Financial statement effects of adopting IFRS: the Canadian experience

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Abstract

Purpose – The purpose of this study is to examine the effects of adopting International Financial Reporting Standards (IFRS) on financial statements of the largest Canadian firms (S&P/TSX 60) listed on the Toronto Stock Exchange (TSX).

Design/methodology/approach – This study investigates the financial statement effects of 46 companies from the S&P/TSX 60 index which report under IFRS in 2011 and switched to IFRS from CGAAP. This study used panel data analysis, which can be considered as more powerful when conducting cross-sectional and in time analysis among companies. Because of weakness of Cramer statistic on R-square, the authors used interaction terms as suggested by Hope (2007).

Findings – Consistent with the authors’ perceptions, this study finds that significant effects of adopting IFRS are associated with industry practices. The empirical results show that the adoption of IFRS in Canada created more relevant financial reporting for book value of equity and net income in the post-adoption periods.

Originality/value – This study should be of interest to the US regulators considering IFRS adoption by US publicly traded companies as well as to regulators, standard setters and listed companies in all countries worldwide that are in transition to IFRS.

Keywords IFRS, Earnings management, Value relevance, Institutional ownership, Financial disclosure

Paper type Research paper

1. Introduction

The widespread acceptance of International Financial Reporting Standards (IFRS) has been remarked upon and studied at great length, and many investigations have confirmed, in general, that IFRS adoption does result in more meaningful financial reporting, as evaluated, variously, by improved transparency and higher quality reporting, with the latter commonly being gauged by the relevance of equity book value and earnings for company share prices.

Prior studies suggesting the beneficent consequences of IFRS adoption have, of necessity, contrasted reporting under pre-change regimes that were significantly at variance with IFRS, often because those were regimes established under code-law legal frameworks.
(Christensen et al., 2007; Barth et al., 2008). Those frequently featured requirements were designed to provide strong creditor protections, but were less pertinent to the concerns of owner-shareholders, as are those financial reporting systems that evolved in common law settings. The current study attempts to correct this unavoidable bias by examining the impact of IFRS adoption by large Canadian public companies, which was mandated effective 2011, and which might more reliably presage the effects of voluntary or mandatory adoption by US public companies, were that to become permitted or required, as has long been debated.

We document that the adoption of IFRS leads to capital market benefits even in a setting having few ex ante differences between domestic standards, that is, Canadian Generally Accepted Accounting Principles (CGAAP) and IFRS. The findings may be useful to companies in transition to IFRS and regulators and policy-makers reviewing financial reporting requirements.

2. Related literature review

Prior studies dealing with the impacts of IFRS adoption have provided somewhat mixed results, with some being notable for positive findings (Ashbaugh and Pincus, 2001; Ball et al., 2003; Barth et al., 2008; and Landsman et al., 2012; Dayanandan et al., 2016) and other being neutral or negative regarding changes in accounting quality (Ahmed et al., 2013a; Burnett et al., 2015; and Liu and Sun, 2015). Dayanandan et al. (2016) suggest that the adoption of high quality standards, such as IFRS, reduces income smoothing and earnings management. In addition, the study finds that earnings management has decreased in the post-IFRS period in particular for French and Scandinavian civil law countries, but not for German civil law countries and common law countries. The latter can be explained by the fact that common law countries have strong investor protection laws, strict law enforcement and high disclosure levels of financial information. The study also finds empirical evidence that the adoption of IFRS reduces earnings management in countries with high levels of financial disclosure. Overall, the study shows that the adoption of IFRS improved the quality of financial reporting. Brochet et al. (2013) and Horton et al. (2013) provide evidence to support the expectation that even moving from otherwise shareholder-oriented financial reporting regimes to IFRS will provide significant improvements in decision usefulness to equity investors.

The adoption of IFRS in Canada has prompted studies on the effects of implementing IFRS. Burnett et al. (2015) and Liu and Sun (2015) found no evidence of improvement after the Canadian IFRS adoption. Prior research also documents that differences between individual IFRS and CGAAP values can be large, particularly on the balance sheet, and the volatility of financial statement figures is in most cases higher under IFRS than under CGAAP (Blanchette et al., 2013; Blanchette and Desfleurs, 2011; Salman and Shah, 2011).

Several studies addressed the effects of adopting IFRS on the value relevance of accounting information that are related to the adoption of IFRS at different times and in different countries. These findings are mixed, with some studies showing that adopting IFRS improves value relevance (Bartov et al., 2005; Chalmers et al., 2011) and others showing that it worsens value relevance (Callao et al., 2007), while yet others find no conclusive evidence either way (Horton and Serafeim, 2010). Research conducted by Cormier (2013), based on a sample of 184 Canadian companies composing S&P/TSX index indicates that implementing IFRS enhances the value relevance of earnings but only for companies with good governance.

The present work is intended to extend prior research on the effects of adopting IFRS in Canada by focusing on the impact of the 2011, or earlier, adoption of IFRS financial
reporting of S&P/TSX 60 Canadian companies, shares of which are the most actively traded on the Toronto Stock Exchange (TSE).

3. Hypotheses development
To focus attention on the matters of concern in this study, those S&P/TSX 60 companies that adopted US GAAP in lieu of IFRS, as permitted under Canadian regulations, have been excluded. Firms adopting IFRS before 2011 (early adopters) are included, however. The objective is to enable a contrast between reporting under predecessor CGAAP with the restated IFRS-based reporting for the same reporting year. Our primary purpose is to investigate the value relevance of IFRS adoption by comparing the association between accounting measures and market values under CGAAP and under IFRS, with a secondary purpose being to explore the effects of IFRS adoption on commonly used financial ratios.

As to the primary purpose, the role of the information content of accounting numbers in ascertaining security prices/returns has long been one of the most fundamental issues in finance and accounting. Absent a relationship between firm value and numbers in the financial statements, such statements have no value relevance, as long defined by, inter alia, Ball and Brown (1968). Therefore, the empirical investigation of value relevance of accounting information is a direct check on the usefulness of accounting data. We expect that the use of IFRS should provide more useful information to investors, thus narrowing the gap between an entity’s book values and market values, and the present study of shifts from CGAAP to IFRS should confirm this expectation, if true.

Regarding the secondary purpose, our research gives particular attention to certain widely used financial statement ratios. These are deemed important for external users of financial statements, making credit and other decisions and for investment recommendations, and for managers who employ them to, for example, implement plans that improve liquidity, financial structure, leverage, profitability and debt coverage ability. Although ratios report mostly on past performances, they also have predictive uses, providing indications of potential problem areas.

We concur with those, such as Blanchette and Desfleurs (2011), who assert that most differences between IFRS and CGAAP are not because of transformations to the fundamental conceptual framework, except for fair value accounting and the entity theory in consolidation. However, we believe several differences arise because of applications in practice rather than from fundamental concepts, such as displaying non-controlling interests inside equity per IFRS, in contrast to CGAAP. Other such items include those flowing from differences in accounting for asset impairments, depreciation (e.g. component depreciation) and the option to revalue items of property, plant and equipment to fair value. Additionally, adopting international accounting rules for employee benefits and electing to charge accumulated actuarial losses against equity may result in an increase in reported liabilities, decrease in equity and increase in future profits reported by first time Canadian IFRS adopters.

Consequently, IFRS adoption can affect several items of financial statements impacting computed ratios. In this study, we focus on items that have a direct impact on the measurement of liquidity, leverage and profitability. The hypotheses to be tested are as follow.

\[ H1a. \text{ Accounting measures under IFRS are equal to those under CGAAP.} \]

\[ H1b. \text{ Financial ratios under IFRS are equal to those under CGAAP.} \]
H2a. The adoption of IFRS increases the association between earnings and market valuation of equity.

H2b. The adoption of IFRS increases the association between book value of equity and market valuation of equity.

H3. The adoption of IFRS increases the explanatory power of earnings and the book value of equity on market valuation of equity.

4. Sample and research design

4.1 Sample and data collection
We identified the 46 companies in the TSX 60 that moved from CGAAP to IFRS in 2011, or earlier, and obtained complete financial statements and corollary materials for each, for the years surrounding the changeover. Table I presents information about accounting standard, IFRS or US GAAP selected.

Annual financial information for Canadian IFRS adopters was drawn from original annual reports prepared in accordance with CGAAP presented for the year before the IFRS adoption (i.e. the comparative year) for the same date and period, from the respective company’s website or Bloomberg. Additionally, data were hand mined from the reconciliations required by IFRS 1 and explanations in the disclosure notes included in the “Transition to IFRS Report” available in the first IFRS financial statements, to further observe main differences in figures reported under IFRS and using CGAAP. All financial information is presented in Canadian dollars (CAD).

The size of companies in the sample varies considerably: total assets range from 1.86bn to 793.83bn under IFRS (1.89bn to 751.70bn under CGAAP), total liabilities extend from 373.43mn to 752.37bn under IFRS (373.43mn to 708.05bn under CGAAP), while total shareholders’ equity ranges from a low of 1.31bn to a high of 44.00bn under IFRS (1.33bn to 46.85bn under CGAAP). The accounting measures of financial performance exhibit significant range values within this sample. Net profit or loss varies from negative 1.53bn to positive 6.05bn under IFRS (negative 350.6mn to positive 5.27bn under CGAAP), while the range for comprehensive income extends from negative 2.35bn to positive 5.12bn under IFRS (negative 1.06bn to 5.33bn under CGAAP). Generally, the range of values is larger under IFRS than under CGAAP.

The following industry sectors are represented in our sample of 46 companies switching from CGAAP to IFRS in 2011 or earlier: 12 (26 per cent) Basic Materials [including 11 (24 per

<table>
<thead>
<tr>
<th>S&amp;P/TSX 60 firms</th>
<th>60</th>
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<tbody>
<tr>
<td><strong>Switch to IFRS</strong></td>
<td></td>
</tr>
<tr>
<td>From Canadian GAAP to IFRS</td>
<td>46</td>
</tr>
<tr>
<td>From US GAAP to IFRS</td>
<td>1</td>
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<tr>
<td><strong>Reporting under US GAAP</strong></td>
<td></td>
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<tr>
<td>Using US GAAP before 2011*</td>
<td>7</td>
</tr>
<tr>
<td>Switched from Canadian GAAP to US GAAP</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
</tr>
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</table>

**Note:** *Excluding one firm which switched from US GAAP to IFRS*

| Table I. | 2011 S&P/TSX 60 Firms’ accounting standard choice: IFRS or US GAAP | 60 |
cent) Energy; 9 (19 per cent) Metals and Mining and 2 (4 per cent) Chemicals; 9 (20 per cent) Financial Services [including 5 (11 per cent) Banks, 3 (7 per cent) Insurance and 1 (2 per cent) Asset Management]; 4 (9 per cent) Technology; and 11 (24 per cent) other sectors, including Consumer Defensive (5), Consumer Cyclical (2) Industrials (2), Utilities (1) and Communication Services (1). Sample companies are classified based on the industry sector and group classification found on TMXMoney[1]. Table II presents sample companies by industry sector and market capitalization during 2008-2012.

The relatively high concentration in our sample companies in the Basic Materials and Energy, as well as in the Financial Services, industry sectors likely reflect the dominance of these industries in the Canadian economy. Additionally, because we find that similar key accounting policy differences affected companies in Basic Materials/Energy, and in Financial Services sectors, key financial figures and ratios are also presented separately for those sectors, to investigate industry effects.

