the interaction of general and specific investments. *The Economic Journal*, 116(514), 903–923.

Kim, I. (2015). Directors’ and officers’ insurance and opportunism in accounting choice. *Accounting and Taxation*, 7(1), 51–65.

Kim, J., Liu, X., and Zheng, L. (2012). The impact of mandatory IFRS adoption on audit fees: Theory and evidence. *The Accounting Review*, 87(6), 2061–2094.

Kiviet, J. F. (1995). On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. *Journal of Econometrics*, 68(1), 53–78.

Kraft, A. G., Vashishtha, R., and Venkatachalam, M. (2018). Frequent financial reporting and managerial myopia. *The Accounting Review*, 93(2), 249–275.

Lee, D., and Wolpin, K. I. (2006). Intersectoral labor mobility and the growth of the service sector. *Econometrica*, 74(1), 1–46.

Liao, R. C. (2014). What drives corporate minority acquisitions around the world? The case for financial constraints. *Journal of Corporate Finance*, 26, 78–95.

Lin, C., Officer, M. S., Wang, R., and Zou, H. (2013). Directors' and officers' liability insurance and loan spreads. *Journal of Financial Economics*, 110(1), 37–60.

Lin, C., Officer, M. S., and Zou, H. (2011). Directors' and officers' liability insurance and acquisition outcomes. *Journal of Financial Economics*, 102(3), 507–525.

Linck, J. S., Netter, J. M., and Yang, T. (2009). The effects and unintended consequences of the Sarbanes-Oxley Act on the supply and demand for directors. *The Review of Financial Studies*, 22(8), 3287–3328.

Liu, G., and Sun, J. (2015). Did the mandatory adoption of IFRS affect the earnings quality of Canadian firms? *Accounting Perspectives*, 14(3), 250–275.

Lu, H., Richardson. G. D. and Salterio, S. (2011). Direct and indirect effects of internal control weakness on accruals quality: Evidence from a unique Canadian regulatory setting. *Contemporary Accounting Research*, 28(2), 675–707

Lundholm, R. (1995). A tutorial on the Ohlson and Feltham/Ohlson models: Answers to some frequently-asked questions. *Contemporary Accounting Research*, 11(2), 749–762.

Mackie-Mason, J. (1990). Do taxes affect corporate financing decisions*? Journal of Finance*, 45(5), 1471–1493.

Merz, M., and Yashiv, E. (2007). Labor and the market value of the firm. *American Economic Review*, 97(4), 1419–1431.

Nelson, M., Elliott, J., and Tarpley, R. (2002). Evidence from auditors about managers' and auditors' earnings management decisions. *The Accounting Review*, 77(Supplement), 175–202.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica*, 49(6), 1417–1426.

O'Sullivan, N. (1997). Insuring the agents: The role of directors' and officers' insurance in corporate governance. *Journal of Risk and Insurance,* 64(3), 545–556.

O'Sullivan, N. (2002). The demand for directors' and officers' insurance by large UK companies. *European Management Journal*, 20(5), 574–583.

Ohlson, J. A. (1979). On financial disclosure and the behavior of security prices. *Journal of Accounting and Economics*, 1(3), 211–232.

Ohlson, J. A. (1995). Earnings, book values, and dividends in equity valuation. *Contemporary Accounting Research*, 11(2), 661–687.

Oi, W. Y. (1962). Labor as a quasi-fixed factor. *Journal of Political Economy*, 70(6), 538–555.

Ouimet, P. P. (2012). What motivates minority acquisitions? The trade-offs between a partial equity stake and complete integration. *The Review of Financial Studies*, 26(4), 1021‒1047.

Oyer, P. (1998). Fiscal year ends and nonlinear incentive contracts: The effect on business seasonality. *The Quarterly Journal of Economics*, 113(1), 149‒185.

Pauly, M. V. (1974). Over insurance and public provision of insurance: The roles of moral hazard and adverse selection. *The Quarterly Journal of Economics*, 88(1), 44–62.

Penman, S. H. (1992). Return to fundamentals. *Journal of Accounting, Auditing, and Finance*, 7(4), 465–483.

Penman, S. H. (2004). *Financial Statement Analysis and Security Valuation*. 2nd edition. New York: Irwin McGraw-Hill.

Penman, S. H., and Sougiannis, T. (1998). A comparison of dividend, cash flow, and earnings approaches to equity valuation. *Contemporary Accounting Research*, *15*(3), 343–383.

Pinnuck, M., and Lillis, A. M. (2007). Profits versus losses: Does reporting an accounting loss act as a heuristic trigger to exercise the abandonment option and divest employees? *The Accounting Review*, 82(4), 1031–1053.

Pissarides, C. A. (2000). *Equilibrium Unemployment Theory*. Cambridge, Mass.: MIT Press.

Ramnath, S. (2002). Investor and analyst reactions to earnings announcements of related firms: An empirical analysis. *Journal of Accounting Research*, 40(5), 1351–1376.

Richardson, S. A., Tuna, A., and Wu, M. (2002). Predicting earnings management: The case of earnings restatements. Working paper.

Roychowdhury, S. (2006). Earnings management through real activities manipulation. *Journal of Accounting and Economics*, 42(3), 335–370.

Schipper, K. (1989). Commentary on earnings management. *Accounting Horizons*, 3(4), 91–102.

Schipper, K. (2003). Principles-based accounting standards. *Accounting Horizons*, 17(1), 61–72.

Securities and Exchange Commission (SEC). (2003). Study Pursuant to Section 108(d) of the Sarbanes-Oxley Act of 2002 on the Adoption by the United States Financial Reporting System of a Principles-Based Accounting System. Available at: http://www.sec.gov/news/studies/principlesbasedstand.htm

Serfling, M. (2016). Firing costs and capital structure decisions. *The Journal of Finance*, 71(5), 2239–2286.

Shleifer, A., and Vishny, R. W. (1986). Large shareholders and corporate control. *The Journal of Political Economy*, 94(3), 461–488.

Shroff, N., Verdi, R., and Yost. B. (2017). When does peer-firm information matter? *Journal of Accounting and Economics*, 64 (2-3), 183–214.

Silva, J. I., and Toledo, M. (2009). Labor turnover costs and the cyclical behavior of vacancies and unemployment. *Macroeconomic Dynamics*, 13(S1), 76–96.

Soderstrom, N. S. and Sun, K. J. (2007). IFRS adoption and accounting quality: A review. *European Accounting Review*, 16(4), 675–702.

Trueman, B., and Titman, S. (1988). An explanation for accounting income smoothing. *Journal of Accounting Research*, 26(Supplement), 127–139.

Verrecchia, R. E. (1983). Discretionary disclosure. *Journal of Accounting and Economics*, 5, 179–194.

Wagenhofer, A. (1990). Voluntary disclosure with a strategic opponent. *Journal of Accounting and Economics*, 12(4), 341–363.

Wynn, J. P. (2008). Legal liability coverage and voluntary disclosure. *The Accounting Review*, 83(6), 1639–1669.

Yermack, D. (1997). Good timing: CEO stock option awards and company news announcements. *The Journal of Finance*, 52(2), 449–476.

Zang, A. Y. (2012). Evidence on the trade-off between real activities manipulation and accrual-based earnings management. *The Accounting Review*, 87(2), 675–703.