4.2 Financial statement effects

To examine whether capital market participants find reported amounts computed in accordance with IFRS to be more relevant information, we investigate the value of two summary accounting measures – book values and net income – measured under CGAAP and IFRS. Liu (2011) suggested that net income under IFRS is still not completely comparable to net income under US GAAP and that the adjustment for tangible assets revaluation is a major contributor to the difference. Value relevance refers to the ability of the accounting measures to reflect the underlying economic value of the company, which we measure through contemporaneous share prices, as per Hung and Subramanyam (2007), serving as proxies for the fundamental value of the company. We thus investigate the extent to which the alternative measurements correlate with the information set used by investors in determining share prices.

Financial statement effects of adopting IFRS are analyzed by comparing mean, medians and standard deviations of selected accounting measures and financial ratios calculated for the same period under CGAAP and under IFRS. The t-test, Wilcoxon Signed-Rank test and F-test are used to test the significance of differences among accounting measures and financial ratios under the two accounting regimes. Using Minitab, both statistical non-parametric and parametric techniques are based on a null

<table>
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<th>Panel A: Market capitalization (in CAD million)</th>
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<tbody>
<tr>
<td>N</td>
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<tr>
<td>All sample</td>
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<tr>
<td>Firms using IFRS</td>
</tr>
<tr>
<td>Basic materials/energy*</td>
</tr>
<tr>
<td>Financial services**</td>
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<tr>
<td>Technology</td>
</tr>
<tr>
<td>Other***</td>
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<tr>
<td>Firms using US GAAP****</td>
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</tbody>
</table>

Table II.
S&P/TSX 60
Canadian firms by industry sectors and market capitalization

Note: *include Energy (11), Metals and Mining (10) and Chemicals (2); **include Banks (5), Insurance (3) and Asset Management (1); *** include Consumer Defensive (5), Consumer Cyclical (2) Industrials (2), Utilities (1) and Communication Services (1); ****Include: Utilities (3), Services (3), Healthcare (2), Energy (2), Basic Materials (1), Consumer Cyclical (1) and Technology (1)

Source: Bloomberg
hypothesis assuming that changes in differences are equally in means, medians and standard deviation.

In addition to the foregoing fundamental financial statement measures, we examine eight ratios that rely on financial statements. These ratios are as follows:

1. current ratio, CR, defined as current assets divided by current liabilities;
2. debt-to-assets, DTA, defined as total liabilities divided by total assets;
3. debt-to-equity, DTE, defined as total liabilities divided by total equity;
4. return on assets, ROA, defined as net income divided by total assets;
5. comprehensive return on assets, CROA, defined as comprehensive income divided by total assets;
6. return on equity, ROE, defined as net income divided by book value of equity;
7. profit margin, PM, defined as net income divided by sales revenue; and
8. net income divided by total comprehensive income NI/CI.

4.3 Value relevance
If IFRS indeed improves value relevance, then we expect a significant association between the summary financial accounting measures, book value and net income and the market values of companies that adopted IFRS. We test this by including a dummy variable for the post-adoption period (e.g. 2011-2013) and interaction variables between the dummy variable, book value and net income (see also Liu et al., 2011). If the adoption of IFRS has value relevance, then we expect a significant influence of the dummy and the interaction variables on the market value of companies that adopted IFRS. We use a panel data analysis by following the same set of companies during the pre- and post-IFRS adoption period to measure the impact of the book value and net income on the market value of the same set of companies during these two periods.

Annual financial information was drawn from the CRSP/COMPSTAT merged database over the period 2008-2013, separately for the three-year period before the adoption of IFRS and the three-year period after the adoption, identifying also the seven companies that were early IFRS adopters and the three-year period before and after the year of IFRS adoption. Our final sample contains 46 companies that converted from CGAAP and reported under IFRS in 2011 or previously.

We use panel data regression (time-fixed effects) to test the value-relevance model of IFRS adoption:

\[
\frac{MV_{i,t}}{MV_{i,t-1}} = \alpha_0 + \beta_1 \frac{NI_{i,t}}{MV_{i,t-1}} + \beta_2 \frac{BVE_{i,t}}{MV_{i,t-1}} + \beta_3 POST_{i,t} + \beta_4 POST_{i,t} \cdot \frac{NI_{i,t}}{MV_{i,t-1}} + \beta_5 POST_{i,t} \cdot \frac{BVE_{i,t}}{MV_{i,t-1}} + \beta_6 MTB_{i,t} + \beta_7 SIZE_{i,t} + \beta_8 LEV_{i,t} + \beta_9 CFO_{i,t} + \beta_{10} INS_{i,t} + \beta_{11} EM_{i,t} + \omega_{i,t},
\]

Where:
- \(MV_{i,t}\) = total market value of equity for firm \(i\), which is equal to the market price per share times the number of outstanding shares at the end of period \(t\);
\[NI = \text{net income};\]
\[BVE = \text{book value of common equity};\]
\[POST = \text{dummy variable, which equals one for the period 2011-2013 (post-IFRS adoption) and is zero otherwise;}\]
\[MTB = \text{Market-to-Book ratio is defined as the market value divided by total assets;}\]
\[SIZE = \text{logarithm of total assets;}\]
\[LEV = \text{total liabilities divided by total assets;}\]
\[CFO = \text{cash flows from operations divided by total assets;}\]
\[INS = \text{the proportion of institutional shareholdings;}\]
\[EM = \text{ represents earnings management by using discretionary accruals. The discretionary accruals are estimated by using the modified Jones model; and}\]
\[\omega_{i,t} = \text{the error term.}\]

Most studies on value relevance use OLS regression analysis. We use panel data analysis, which can be considered as more powerful when conducting cross-sectional and in-time analysis among companies. Because of weakness of Cramer statistic on R-square, we used interaction terms as suggested by Hope (2007). The dummy variable POST takes the value of one for the period 2011-2013 and is zero otherwise. Prior research, for example, Barth, (2001), Bartov et al., (2005) and Liu et al. (2011), used stock returns and stock prices as dependent variables. We used the market value of equity as dependent variable, consistent with, for example, Macias and Muñño (2011). If the adoption of IFRS generates value-relevance, then the coefficients for the term interacting with POST are expected to be positive and statistically significant (β4 and β5). Chen and Rezaee (2012) examined the role of corporate governance in convergence with IFRS. We investigated impact of institutional shareholdings on value relevance. Finally, we tested the impact of IFRS on earnings management, which has been a focus point of several studies (Noh et al., 2017; Liu et al., 2014; Liu and O’Farrell, 2011).

5. **Empirical results and discussion**

5.1 **Financial statement effects**

5.1.1 **Effects on all sample companies.** Panel A of Table III provides descriptive statistics on key accounting measures reported in the statement of financial position and comprehensive income.

Both total assets and total liabilities are found to be higher under IFRS than under CGAAP: the mean total assets and the mean non-current assets under IFRS are higher than under CGAAP at \(p \leq 5\) per cent and at \(p \leq 10\) per cent, respectively, while the mean total liabilities under IFRS are higher than under CGAAP at \(p \leq 10\) per cent. This implies that IFRS either recognizes more asset and liability items in the statement of financial position or that it measures them at higher values or both. Assets are higher primarily as a result of fair value accounting for investment property, consolidation, securitization and financial instruments. Higher liabilities are caused by an increase in the defined employee benefit obligation, consolidation, asset retirement obligations and deferred taxes (See Summary of Significant Accounting Standard Differences between IFRS and CGAAP). These differences are almost offset in shareholders’ equity, which is insignificantly increased under IFRS.

- **IFRS 1 First-time Adoption of IFRS**: Optional exemptions in IFRS 1 to the general requirement for full retrospective application of IFRS that are available on the transition date include: Property, plant and equipment (PPE) reported at deemed cost (i.e. fair value); cumulative translation gains or losses in AOCI reclassified to retained earnings; decommissioning liabilities re-measured; and all cumulative actuarial gains and losses recognized in opening equity.*
<table>
<thead>
<tr>
<th></th>
<th>IFRS</th>
<th>CGAAP</th>
<th>t-tests (2-tailed)</th>
<th>IFRS</th>
<th>CGAAP</th>
<th>Wilcoxon Signed-Rank Stat. (2-tailed)</th>
<th>IFRS</th>
<th>CGAAP</th>
<th>F-tests (1-tailed)</th>
<th>Sig.</th>
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<tr>
<td><strong>Panel A:</strong></td>
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<td>(N = 46)</td>
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<tr>
<td>Noncurrent assets</td>
<td>69,608.43</td>
<td>65,371.10</td>
<td>1.775</td>
<td>0.084*</td>
<td>14,452.00</td>
<td>12,071.00</td>
<td>-1.252</td>
<td>0.211*</td>
<td>158,430.44</td>
<td>150,939.00</td>
</tr>
<tr>
<td>Total assets</td>
<td>88,705.00</td>
<td>79,035.01</td>
<td>2.028</td>
<td>0.048**</td>
<td>18,709.00</td>
<td>18,465.50</td>
<td>-1.642</td>
<td>0.101</td>
<td>180,493.81</td>
<td>164,160.11</td>
</tr>
<tr>
<td>L-T liabilities</td>
<td>54,880.51</td>
<td>55,823.60</td>
<td>1.143</td>
<td>0.339</td>
<td>8,114.00</td>
<td>6,405.00</td>
<td>-2.621</td>
<td>0.009***</td>
<td>151,406.85</td>
<td>143,503.96</td>
</tr>
<tr>
<td>Total liabilities</td>
<td>77,417.01</td>
<td>67,981.97</td>
<td>1.940</td>
<td>0.059*</td>
<td>10,212.00</td>
<td>9,691.00</td>
<td>-2.567</td>
<td>0.010***</td>
<td>172,441.73</td>
<td>155,809.54</td>
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<tr>
<td>Total equity</td>
<td>11,204.42</td>
<td>11,150.60</td>
<td>-0.761</td>
<td>0.451</td>
<td>6,942.74</td>
<td>7,225.99</td>
<td>-0.448</td>
<td>0.121</td>
<td>10,614.36</td>
<td>10,904.27</td>
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<tr>
<td>Sales revenue</td>
<td>11,326.17</td>
<td>12,052.55</td>
<td>-0.854</td>
<td>0.097*</td>
<td>9,218.05</td>
<td>9,101.90</td>
<td>-0.828</td>
<td>0.408</td>
<td>10,119.63</td>
<td>10,087.56</td>
</tr>
<tr>
<td>Net income</td>
<td>1,218.88</td>
<td>1,194.52</td>
<td>-0.300</td>
<td>0.698</td>
<td>823.55</td>
<td>741.50</td>
<td>-0.617</td>
<td>0.537</td>
<td>1,351.91</td>
<td>1,507.16</td>
</tr>
<tr>
<td>Comprehensive income</td>
<td>1,165.87</td>
<td>1,116.72</td>
<td>-0.167</td>
<td>0.868</td>
<td>755.50</td>
<td>677.19</td>
<td>-1.207</td>
<td>0.227</td>
<td>1,513.44</td>
<td>1,380.81</td>
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<td><strong>Panel B:</strong></td>
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<tr>
<td>CR</td>
<td>1.66</td>
<td>1.48</td>
<td>1.612</td>
<td>0.114</td>
<td>1.22</td>
<td>1.13</td>
<td>-1.194</td>
<td>0.232</td>
<td>1.45</td>
<td>0.88</td>
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<tr>
<td>DTA</td>
<td>0.56</td>
<td>0.68</td>
<td>-0.917</td>
<td>0.364</td>
<td>0.57</td>
<td>0.54</td>
<td>-1.943</td>
<td>0.052***</td>
<td>0.26</td>
<td>0.90</td>
</tr>
<tr>
<td>DTE</td>
<td>4.13</td>
<td>3.44</td>
<td>2.053</td>
<td>0.046**</td>
<td>1.34</td>
<td>1.18</td>
<td>-3.431</td>
<td>0.001***</td>
<td>6.45</td>
<td>5.30</td>
</tr>
<tr>
<td>ROA</td>
<td>0.05</td>
<td>0.07</td>
<td>-0.707</td>
<td>0.483</td>
<td>0.05</td>
<td>0.04</td>
<td>-0.811</td>
<td>0.417</td>
<td>0.04</td>
<td>0.21</td>
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<td>CROA</td>
<td>0.05</td>
<td>0.07</td>
<td>-0.826</td>
<td>0.413</td>
<td>0.04</td>
<td>0.04</td>
<td>-0.666</td>
<td>0.505</td>
<td>0.04</td>
<td>0.19</td>
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<tr>
<td>ROE</td>
<td>0.14</td>
<td>0.12</td>
<td>2.201</td>
<td>0.033**</td>
<td>0.12</td>
<td>0.11</td>
<td>-3.037</td>
<td>0.002***</td>
<td>0.10</td>
<td>0.11</td>
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<tr>
<td>PM</td>
<td>0.17</td>
<td>0.15</td>
<td>1.293</td>
<td>0.203</td>
<td>0.13</td>
<td>0.12</td>
<td>-0.748</td>
<td>0.454</td>
<td>0.14</td>
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</tr>
<tr>
<td>NI/CI</td>
<td>1.03</td>
<td>0.98</td>
<td>1.657</td>
<td>0.105</td>
<td>1.05</td>
<td>1.00</td>
<td>-3.431</td>
<td>0.001***</td>
<td>0.51</td>
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**Notes:** Variable definitions: CR is current ratio, which equals current assets divided by current liabilities; DTA is debt-to-assets, defined as total liabilities divided by total assets; DTE is debt-to-equity, which equals total liabilities divided by total equity; ROA is return on assets, which equals net income divided by total assets; CROA is comprehensive return on assets, which equals comprehensive income divided by total assets; ROE is return on equity, which equals net income divided by book value of equity; PM profit margin, which equals net income divided by sales revenue; and NI/CI, which equals net income divided by total comprehensive income. The difference in mean is based on t-tests. The difference in median is based on Wilcoxon Signed-Rank tests. The difference in standard deviation is based on F-tests; Null hypothesis for test of equality of means/medians/variances; **null hypothesis rejected at the 1 per cent level of confidence; ***null hypothesis rejected at the 5% level of confidence; *null hypothesis rejected at the 10% level of confidence; All (46) S&P/TSX 60 firms that reported under IFRS in 2011 and switched to IFRS from CGAAP.
• **Financial Instruments – Recognition and Measurement (IFRS 9)**: Certain equity securities that are measured at fair value under IFRS were measured at cost under CGAAP. As to derecognition of financial instruments, securitization transactions, including transfers of financial assets to QSPEs, are more likely to be accounted for as secured borrowings in IFRS 9, rather than as sales using CGAAP. Also, the criteria for hedge accounting may differ under the two accounting frameworks.

• **Property, Plant and Equipment (IAS 16)**: PPE may be revalued to fair value if fair value can be measured reliably. Also, componentization – each part of an item of PPE with a cost that is significant in relation to the total cost is depreciated separately under IAS 16 (“component depreciation”).

• **Investment Property (IAS 40)**: Investment property is measured at fair value under IFRS 40 and any changes in fair value in net income during the period of change. Under CGAAP, it is measured at historical cost and depreciated over its estimated useful life.

• **Impairment of Assets (IAS 36)**: Under IFRS, recoverability of PPE is based on the higher of fair value less costs to sell and value in use (when the undiscounted future cash flows exceed the net carrying amount) of the asset group. Two-step impairment test in CGAAP.

• **Impairment of Goodwill (IAS 36)**: Goodwill is tested at the CGU level under IAS 36, a more granular level than a “reporting unit” level under CGAAP, which may result in impairment charges upon transition to IFRS and more frequent impairment charges going forward under IFRS.

• **Employee Benefits (IAS 19)**: Different accounting for actuarial gains and losses as well as differences in the measurement of the defined benefit obligation and plan assets (e.g. the use of fair values for determining the expected return on pension assets) in IAS 19 versus CGAAP result in significant reconciling adjustments in transition to IFRS.

• **Revenue (IAS 18)**: Revenue recognized when all significant risks and rewards of ownership are transferred to the purchaser. Differences in application guidance in IFRS and CGAAP available in various other related standards.

• **Business Combinations (IFRS 3)**: Applying the acquisition method may result in transactions being recognized as business combination under IFRS 3 that would not be recognized under CGAAP. Also, acquisition-related costs, other than debt or equity issue costs, are expensed in IFRS, included in goodwill in CGAAP.

• **Non-controlling Interest (IFRS 3)**: Non-controlling interest is included in equity under IFRS 3, presented within liabilities or in-between liabilities and shareholders’ equity in CGAAP. Also, share of profit/loss attributable to non-controlling interest recognized in equity in IFRS, treated as an expense/revenue in calculating consolidated profit/loss in CGAAP.

• **Consolidated Financial Statements (IFRS 10)**: Consolidation based on a control model in IFRS 10, which is broader than the two frameworks: the voting interest model or, when the entity is a VIE, the variable interest model applied under CGAAP. Several entities, including certain private equity investments and financing vehicles that were not consolidated under CGAAP, are consolidated under IFRS.

• **Asset Retirement Obligation (IAS 37)**: Asset retirement obligation (ARO) (also called decommissioning liabilities) is measured under IAS 37 using a risk-free interest rate
and is re-measured using the period end discount rate. Under CGAAP, no subsequent re-measurement is required.

- **Exploration and Evaluation Assets (IFRS 6):** Under IFRS 6, the classification of activities designated as exploratory or developmental determines the appropriate treatment and classification of the costs incurred while the full cost approach was available in CGAAP. Also, capitalized exploration and evaluation costs (E&E) are presented separately from PP&E as E&E assets.

- **Share-Based Compensation (IFRS 2):** Outstanding share-based compensation is measured at fair value under IFRS. It is measured at the intrinsic value in CGAAP. Furthermore, under IFRS, forfeitures are estimated on the grant date and included in the measurement of the liability.

- **Deferred Tax (IAS 12):** In transition to IFRS, **Deferred Income Taxes** are adjusted to reflect the tax effect arising from the temporary differences between IFRS and CGAAP. All deferred taxes are classified as non-current under IFRS.

[Notes: *This option is no longer available in IFRS 1. Other exemptions applied include no restatement of business combinations or share-based payments; **IFRS 9 Financial Instruments, issued in 2014, completed the IASB’s project to replace IAS 39; ***Amended IAS 19, effective from 2013, eliminated the existing option to defer actuarial gains and losses (“corridor approach”); ****In 2014 IFRS 15 Revenue from Contracts with Customers was issued (effective for annual periods beg. January 1, 2017).]

Regarding the statement of comprehensive income, the equality of means is statistically rejected for sales revenue at $p \leq 10$ per cent. This is consistent with previous findings that companies are more likely to report a noticeable lower sales figure in IFRS than in CGAAP. Differences in profit or loss in IFRS and CGAAP are mostly because of fair value adjustments, consolidation and equity-method accounting, impairments and the share of profit/loss attributable to non-controlling interests in IFRS. The ratio of profit or loss to comprehensive income is higher under IFRS, because comprehensive income is predominantly lower in IFRS than in CGAAP. This is largely a result of the negative adjustments made under IFRS 1 to other comprehensive income (OCI) at the date of transition and related, for example, to resetting to zero cumulative translation differences and accumulated actuarial losses (See Summary of Significant Accounting Standard Differences between IFRS and CGAAP).

There are also differences between the mean and median results, because the mean takes into account all observations, making this statistic sensitive to extreme values, whereas the median is not so affected. The equality of medians for non-current assets is rejected at $p \leq 10$ per cent and for total liabilities and long-term liabilities, which are higher under IFRS, is statistically rejected at $p \leq 1$ per cent. The difference between the mean and median indicates the influence of outliers in distorting the mean, common to small samples. Also, we find that the equality of standard deviations is rejected for total assets at $p \leq 10$ per cent, which suggests that greater volatility (measured as variance) exists in reported non-current assets in IFRS among companies represented. This comports with previous findings, for example, in Blanchette et al. (2013), indicating higher variability of book value and net income under IFRS.

The presentation of non-controlling interests in shareholders’ equity under IFRS and between liabilities and equity, or in liabilities under CGAAP, may represent a key accounting difference for companies transitioning to IFRS, resulting in an increase in equity. For example, TD Bank Group, at the date of transition to IFRS, recognized an increase in equity of CAD 1,493mn from reclassification of non-controlling interests to equity.
Panel B of Table III provides descriptive characteristics on key financial ratios. The DTE ratio is a measurement of a firm’s degree of leverage. We find that the equality of means of IFRS and CGAAP financial ratios, which are higher under IFRS, is statistically rejected for DTE and ROE ratio at $p \leq 5$ per cent. This is consistent with the results of prior studies, such as that by Iatridis and Rouvolis (2010), which they attributed to enhanced credibility of reported financial numbers under IFRS. The equality of medians is statistically rejected for DTA at $p \leq 10$ per cent as well as for DTE, ROE and NI/CI at $p \leq 1$ per cent. Financial ratios also show some volatility (measured as variance). The equality of variances of is statistically rejected for two ratios: ROE at $p \leq 10$ per cent and NI/CI at $p \leq 1$ per cent, which reveal greater volatility in CGAAP, implying that IFRS tends to smooth differences in those ratios among sample companies. There are significant differences between CGAAP and IFRS, as highlighted in (See Summary of Significant Accounting Standard Differences between IFRS and CGAAP), which directly affect those ratios, for example, recognizing cumulative translation gains or losses as well as actuarial gains and losses in opening equity in accordance with IFRS 1. A study of Canadian early IFRS adopters conducted by Hilliard (2013) indicates that volatility in earnings under a previous GAAP system is adjusted or corrected through the transition to IFRS.

Our sample results suggest that, in the aggregate, the amounts reported as book value of equity and net income under CGAAP do not change significantly after adopting IFRS. However, several financial statement measures and ratios are affected significantly in transition to IFRS. Therefore, the results are partially supportive of $H1a$ and $H1b$. The analyses of key figures and financial ratios in CGAAP and IFRS were performed separately for companies representing the Basic Materials/Energy and Financial Services sectors. The results are presented in Tables IV and V.

5.1.2 Effects on basic materials and energy companies. Panel A of Table IV A provides descriptive statistics on key accounting measures for Basic Materials and Energy sample firms.

Non-current assets and book value of equity are lower under IFRS: the mean and median non-current assets under IFRS are lower at $p \leq 5$ per cent, while mean (median) book value of equity under IFRS are lower than under CGAAP at $p \leq 5$ per cent ($p \leq 1$ per cent). This implies that IFRS either recognizes less non-current asset items in the statement of financial position or that it measures them at lower values or both. Lower valuations result from accounting for depreciation (e.g. component depreciation under IFRS), amortization, depletion, impairments, exploration expenses and decommissioning and restoration costs. Differences in accounting for employee benefits (i.e. increase in the defined benefit obligation) and recognizing an increase in deferred taxes also significantly contributed to lower equity reported under IFRS (Tables VI and VII).

Accounting policy differences regarding asset retirement obligations, mainly related to the discount rate used to measure the provision, significantly impacted companies representing this sector during transition to IFRS. Under IFRS, changes in obligations to dismantle, remove and restore items of PPE (i.e. asset retirement obligations or decommissioning liabilities) are measured under IFRS using a risk-free interest rate and are re-measured at the end of each reporting period to reflect a change in the discount rate. Under CGAAP, no subsequent re-measurement is required.

Also, under IFRS, the classification of activities designated as either exploratory or developmental determines the appropriate treatment and classification of the costs incurred. As a result, certain exploration costs capitalized under CGAAP using the full cost approach are expensed under IFRS, resulting in a decrease in exploration and development assets. In addition, capitalized exploration and evaluation costs (E&E) are presented separately from
<table>
<thead>
<tr>
<th></th>
<th>Means</th>
<th>Medians</th>
<th>Standard deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IFRS</td>
<td>CGAAP</td>
<td>IFRS</td>
</tr>
<tr>
<td>(in CAD million)</td>
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<tr>
<td><strong>Panel A:</strong></td>
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</tr>
<tr>
<td><strong>Accounting measures</strong></td>
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<td></td>
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<tr>
<td>(N = 22)/3</td>
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<td>Noncurrent assets</td>
<td>14,830.02</td>
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<td>Total assets</td>
<td>17,979.67</td>
<td>17,872.35</td>
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<td>L-T liabilities</td>
<td>6,109.64</td>
<td>6,631.59</td>
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<tr>
<td>Total liabilities</td>
<td>8,348.40</td>
<td>8,334.03</td>
<td>0.156</td>
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<tr>
<td>Total equity</td>
<td>9,761.28</td>
<td>10,114.58</td>
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<tr>
<td>Sales revenue</td>
<td>6,656.59</td>
<td>6,676.98</td>
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<tr>
<td>Net income</td>
<td>1,040.64</td>
<td>930.97</td>
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<td>Comprehensive income</td>
<td>1,017.12</td>
<td>922.08</td>
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<td><strong>Panel B:</strong></td>
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<tr>
<td><strong>Financial ratios</strong></td>
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<tr>
<td>CR</td>
<td>2.88</td>
<td>1.45</td>
<td>1.417</td>
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<tr>
<td>DTA</td>
<td>0.40</td>
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<tr>
<td>DTE</td>
<td>0.79</td>
<td>0.75</td>
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<td>ROA</td>
<td>0.07</td>
<td>0.12</td>
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<td>CROA</td>
<td>0.06</td>
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<tr>
<td>ROE</td>
<td>0.12</td>
<td>0.09</td>
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<td>PM</td>
<td>0.24</td>
<td>0.20</td>
<td>1.480</td>
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<tr>
<td>NI/CI</td>
<td>1.10</td>
<td>0.85</td>
<td>1.563</td>
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**Note:** Basic Materials and Energy firms include the following: Energy (11), Metals and Mining (9) and Chemicals (2)

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<thead>
<tr>
<th></th>
<th>IFRS</th>
<th>CGAAP</th>
<th>IFRS</th>
<th>CGAAP</th>
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<tbody>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
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<tr>
<td>Wilcoxon Signed-Rank Stat.</td>
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<td>Sig. (2-tailed)</td>
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<tr>
<td>F-tests</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Sig. (1-tailed)</td>
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Table IV. Tests of equality for basic materials and energy firms – means, medians and standard deviations.
Table V. Tests of equality for finance firms - means, medians and standard deviations

<table>
<thead>
<tr>
<th></th>
<th>Means (in CAD million)</th>
<th>Medians</th>
<th>Wilcoxon Signed-Rank Stat (2-tailed)</th>
<th>Standard deviations</th>
</tr>
</thead>
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<tr>
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<td>IFRS</td>
<td>CGAAP</td>
<td>t-tests Sig. (2-tailed)</td>
<td>IFRS</td>
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<tr>
<td>Non-current assets</td>
<td>225,245.38</td>
<td>201,193.14</td>
<td>0.800 0.454</td>
<td>200,965.00</td>
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<tr>
<td>Total assets</td>
<td>385,131.11</td>
<td>335,376.78</td>
<td>2.355 0.046**</td>
<td>383,758.00</td>
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<tr>
<td>L-T liabilities</td>
<td>278,269.60</td>
<td>249,482.45</td>
<td>-0.538 0.607</td>
<td>176,770.00</td>
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<tr>
<td>Total liabilities</td>
<td>359,087.67</td>
<td>311,853.89</td>
<td>2.208 0.058*</td>
<td>367,667.00</td>
</tr>
<tr>
<td>Total equity</td>
<td>24,776.78</td>
<td>22,285.78</td>
<td>0.323 0.755</td>
<td>23,851.00</td>
</tr>
<tr>
<td>Sales revenue</td>
<td>21,148.33</td>
<td>21,190.33</td>
<td>-0.395 0.703</td>
<td>21,662.00</td>
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<td>Net income</td>
<td>2,419.67</td>
<td>2,560.56</td>
<td>-0.488 0.639</td>
<td>1,518.00</td>
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<tr>
<td>Comprehensive income</td>
<td>2,339.11</td>
<td>2,446.33</td>
<td>-0.417 0.688</td>
<td>1,280.00</td>
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Panel B:

Financial ratios

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<td>CR</td>
<td>2.13</td>
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<tr>
<td>DTA</td>
<td>0.90</td>
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<tr>
<td>DTE</td>
<td>14.98</td>
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<tr>
<td>ROA</td>
<td>0.00</td>
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<td>CROA</td>
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<tr>
<td>ROE</td>
<td>0.10</td>
<td>0.11</td>
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<tr>
<td>PM</td>
<td>0.14</td>
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<tr>
<td>NI/CI</td>
<td>0.93</td>
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Note: *Finance firms in our sample include the following: Banks (5), Insurance (3) and Asset Management (1)
PPE as E&E assets in IFRS. Consequently, this requires a reclassification of E&E costs out of PPE and reporting them as a separate line item in the statement of financial position in transition to IFRS, which significantly decreased the amount reported as PPE (Tables VI and VII).

Panel B of Table IV A provides descriptive characteristics on key financial ratios. The results reveal that the equality of means is statistically rejected for DTE at $p \leq 1$ per cent and for ROE at $p \leq 5$ per cent, as the ratios are higher under IFRS. Our findings suggest that the higher ratios under IFRS mainly result from higher liabilities and lower book value of equity under IFRS. The equality of medians is rejected for DTA at $p \leq 10$ per cent as well as for DTE at $p \leq 1$ per cent, ROE at $p \leq 5$ per cent and NI/CI at $p \leq 1$ per cent. There also is greater volatility under CGAAP, for two ratios: CRA at $p \leq 10$ per cent and NI/CI at $p \leq 1$ per cent.

5.1.3 Effects on finance companies. Panel A of Table V provides descriptive statistics on key accounting measures for sample Finance firms.

Companies in the Finance sector report both total assets and total liabilities higher under IFRS. The mean (median) total assets under IFRS are higher than that under CGAAP at $p \leq 5$ per cent ($p \leq 1$ per cent), while mean (median) total liabilities under IFRS are higher than that under CGAAP at $p \leq 10$ per cent ($p \leq 5$ per cent). This implies that IFRS either recognizes more asset and liability items in the statement of financial position or that it measures them at higher values or both. Higher assets recognized under IFRS result from fair value measurements under IFRS, differences in the scope of consolidation accounting (e.g. consolidation of special purpose entities (SPEs)) and recognition of financial assets transferred in securitization transactions. However, the amounts of total assets reported by the sample companies were also often affected by impairments of intangibles and other assets (Tables VI and VII).

Higher liabilities under IFRS related predominantly to employee benefits, consolidation and on-balance sheet accounting for securitization transactions (derecognition), share-based payments and deferred tax. Although differences between assets and liabilities mostly offset, the largest negative difference in equity values is 65 per cent and the largest positive difference is 207 per cent under IFRS. Because liabilities have generally increased more than equity, IFRS adoption increases the average debt-to-equity ratio.

Panel B of Table V reveals that the equality of medians of IFRS and CGAAP figures is statistically rejected for three financial ratios, DTE, ROA and CROA, at $p \leq 10$ per cent, resulting from differences in values of assets and liabilities. Greater volatility (measured as variance) is noted for DTA, ROA, CROA and NC/CI at $p \leq 1$ per cent. These results imply that IFRS tends to magnify differences in those ratios, consistent with previous studies that examined early adopters of IFRS in Canada and found higher volatility of financial ratios under IFRS.

On average, banks included in the financial services sector reported lower equity after implementing IFRS, primarily because of significant transition adjustments for employee benefits, securitized mortgages previously derecognized, the fair value of private equity securities and the consolidation of certain SPEs. There were also increases because of the consolidation of SPEs.

5.1.4 Main accounting standard differences. The objectives of general purpose financial reporting under IFRS are targeted to provide useful information primarily to equity investors and other capital providers in making resource allocation decisions. Two primary qualities of useful information are relevance and faithful representation, both deemed enhanced by the use of fair value measurements.
### Table VI.
Descriptive statistics on the book value reconciliation adjustments between CGAAP and IFRS*

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<th>Reconciliations</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>N</th>
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</thead>
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<tr>
<td><strong>Panel A: Book value reconciliation – all observations (N = 46 firms)</strong></td>
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</tr>
<tr>
<td>Book value, CGAAP</td>
<td>11,187</td>
<td>7,226</td>
<td>10,651</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Deferred tax</td>
<td>−182</td>
<td>−12</td>
<td>590</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>Employee benefits</td>
<td>−412</td>
<td>−123</td>
<td>748</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Property, plant and equipment</td>
<td>−326</td>
<td>−196</td>
<td>1,980</td>
<td>33</td>
<td></td>
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<tr>
<td>Financial instruments</td>
<td>−85</td>
<td>−15</td>
<td>238</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Asset retirement obligation</td>
<td>−81</td>
<td>−6</td>
<td>429</td>
<td>27</td>
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<tr>
<td>Non-controlling interest</td>
<td>852</td>
<td>178</td>
<td>1,905</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Share-based payments</td>
<td>2</td>
<td>1</td>
<td>101</td>
<td>21</td>
<td></td>
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<tr>
<td>Translation differences</td>
<td>22</td>
<td>1</td>
<td>87</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Business combinations</td>
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<td>−2</td>
<td>766</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Revenue</td>
<td>−76</td>
<td>−16</td>
<td>170</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Leases</td>
<td>−87</td>
<td>2</td>
<td>218</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Exploration and evaluation</td>
<td>866</td>
<td>128</td>
<td>1,216</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Revaluations to fair value</td>
<td>154</td>
<td>86</td>
<td>325</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Consolidation</td>
<td>−15</td>
<td>−80</td>
<td>266</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Securitization</td>
<td>−242</td>
<td>−190</td>
<td>211</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Investments in joint ventures, associates</td>
<td>63</td>
<td>22</td>
<td>73</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Investment property</td>
<td>419</td>
<td>100</td>
<td>1,124</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Goodwill impairment</td>
<td>−784</td>
<td>−103</td>
<td>1,021</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Intangible assets</td>
<td>234</td>
<td>−5</td>
<td>446</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>IFRS</td>
<td>6,103</td>
<td>6,103</td>
<td>7,743</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>−1</td>
<td>0</td>
<td>19</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Book value, IFRS</td>
<td>11,199</td>
<td>7,383</td>
<td>10,537</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td><strong>Panel B: Book value reconciliation – basic materials (N = 22 firms)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book value, CGAAP</td>
<td>10,131</td>
<td>7,427</td>
<td>8,196</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Deferred tax</td>
<td>−176</td>
<td>−19</td>
<td>426</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Property, plant and equipment</td>
<td>−858</td>
<td>−315</td>
<td>1,456</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Asset retirement obligation</td>
<td>−11</td>
<td>−1</td>
<td>206</td>
<td>16</td>
<td></td>
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<tr>
<td>Financial instruments</td>
<td>7</td>
<td>−5</td>
<td>163</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Share-based payments</td>
<td>23</td>
<td>4</td>
<td>95</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Employee benefits</td>
<td>−59</td>
<td>−16</td>
<td>206</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Exploration and evaluation</td>
<td>944</td>
<td>300</td>
<td>1,252</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Non-controlling interest</td>
<td>219</td>
<td>58</td>
<td>509</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Investments in joint ventures, associates</td>
<td>−88</td>
<td>−39</td>
<td>218</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Translation differences</td>
<td>47</td>
<td>67</td>
<td>98</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Business combinations</td>
<td>290</td>
<td>4</td>
<td>396</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Goodwill impairment</td>
<td>−23</td>
<td>−17</td>
<td>12</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>8</td>
<td>14</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Book value, IFRS</td>
<td>9,748</td>
<td>7,427</td>
<td>8,196</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td><strong>Panel C: Book value reconciliation – finance (N = 9 firms)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book value, CGAAP</td>
<td>22,522</td>
<td>18,359</td>
<td>14,065</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Financial instruments</td>
<td>−180</td>
<td>−120</td>
<td>343</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Employee benefits</td>
<td>−537</td>
<td>−428</td>
<td>451</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Non-controlling interest</td>
<td>1,740</td>
<td>675</td>
<td>2,994</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Consolidation</td>
<td>−95</td>
<td>−82</td>
<td>323</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Securitization</td>
<td>−302</td>
<td>−315</td>
<td>201</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Business combinations</td>
<td>−496</td>
<td>−21</td>
<td>986</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Share-based payments</td>
<td>−55</td>
<td>−27</td>
<td>171</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Investment property</td>
<td>1,101</td>
<td>428</td>
<td>1,546</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Deferred tax</td>
<td>−687</td>
<td>−10</td>
<td>1,579</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Translation differences</td>
<td>83</td>
<td>63</td>
<td>95</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Revenue</td>
<td>−85</td>
<td>−6</td>
<td>158</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Leases</td>
<td>−188</td>
<td>−374</td>
<td>289</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IFRS</td>
<td>6,103</td>
<td>6,103</td>
<td>7,743</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Goodwill impairment</td>
<td>−1,898</td>
<td>−1,898</td>
<td>180</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Property, plant and equipment</td>
<td>8,585</td>
<td>8,585</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>−6</td>
<td>−20</td>
<td>36</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Book value, IFRS</td>
<td>24,822</td>
<td>23,674</td>
<td>11,408</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

*All numbers are in CAD millions, as reported in reconciliations from CGAAP to IFRS*
Table VII.
Panel data regression results using time-fixed effects of IFRS adoption of TSX 60 firms from 2008-2013

<table>
<thead>
<tr>
<th>Variable</th>
<th>2008-2010 Before adoption</th>
<th>2011-2013 After adoption</th>
<th>2008-2013 Total sample</th>
<th>2008-2013 Total sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.565***</td>
<td>0.289***</td>
<td>0.689***</td>
<td>1.444</td>
</tr>
<tr>
<td></td>
<td>(0.078)</td>
<td>(0.088)</td>
<td>(0.052)</td>
<td>(1.036)</td>
</tr>
<tr>
<td>NI&lt;sub&gt;it&lt;/sub&gt;/MV&lt;sub&gt;i,t-1&lt;/sub&gt;</td>
<td>0.535</td>
<td>1.593***</td>
<td>0.053</td>
<td>0.148</td>
</tr>
<tr>
<td></td>
<td>(0.342)</td>
<td>(0.442)</td>
<td>(0.122)</td>
<td>(0.136)</td>
</tr>
<tr>
<td>BVE&lt;sub&gt;it&lt;/sub&gt;/MV&lt;sub&gt;i,t-1&lt;/sub&gt;</td>
<td>0.247***</td>
<td>0.874***</td>
<td>0.108***</td>
<td>0.118***</td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td>(0.125)</td>
<td>(0.044)</td>
<td>(0.044)</td>
</tr>
<tr>
<td>POST&lt;sub&gt;it&lt;/sub&gt;</td>
<td>-0.401</td>
<td>-0.259*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.165)</td>
<td>(0.152)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST&lt;sub&gt;it&lt;/sub&gt; · (NI&lt;sub&gt;it&lt;/sub&gt;/MV&lt;sub&gt;i,t-1&lt;/sub&gt;)</td>
<td>1.759***</td>
<td>1.012**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.499)</td>
<td>(0.428)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST&lt;sub&gt;it&lt;/sub&gt; · (BVE&lt;sub&gt;it&lt;/sub&gt;/MV&lt;sub&gt;i,t-1&lt;/sub&gt;)</td>
<td>0.226***</td>
<td>0.228***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.092)</td>
<td>(0.089)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTB&lt;sub&gt;it&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>0.411***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.049)</td>
<td></td>
</tr>
<tr>
<td>SIZE&lt;sub&gt;it&lt;/sub&gt;</td>
<td>-0.219</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.226)</td>
<td></td>
</tr>
<tr>
<td>LEV&lt;sub&gt;it&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>0.188</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.413)</td>
<td></td>
</tr>
<tr>
<td>CFO&lt;sub&gt;it&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>-2.111***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.816)</td>
<td></td>
</tr>
<tr>
<td>INS&lt;sub&gt;it&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>-0.029</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.132)</td>
<td></td>
</tr>
<tr>
<td>EM&lt;sub&gt;it&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>-0.478</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(0.359)</td>
<td></td>
</tr>
<tr>
<td>Years</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.1650</td>
<td>0.5135</td>
<td>0.3274</td>
<td>0.3776</td>
</tr>
<tr>
<td>Firm year observations</td>
<td>n = 138</td>
<td>n = 138</td>
<td>n = 276</td>
<td>n = 276</td>
</tr>
</tbody>
</table>

Notes: This table shows the results of the following model using panel data regressions (time-fixed effects):

\[
\frac{MV_{i,t}}{MV_{i,t-1}} = \alpha_0 + \beta_1 \frac{NI_{i,t}}{MV_{i,t-1}} + \beta_2 \frac{BVE_{i,t}}{MV_{i,t-1}} + \beta_3 POST_{it} + \beta_4 POST_{it} \cdot \frac{NI_{i,t}}{MV_{i,t-1}} + \beta_5 POST_{it} \cdot \frac{BVE_{i,t}}{MV_{i,t-1}} + \beta_6 MTB_{it} + \beta_7 SIZE_{it} + \beta_8 LEV_{it} + \beta_9 CFO_{it} + \beta_10 INS_{it} + \beta_11 EM_{it} + \omega_{it}
\]

The dependent variable is equal to the firm’s market value scaled by the firm’s market value in the previous year. The variable NI is defined as net income. The variable BVE is the book value of common equity. POST is a dummy variable, which equals one for the period 2011-2013 (after adoption) and is zero otherwise. The variable MV is the market value for the firm, which is equal to the market price per share times the number of outstanding shares. Market-to-Book ratio (MTB) is defined as the market value divided by total assets. The variable SIZE is the logarithm of total assets. The variable LEV is defined as total liabilities divided by total assets. The variable CFO is defined as cash flows from operations divided by total assets. The variable INS is defined as the proportion of institutional shareholdings. The variable EM represents earnings management by using discretionary accruals. The discretionary accruals are estimated by using the modified Jones model (Jones, 1991). ***, **, * indicate statistical significance at the 1, 5 and 10 per cent level (two-sided), respectively; Robust standard errors are in brackets.
Table VI shows major book value of equity reconciliation categories (in million) in the order of their frequency.

*Deferred tax* is the most frequent adjustment item among all sample firms, with a frequency of 38 out of 46 observations. Deferred tax differences reflect the tax effect of temporary differences arising between IFRS and CGAAP, mostly because of IFRS use of fair values. The average effect is to reduce equity (mean reduction, 182), but the standard deviation of 590 is higher because of the presence of both equity increasing (i.e. recognition of deferred tax assets) and equity decreasing (i.e. deferred tax liabilities) adjustments.

*Employee benefits* (pension) adjustments (35 firms) significantly affected Canadian companies’ reported equity and results in transition to IFRS. This is because of (a) decisions regarding off-balance sheet amounts at the transition date, (b) differences in accounting rules and (c) amended IFRS effective in 2013\[2\]. One of the exemptions that Canadian companies could elect in transition was to recognize all previously unrecognized cumulative actuarial gains and losses at the transition date. Under pre-changeover CGAAP, actuarial gains and losses were allowed to remain unrecognized for extended periods of time. This option results in a one-time increase in reported liabilities and a decrease in reported equity and, consequently, avoids recognition of losses in transition to IFRS and subsequently. However, this one-time adjustment significantly impacts balance sheet equity\[3\] (mean reduction, 412; standard deviation, 748). Financial services companies that have to meet regulatory capital requirements may be hesitant to choose this one-time adjustment to equity at transition (e.g. Manulife). However, Manulife decided to apply another election by writing off cumulative translation losses of 5,148 million against equity. In our sample, 31 companies elected to write-off actuarial losses against equity.\[4\]

*Fair value measurements* are significant to many IFRS financial statements, particularly regarding the opening balance sheet at transition date, which often reflects the revaluation of several assets to fair value. Fair value adjustments observed in the sample companies come from one-time adjustments at the date of transition (i.e. fair value as deemed cost under IFRS 1), fair value measurements (e.g. for investment property, financial instruments) and revaluation models for PPE, as well as intangible assets (if there is an active market). Thus, FV adjustments are part of several reconciling items presented in Table VI (See Summary of Significant Accounting Standard Differences between IFRS and CGAAP).

Non-controlling interest adjustments increase book value of equity (mean, 852; standard deviation, 1,905) and are required because under IFRS this item is presented in equity, and the related share of profit/loss is treated as a capital adjustment. Under CGAAP, non-controlling interest is presented either between liabilities and equity or in liabilities, and the relevant share of profit/loss is in consolidated profit/loss.

*Consolidation* under IFRS is based on the principles of control\[5\], which is broader than the two allowable models (variable interests and voting interests) under CGAAP. Also, proportional consolidation is not allowed under IFRS. Consequently, more entities were consolidated and more joint ventures recognized under the equity method using IFRS, resulting in increased assets, liabilities and non-controlling interest. On average, consolidation reduced equity of our sample companies (mean, 15; standard deviation, 266).

Goodwill is tested for impairment under IFRS at the more granular cash generating unit level, which may result in impairment charges upon transition and more frequent future impairment charges. Firms in the insurance industry were significantly affected by goodwill impairment charges (in CAD million): Manulife (2,025) and SunLife (1,771). Henry *et al.* (2009) found that pensions and goodwill were the most dominant reconciliation items.

One of the biggest challenges in transitioning is assessing which accounting policies to use. For example, IFRS 1 provides optional exemptions from full retrospective application of
IFRS accounting policies, available only at the date of transition. The effects on prior periods of optional exemptions from some requirements of IFRS (other than IFRS 1) are recognized as one-time adjustments in shareholders’ equity, often in retained earnings. Furthermore, IFRS 1 optional exemptions, such as measuring PPE in the opening statement of financial position at a deemed cost and recognizing accumulated actuarial losses as well as foreign currency translation effects directly in equity at the date of transition decrease equity. The Summary of Significant Accounting Standard Differences between IFRS and CGAAP presents main accounting standard differences between CGAAP and IFRS.

5.2 Value relevance

We now address the value relevance comparison between the period before IFRS adoption and the period after the adoption of IFRS. Value relevance is measured in terms of accounting measures’ ability to estimate market capitalization. The results in Table VII show that the adjusted R-square of the panel data regression for the post-IFRS period (adjusted \( R^2 = 0.5135 \)) is higher than the adjusted R-square for the pre-IFRS period (adjusted \( R^2 = 0.1650 \)) which indicates higher value relevance for net income and equity reported after the adoption of IFRS (H3) in Canada in 2011 (H3). The Coefficient \( \beta_4 \) of 1.759 for \( \frac{POST \times N_{Li}}{MV_{Li-1}} \) is positive and statistically significant at the 1 per cent level. This result is in line with Cormier and Magnan (2016), who showed that migrating from Canadian GAAP to IFRS enhances the value relevance of earnings, but the effect is concentrated among firms that are cross-listed in the US Coefficient \( \beta_5 \) of 0.226 for \( POST \times \frac{BVE_{Li}}{MV_{Li-1}} \) is also statistically significant at the 1 per cent level. These results confirm H2.

Furthermore, Table VII shows that growth opportunities (proxied by MTB) have a positive impact on value relevance (p-value < 0.01). Other control variables such as firm size (SIZE) and leverage (LEV) are not significant. The coefficient of the control variable related to Cash Flows from Operations (CFO) is negative and significant at the 1 per cent level. This result is in alignment with the free cash flow theory (Jensen, 1986) which predicts that firms generating cash in excess of that required to fund positive NPV projects face greater agency problems and are more likely to invest in value-decreasing activities. We do not find empirical evidence of institutional shareholdings (INS) and reporting incentives (earnings management) on value relevance. We estimated reporting incentives by using discretionary accruals, estimated using the modified Jones model (Jones, 1991). A multicollinearity check was also performed. The variance inflation factors (VIF) are for all variables below 4. The correlation matrix (not shown here) also indicates that multicollinearity does not appear to be a problem. To decide between fixed or random effects, we ran a Hausman test. The test indicated that the preferred model is fixed effects. In our panel data analysis, we used fixed year effects to capture the influence of aggregate (time-series) trends.

We divided our sample into firms that are cross-listed on the TSX and NYSE/Nasdaq, and firms that are only listed on TSX. Table VIII shows the empirical results. Interestingly, our results indicate that earnings of cross-listed firms after the adoption of IFRS contains more value relevance than earnings of non-cross-listed firms. The coefficient \( \beta_4 \) of 2.376 for \( POST \times \frac{N_{Li}}{MV_{Li-1}} \) is statistically significant at the 1 per cent level. The same coefficient for non-cross-listed firms is negative and insignificant. We divided our sample into Basic Materials/Energy (22 companies) and other industries (24 companies). Table VIII shows that higher value relevance is identified for earnings and equity after the adoption of IFRS in the Basic Materials/Energy sector. The coefficient \( \beta_4 \) is positive, but not significant. Coefficient \( \beta_5 \) of 0.824 for \( POST \times \frac{BVE_{Li}}{MV_{Li-1}} \) is statistically significant at the 1 per cent level. The coefficients for earnings and equity in the post-IFRS period are negative in non-basic industries.
Table VIII.
Panel data regression results using time-fixed effects of IFRS adoption of TSX 60 firms from 2008-2013

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cross-listed</th>
<th>Non-Cross-listed</th>
<th>Basic Industries</th>
<th>Non-basic Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.211</td>
<td>-2.446**</td>
<td>1.064</td>
<td>-0.068</td>
</tr>
<tr>
<td></td>
<td>(1.272)</td>
<td>(1.079)**</td>
<td>(1.278)</td>
<td>(1.320)</td>
</tr>
<tr>
<td>(N_{i,t}/MV_{i,t-1})</td>
<td>-1.236</td>
<td>0.810</td>
<td>0.149</td>
<td>2.132***</td>
</tr>
<tr>
<td></td>
<td>(0.906)</td>
<td>(0.382)**</td>
<td>(0.260)***</td>
<td>(0.652)</td>
</tr>
<tr>
<td>(BVE_{i,t}/MV_{i,t-1})</td>
<td>0.479**</td>
<td>0.304**</td>
<td>0.119</td>
<td>0.620</td>
</tr>
<tr>
<td></td>
<td>(0.162)</td>
<td>(0.080)</td>
<td>(0.032)</td>
<td>(0.097)</td>
</tr>
<tr>
<td>(POST_{i,t})</td>
<td>-0.308*</td>
<td>0.231**</td>
<td>-0.421</td>
<td>0.048</td>
</tr>
<tr>
<td></td>
<td>(0.175)</td>
<td>(0.130)</td>
<td>(0.354)</td>
<td>(0.123)</td>
</tr>
<tr>
<td>(POST_{i,t} \cdot (N_{i,t}/MV_{i,t-1}))</td>
<td>2.376**</td>
<td>-0.156</td>
<td>0.799</td>
<td>-0.128</td>
</tr>
<tr>
<td></td>
<td>(0.935)</td>
<td>(0.793)</td>
<td>(0.631)</td>
<td>(0.724)</td>
</tr>
<tr>
<td>(POST_{i,t} \cdot (BVE_{i,t}/MV_{i,t-1}))</td>
<td>0.151</td>
<td>-0.094</td>
<td>0.824***</td>
<td>-0.149***</td>
</tr>
<tr>
<td></td>
<td>(0.104)</td>
<td>(0.043)</td>
<td>(0.236)</td>
<td>(0.044)</td>
</tr>
<tr>
<td>(MTB_{i,t})</td>
<td>0.441***</td>
<td>0.632***</td>
<td>0.424</td>
<td>0.497***</td>
</tr>
<tr>
<td></td>
<td>(0.062)</td>
<td>(0.102)**</td>
<td>(0.080)</td>
<td>(0.113)</td>
</tr>
<tr>
<td>(SIZE_{i,t})</td>
<td>-0.172</td>
<td>0.465**</td>
<td>-0.147**</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>(0.245)</td>
<td>(0.258)</td>
<td>(0.307)</td>
<td>(0.207)</td>
</tr>
<tr>
<td>(LEV_{i,t})</td>
<td>0.111</td>
<td>1.100***</td>
<td>0.198</td>
<td>0.086</td>
</tr>
<tr>
<td></td>
<td>(0.637)</td>
<td>(0.378)</td>
<td>(0.586)***</td>
<td>(0.723)</td>
</tr>
<tr>
<td>(CFO_{i,t})</td>
<td>-2.373**</td>
<td>0.097**</td>
<td>-2.180***</td>
<td>-1.691</td>
</tr>
<tr>
<td></td>
<td>(1.098)</td>
<td>(0.634)</td>
<td>(0.849)***</td>
<td>(1.136)</td>
</tr>
<tr>
<td>(INS_{i,t})</td>
<td>0.009</td>
<td>-0.231***</td>
<td>0.110**</td>
<td>-0.238***</td>
</tr>
<tr>
<td></td>
<td>(0.214)</td>
<td>(0.068)**</td>
<td>(0.292)</td>
<td>(0.127)</td>
</tr>
<tr>
<td>(EM_{i,t})</td>
<td>-0.546</td>
<td>-0.355</td>
<td>-1.048*</td>
<td>0.222</td>
</tr>
<tr>
<td></td>
<td>(0.536)</td>
<td>(0.462)</td>
<td>(0.638)</td>
<td>(0.453)</td>
</tr>
<tr>
<td>Years</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Adjusted (R^2)</td>
<td>0.4077</td>
<td>0.1382</td>
<td>0.5208</td>
<td>0.3995</td>
</tr>
<tr>
<td>Firm year observations</td>
<td>(n = 189)</td>
<td>(n = 87)</td>
<td>(n = 132)</td>
<td>(n = 144)</td>
</tr>
</tbody>
</table>

Notes: This table shows the results of the following model using panel data regressions (fixed effects):

\[
\frac{MV_{i,t}}{MV_{i,t-1}} = \alpha_0 + \beta_1 \frac{NI_{i,t}}{MV_{i,t-1}} + \beta_2 \frac{BVE_{i,t}}{MV_{i,t-1}} + \beta_3 POST_{i,t} + \beta_4 POST_{i,t} \cdot \frac{NI_{i,t}}{MV_{i,t-1}} + \\
\beta_5 POST_{i,t} \frac{BVE_{i,t}}{MV_{i,t-1}} + \beta_6 MTB_{i,t} + \beta_7 SIZE_{i,t} + \beta_8 LEV_{i,t} + \beta_9 CFO_{i,t} + \beta_{10} INS_{i,t} + \beta_{11} EM_{i,t} + \omega_{i,t}
\]

The dependent variable is equal to the firm’s market value scaled by the firm’s market value in the previous year. The variable \(NI\) is defined as net income. The variable \(BVE\) is the book value of common equity. \(POST\) is a dummy variable, which equals one for the period 2011-2013 (after adoption) and is zero otherwise. The variable \(MV\) is the market value for the firm, which is equal to the market price per share times the number of outstanding shares. Market-to-Book ratio (MTB) is defined as the market value divided by total assets. The variable \(SIZE\) is the logarithm of total assets. The variable \(LEV\) is defined as total liabilities divided by total assets. The variable \(CFO\) is defined as cash flows from operations divided by total assets. The variable \(INS\) is defined as the proportion of institutional shareholdings. The variable \(EM\) represents earnings management by using discretionary accruals. The discretionary accruals are estimated by using the modified Jones model. ***, ** and * indicate statistical significance at the 1, 5 and 10 per cent level (two-sided), respectively; Robust standard errors in brackets.
Overall, our results confirm our hypotheses that the adoption of IFRS improves value-relevance. Liu et al. (2011) and Jermakowicz et al. (2007) found similar results for China and Germany. Our results on earnings are in alignment with the international meta-study of Ahmed et al. (2013b). They conclude that the overall meta-analysis results show that the adoption of IFRS increases earnings value relevance. These results hold for all common law systems.

6. Conclusions
This paper investigates the impact of adopting IFRS in a financial reporting environment that ex ante has domestic standards similar to IFRS (AcSB, 2011). Our focus is on Canadian companies from the S&P/TSX 60 index, representing dominant industries in the Canadian economy. Most of those companies choose to apply IFRS although companies cross-listed in the USA were permitted to report under US GAAP. We investigate the financial statement effects on those (46) companies from the S&P/TSX 60 index which report under IFRS in 2011, having switched from CGAAP. Three major findings emerge from our analyses.

First, our study confirms findings by Blanchette et al. (2013) that at the aggregate level, IFRS adoption does not significantly change the central values that depict the financial position and performance of Canadian companies in financial statements. Our results suggest that the fundamental values of book value of equity and net income under CGAAP do not change significantly after adopting IFRS. However, several financial statement measures and ratios are affected significantly in transition to IFRS.

Second, we add to prior studies documenting significant industry effects in transition to IFRS (Blanchette et al., 2013; Hilliard, 2013). We find that noncurrent assets and book value of equity are lower under IFRS than under CGAAP for firms in the Basic Materials and Energy sectors, mainly from differences in accounting for exploration and evaluation assets, decommissioning liabilities, asset impairments, depreciation, amortization and depletion, as well as optional exemptions in IFRS 1. Our sample companies in the Finance sector report both total assets and total liabilities higher under IFRS, mainly as a result of fair value measurements, consolidating SPEs, recognition of financial assets transferred in securitization transactions and recognition of employee benefits (See Summary of Significant Accounting Standard Differences between IFRS and CGAAP).

Third, we add to the literature investigating whether IFRS adoption alters the information environment within countries that ex ante have domestic standards similar to IFRS (Brochet et al., 2013). The transition from CGAAP to IFRS provides investors with more relevant information by reducing the information gap between accounting measures and market values. The book value of equity and earnings have greater explanatory power regarding market values after adopting IFRS (Table VII). Therefore, it appears that transition from CGAAP to IFRS provided more useful information to investors, thus reducing the gap between an entity’s financial information and market values. Additionally, earnings of cross-listed firms after the adoption of IFRS seemingly contain more value relevance than earnings of non-cross-listed firms (Table VIII). Higher value relevance is also identified for earnings and equity after the adoption of IFRS in the Basic Materials/Energy sector (Table VIII). We observe an enhancement in the value relevance of earnings and equity following IFRS adoption. Our results show that earnings and equity are the most value relevant factors. These empirical findings may be of interest to US regulators, as the Canadian context is comparable to the USA situation in many aspects.

We acknowledge several limitations of our study. First, our relatively small sample size compared to typical market-based analyses limits generalizability and the power of our empirical analyses. Also, the companies in our sample were heavily concentrated in two
industry sectors: Basic Materials/Energy and Financial services. Second, the analysis is restricted to Canadian companies and as such results from this study may not be generalized to other countries. Also, the information environment differs and, consequently, share prices used in value-relevance studies may incorporate information in a different manner across companies (Soderstrom and Sun, 2007). Finally, the development of IFRS is a continuing process and IASB has recently enacted several standards affecting recognition, measurement and presentation of important economic activities, which may affect future IFRS adoptions.

Academicians are encouraged to develop future research that expands on our results regarding the potential benefits to investors from global accounting convergence. Particularly, addressing the extent to which companies adopt IFRS and which IFRS accounting policies are selected, as well as its impact on the quality of accounting information, should be explored and will be of interest to investors, regulators, standard setters and publicly traded companies.

This study is motivated by the US SEC’s current deliberations over whether US companies should be permitted or required to report under IFRS. Because financial reporting and legal environments in the USA and Canada are similar, we expect that the Canadian experience in adopting IFRS would probably resemble the situation that the US companies would face if the US SEC decides to require IFRS or permits companies to choose between US GAAP and IFRS. However, this view is subject to the following considerations:

- CGAAP has gradually evolved towards IFRS during at least five years, from the initial announcement in 2006, to the actual changeover in 2011. For example, in 2007, the AcSB eliminated the LIFO inventory costing method to converge with IFRS and, in 2009, accounting for development costs was converged with IFRS. These are two major differences between IFRS and US GAAP that many consider as impediments to adopting IFRS in the USA (AcSB, 2011).

- The impact of adopting IFRS on the financial statements of Canadian companies representing financial services may be significantly different than the potential effects of IFRS adoption on US financial institutions. This is because Canadian banks were not as involved in the sub-prime lending and securitization activities (Abdel-khalik, 2013)[6].

- Because IFRS is more principles-based than US GAAP, there are several areas where IFRS and US GAAP involve different levels of judgment (e.g. consolidation accounting).

Notes

1. TMXMoney is the official financial portal of the Toronto Stock Exchange.

2. Amended IAS 19 eliminated the existing option to defer actuarial gains and losses (known as the corridor approach), require changes from re-measurement of defined benefit plan assets and liabilities to be presented in the statement of other comprehensive income and require additional disclosures (effective for annual periods beginning on or after January 1, 2013). Also, the optional exemption to write off all cumulative actuarial gains and losses is no longer available.

3. Similarly, recognition of actuarial gains and losses in other comprehensive income (OCI) under new IFRS pension rules would have no impact on pension expense but result in greater volatility in equity.

4. US GAAP requires firms to recognize pension funded status (net pension asset/liability) in the balance sheet.
5. IFRS 10 *Consolidated Financial Statements* issued in 2011, superseded IAS 27 *Consolidated and Separate Financial Statements* and SIC-12 *Consolidation – Special Purpose Entities*.


References


Further reading


SEC “Acceptance from foreign private issuers of financial statements prepared in accordance with international financial reporting standards without reconciliation to GAAP (2007a)”, available at: www.sec.gov


Appendix. List of TSX-60 firms included in the study

- COMPANY NAME
- Agrium Inc.
- ARC Resources Ltd.
- Bank of Nova Scotia
- BCE Inc.
- Bombardier Inc.
- Brookfield Asset Management
IJAIM

264

490

- Cameco Corp.
- Canadian Imperial Bank of Commerce
- Canadian Natural Resources
- Canadian Oil Sands
- Canadian Tire Corp. Ltd.
- Cenovus Energy
- Eldorado Gold
- EnCana Corp.
- First Quantum Minerals
- George Weston Ltd.
- Gildan Activewear Inc.
- Goldcorp Inc.
- Husky Energy
- IamGold Corp
- Inmet Mining Corp
- Kinross Gold
- Loblaw Companies
- Manulife Financial
- Metro Inc.
- National Bank of Canada
- Nexen
- Penn West Petroleum
- Potash Corp. of Saskatchewan
- Power Corp. of Canada
- Rogers Communications
- Royal Bank of Canada
- Saputo Inc.
- Shaw Communications
- Shoppers Drug Mart Corp.
- Silver Wheaton
- SNC-Lavalin Group
- Sun Life Financial
- Suncor Energy
- Talisman Energy
- Teck Resources
- Telus Corp.
- Thomson Reuters Corp.
- Toronto-Dominion Bank
- TransAlta Corp.
- Yamana Gold
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Corporate governance, accounting information environment and investment-cash flow sensitivity

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Liang Song
Charlton College of Business, University of Massachusetts Dartmouth, Dartmouth, Massachusetts, USA

Abstract
Purpose – The purpose of this paper is to test the effects of antitakeover protection on investment-cash flow sensitivity and whether these effects are moderated by firms’ accounting information environment and agency problems.

Design/methodology/approach – To test the effects of agency problems, the authors use the passage of second-generation antitakeover laws as the testing ground, which is a pseudo-natural experiment that is widely used in the accounting, finance and economics literature (e.g. Armstrong et al., 2012; Bertrand and Mullainathan, 2003).

Findings – The authors’ analysis shows that investment-cash flow sensitivity is greater when managers are insulated from takeovers. The authors’ results also demonstrate that the effects of the passage of antitakeover laws on investment-cash flow sensitivity are greater when firms’ accounting information environment is poor, which is measured by fewer analysts following and higher analyst forecast dispersion. The authors also show that the effects of the passage of antitakeover laws on investment-cash flow sensitivity are greater when firms have severe agency problems, which are measured by more free cash flow.

Originality/value – The authors’ research extends the empirical accounting literature about the effects of corporate governance and accounting information environment on firms’ operating and financial decisions.

Keywords Corporate governance, Investment, cash flow, Accounting information environment

Paper type Research paper

1. Introduction
Problems of financing constraints resulting from firms’ agency and information asymmetry problems when making investment decisions is a central point in academic research (Stein, 2003)[1]. However, the extant empirical accounting and finance literature does not provide convincing evidence on the effects of agency and information asymmetry problems on firms’ investment-cash flow sensitivity (Cho, 1998; Goergen and Renneboog, 2001; Hadlock, 1998; Vogt, 1994)[2]. In our paper, we test the effects of antitakeover protection on investment-cash flow sensitivity and whether these effects are moderated by firms’

JEL classification – M41, M48

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accounting information environment and agency problems. Specifically, we use the passage of second-generation antitakeover laws as our testing ground, which is a pseudo-natural experiment that is widely used in the accounting, finance and economics literature (Armstrong et al., 2012; Bertrand and Mullainathan, 2003).

Theoretically, such antitakeover protection reduces management’s fear of a hostile takeover, and managers are less concerned about subsequent job loss. Therefore, there will be more agency problems (Bertrand and Mullainathan, 1999, 2003). For example, Bertrand and Mullainathan (1999) find evidence that managers increase managerial discretion to affect wages. Bertrand and Mullainathan (2003) show that managers become more entrenched and enjoy the quiet life. According to theories of capital-market imperfections, the increased financing frictions caused by greater monitoring costs incurred by outside investors will result in firms being more dependent on internal cash flow to invest and have greater investment-cash flow sensitivity (Hubbard, 1998).

However, the prior literature suggests that stronger takeover protection may be beneficial to bondholders because it mitigates agency conflicts between shareholders and bondholders by protecting bondholders from expropriation in takeovers (Klock et al., 2005; Chava et al., 2008). In particular, Francis et al. (2010) find a negative association between antitakeover protection and the cost of debt. Therefore, antitakeover protection allows firms to have better access to the debt market, and firms are likely to rely more on external funds. This perspective suggests that investment-cash flow sensitivity is lower for firms that are more protected from takeover threats. Therefore, the effects of the passage of antitakeover laws on investment-cash flow sensitivity remains an empirical question.

We test the influences of the passage of antitakeover laws on investment-cash flow sensitivity using a sample of manufacturing firms between 1981 and 1994. Unlike the Sarbanes–Oxley Act or Regulation Fair Disclosure, the passage of antitakeover laws did not occur in all states at the same time (Armstrong et al., 2012). The advantage of this empirical setting is that it provides a control group of firms in our empirical test, which allows us to use a differences-in-differences approach to investigate the causal effects of corporate governance on firms’ investment-cash flow sensitivities. Our investment equations are similar to those of Fazzari et al. (1988).

We find robust evidence suggesting an increase in investment-cash flow sensitivity when managers are insulated from takeovers. Our results also demonstrate that the effects of the passage of antitakeover laws on investment-cash flow sensitivity are greater when firms’ accounting information environment is poor, which is measured by fewer analysts following and higher analyst forecast dispersion. We also show that the effects of the passage of antitakeover laws on investment-cash flow sensitivity are greater when firms have severe agency problems, which are measured by more free cash flow.

Our paper contributes to the extant literature from several perspectives. Specifically, our research extends the empirical accounting and finance literature about the effects of laws on firms’ operating and financial decisions. For example, at the state level within the USA, after the passage of antitakeover laws, managers increase financial statement informativeness (Armstrong et al., 2012); increase their pay performance sensitivity (Cheng and Indjejikian, 2009); mitigate earnings management (Zhao and Chen, 2009); increase managerial discretion to affect wages (Bertrand and Mullainathan, 1999); reduce their use of debt (Garvey and Hanka, 1999); enjoy the quiet life (Bertrand and Mullainathan, 2003); reduce dividend payouts (Francis et al., 2011) and reduce their stockholdings (Cheng et al., 2005). Our paper contributes to this stream of literature by showing that these laws also have a significant impact on firms’ investment behaviors.
Our paper also contributes to the emerging empirical literature on the relationship between capital-market imperfections and investment behaviors (Hubbard, 1998; Ağca and Mozumdar, 2008; Bushman et al., 2011) by investigating the causal effects of these two constructs. Specifically, Fazzari et al. (1988) argue that the effects of financing constraint on corporate investment exist when comparing investment-cash flow sensitivities across firms sorted on indicators for financial constraints. However, Kaplan and Zingales (1997) argue that such a test is valid only if investment-cash flow sensitivity monotonically increases with respect to the degree of financing constraints. Cleary et al. (2007) reconcile the findings of both Fazzari et al. (1988) and Kaplan and Zingales (1997). Cleary et al. argue that when the classification criteria are based upon a measure of financing frictions, and when firms are not financially distressed, then investment-cash flow sensitivity increases in the degree of financing frictions encountered. However, when the classification is based upon a measure correlated with internal funds, as Kaplan and Zingales (1997) found, we can find such results.

In our paper, we focus only on large firms that are less likely to suffer from financial distress problems. Our exogenous measure of agency problems allows us to avoid the classification scheme problems encountered by Kaplan and Zingales (1997). Moreover, we do not completely rely on the existing cross-sectional analysis methodology, which classifies sample firms into the “financially constrained” and the “not financially constrained” categories based on a prior measure of financing constraints. Instead, we focus on the time-series component by testing how investment-cash flow sensitivity changes within firms after an important and direct determinant of financing frictions, agency problems, becomes worse. We also show that the effects of the passage of antitakeover laws on investment-cash flow sensitivity are more pronounced for firms with a poor accounting information environment and severe agency problems. Thus, our methodology alleviates Kaplan and Zingales’ other concern— that managers may retain some current cash flows to avoid future problems.

In addition, Erickson and Whited (2000), Gomes (2001), and Alti (2003) have demonstrated that higher investment-cash flow sensitivities for constrained firms may be caused by measurement problems related to the Q variable. Specifically, when the Q variable is improperly calculated, the cash flow variable contains information about investment opportunities. Therefore, the level of investment-cash flow sensitivities will be biased upwards for firms even without financing frictions. As we use the differences-in-differences approach and focus on the coefficient representing the difference of investment-cash flow sensitivity between our sample group firms and control group firms, any bias that is systematically related to our variables will be differenced out.

Finally, our paper has policy implications. We show that state antitakeover laws may increase investment-cash flow sensitivity, which is consistent with the prior literature suggesting that takeover protection is value-destroying to shareholders. However, more recent studies further suggest that takeover protection may benefit shareholders in certain situations (Ahn and Shrestha, 2013; Duru et al., 2013; Bhojraj et al., 2017). Thus, the overall effects of such regulations remain an open question. Policymakers should consider both benefits and costs in their decision-making process related to state antitakeover statutes.

This paper is organized as follows. Section 2 describes the second-generation antitakeover laws. Section 3 describes and summarizes our data. Section 4 reports the methodology and results. The conclusions are presented in Section 5.

2. Background of antitakeover laws
In the mid-to-late 1980s, several states passed antitakeover legislation. These laws, referred to as second-generation antitakeover legislation, increased the difficulty of a successful
takeover for firms incorporated in those states. Many studies consider such events to be exogenous[3]. Second-generation laws include three types:

(1) control share acquisition;
(2) fair price; and
(3) business combination.

Regarding the degree of the impact of these antitakeover laws, Karpoff and Malatesta (1989) find that investor reaction is the most negative to the announcement of the passage of business combination laws. Based on these findings, Bertrand and Mullainathan (1999, 2003) argue that the business combination laws are the most stringent of the three laws. However, Cheng et al. (2005) argue that the first law has the most influence on investors, as investors may anticipate the passage of subsequent laws. In our empirical section, our test obtains the same qualitative results using these two different approaches.

3. Data
3.1 Sample
Our sample data are generated from the Compustat database and include the USA manufacturing firms because firms in other sectors have different investment behaviors (Whited, 1992)[4]. Since the second-generation antitakeover law passed in the middle of 1980s and in the beginning of 1990s, we focus on the period from 1981 to 1994 to include all possible related influences of these antitakeover laws[5].

We use capital expenditures (item 128) to measure the variable Investment. The variable Cash Flow is constructed as the sum of earnings before extraordinary items (item 18) and depreciation (item 14). The variable Sales is defined as sales (net), (item 12), and the variable Cash is measured as cash (item 162). The variables Investment, Cash Flow, Sales and Cash are all deflated by Capital, which is measured as net property, plant and equipment (item 8) at the beginning of the year. The variable Q is constructed as the market value of assets divided by the book value of assets (item 6), where the market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity (item 60) and balance sheet deferred taxes (item 74). A firm’s state of incorporation is also collected from the Compustat database. The various years when antitakeover laws are passed in each state is obtained from Bertrand and Mullainathan (2003).

We exclude firms with Q greater than 10 from our sample, as these firms are more likely subject to large corporate events like mergers and acquisitions. We also exclude firms for which the required Compustat data were not available in the sample period. One advantage of a balanced sample is that we can obtain a stable data series and avoid distortions arising from mergers and acquisitions, delisting and initial public offerings. Another advantage is that we implicitly eliminate small firms, those for which linear investment models are likely inadequate (Gilchrist and Himmelberg, 1995). We acknowledge that we cannot avoid the survivor bias problem and thus leave it for future research. In total, our balanced sample comprised 2,786 observations across 199 firms between the years 1981-1994.

3.2 Summary statistics and univariate analysis
Table I presents descriptive statistics for the regression variables used in our analysis. The average value of Q is 1.45, which is similar compared with the reported Q of 1.2 by Kaplan and Zingales (1997).

Table II compares the mean of variables used in our regression analysis for companies incorporated in the states that passed antitakeover laws before and after state adoption of
antitakeover legislation. The significance level is based on a two-sample t-test. The results show that the Q, pre- and post-passing of antitakeover laws does not statistically change; neither do sales. This confirms that the passage of antitakeover laws is exogenous and that it does not influence firms’ investment opportunity. The results also show that firms reserve more cash after management becomes insulated from takeovers. This is consistent with the primary argument of agency theory that suggests that managers want to retain more cash inside the firm.

4. Methodology and results

4.1 Differences-in-differences approach

To examine the change in investment-cash flow sensitivity before and after the passage of antitakeover laws, we use the same differences-in-differences methodology as
Bertrand and Mullainathan (1999, 2003). The advantage of this methodology is that we can avoid omitted variable problems because for any given year, we have a control group, which is the set of states that did not pass antitakeover laws at that time (Bertrand and Mullainathan, 2003).

For example, we attempt to examine the effect of the Massachusetts law passed in 1989 on firms’ investment-cash flow sensitivity. We would calculate the difference in investment-cash flow sensitivity measures after 1989 and before 1989 for Massachusetts firms. However, if the recession in 1982 affected Massachusetts firms, such an economic event cannot be easily controlled for in our empirical tests and will bias our inference about the effects of the law.

Using a control state (i.e. Hawaii) would help to control for such an event. If Hawaii firms are also subject to this recession, the difference in investment-cash flow sensitivity measures between Massachusetts firms and Hawaii firms would eliminate the influence of this recession. Therefore, we would compare the difference in investment-cash flow sensitivity between Massachusetts and Hawaii before 1989 to the difference in investment-cash flow sensitivity after 1989. The disparity in these two differences would be the measure of the law’s effect in Massachusetts.

Our regressions are based on the methodology used in Fazzari et al. (1988). To accommodate our research question, we adjust the model in several ways, as described below, to test pre- and post-antitakeover laws effects. The regression equation has the following form:

\[
Investment_t = \alpha + \beta_1 Q_{t-1} + \beta_2 CashFlow_t + \beta_3 Treat \times CashFlow_t + \beta_4 PostLaw \times CashFlow_t + \beta_5 PostLaw + \beta_6 Control\ variables + \epsilon
\]  

where the dependent variable is firms’ investment (\(Investment_t\)). We use Tobin’ Q at the beginning of the current year (\(Q_{t-1}\)) to control for firms’ investment opportunities. Classical investment theory predicts a positive relation between Tobin’ Q and investment if Q correctly measures the firm’s investment opportunities and if the firm invests according to these investment opportunities. We also include cash flow (\(CashFlow_t\)). Fazzari et al. (1988) argue that if we control for investment opportunities and there is costly access to external capital markets, then there will be a positive relationship between internally generated cash flow and the amount of investment. \(Treat\) is a dummy variable, equal to 1 if a firm is incorporated in a state which passed antitakeover laws and 0 otherwise. We do not individually include this variable into our regression equation because the firm-fixed effect accounts for this effect. The interaction variable between \(CashFlow_t\) and \(Treat\) is used to capture the difference in investment-cash flow sensitivity across our treatment group firms, which include firms in antitakeover states and our control group, which are firms in states that have not passed any antitakeover legislation.

\(PostLaw\) is a dummy variable equal to 1 after the antitakeover law is passed for a certain company and 0 otherwise. In this paper, we apply two different methods to define this dummy variable. First, Bertrand and Mullainathan (1999, 2003) use the passage of Business Combination laws to represent the antitakeover law passage, as they argue that Business Combination laws are the most stringent of the three laws. In this way, we define the dummy variable \(PostLaw\) for each firm that takes a value of one after Business Combination laws have passed. The results presented in this paper are based on this approach. Second, Cheng et al. (2005) use the passage of the first antitakeover law to represent antitakeover law passage, as they argue that investors will anticipate the passage of the next law after the
passage of the first law. Thus, they believe it is the first law that has the greatest influence on investors. In this way, we define the dummy variable PostLaw for each firm that takes a value of one after the corresponding state’s first antitakeover law has passed, and we use this as a robustness test.

The interaction term between PostLaw and Cash Flow is our key variable, which captures the effect of the passage of antitakeover laws on investment-cash flow sensitivity, as the variable “Cash Flow multiplied by Treat” has captured all other differences between our treatment group firms and control group firms. According to our theoretical prediction, this variable should be positive, which means that firms’ investment is more sensitive to internal cash flow after states adopt antitakeover laws.

We also include other control variables. The variable Sales is a proxy for firms’ production to control for a possible accelerator effect (Hoshi et al., 1991). The variable Cash is included in the regression, as we want to control the effect that the sensitivity of investment to cash flow is likely to be lower if a firm has considerable financial slack. We estimate a firm and year fixed-effect model. We report robust standard errors that also incorporate clustering around each firm.

4.2 Results
4.2.1 Effects of the passage of antitakeover laws. As we have discussed, the key variable for our baseline analysis is the interaction term among the cash flow and PostLaw dummy variable (PostLaw*Cash Flow). This represents the antitakeover law effect on investment-cash flow sensitivity. According to column (1) of Table III, we find a positive and significant coefficient for this interaction term. This implies that after the passage of antitakeover laws, the investment sensitivity of cash flow has significantly increased. Moreover, this result is not only statistically significant but also economically significant. Specifically, the coefficient of the variable Cash Flow is 0.142, representing investment-cash flow sensitivity for our control group firms. The coefficient of the variable Treat * Cash Flow is −0.086, which is equal to the difference in investment-cash flow sensitivity between our treatment group firms and control group firms caused by other contemporary economic events. The coefficient of the variable PostLaw * Cash Flow is 0.045. These results suggest that investment-cash flow sensitivity increases by 0.045 after the passage of antitakeover laws, which is comparable with that reported in our control group firms and the difference in investment-cash flow sensitivity between our treatment group firms and control group firms caused by other contemporary economic events.

To make our results more robust, we use other regression specifications, and our results do not change qualitatively. Following Kaplan and Zingales (1997), in column (2) we remove Q_{t-1} as an independent variable from the regression, leaving cash flow as the only independent variable. Similarly, in column (3), we include the Q_{t} into our regression equation, which includes the information from the cash flow during the current period. In columns (4) and (5), we add lagged cash flow, as Hoshi et al. (1991) argue that cash flow during the current period might reflect some investment opportunity information not included within Q_{t-1}.

In Table IV, we present the baseline regression results on the effects of the passage of laws on investment-cash flow sensitivity with more specifications. In column (1), all variables are winsorized to ensure that our results are not affected by outliers. In column (2), only firms in states that have antitakeover legislation are included, as these states have different characteristics compared to firms in states where antitakeover legislation does not exist. In column (3), firms in Texas and California are excluded, since during this sample period, environmental shocks in the oil and defense industries drastically influenced the
Table III. Effects of the passage of laws on Investment-Cash flow sensitivity: Accounting information environment

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow</td>
<td>0.142***</td>
<td>0.179***</td>
<td>0.137***</td>
<td>0.134***</td>
<td>0.134***</td>
</tr>
<tr>
<td>Cash Flow</td>
<td>(0.023)</td>
<td>(0.028)</td>
<td>(0.023)</td>
<td>(0.025)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>Treat*Cash Flow</td>
<td>-0.086**</td>
<td>-0.107***</td>
<td>-0.082**</td>
<td>-0.095**</td>
<td>-0.094**</td>
</tr>
<tr>
<td>PostLaw*Cash Flow</td>
<td>0.045*</td>
<td>0.051*</td>
<td>0.044*</td>
<td>0.054**</td>
<td>0.058*</td>
</tr>
<tr>
<td>PostLaw</td>
<td>(0.026)</td>
<td>(0.031)</td>
<td>(0.026)</td>
<td>(0.027)</td>
<td>(0.030)</td>
</tr>
<tr>
<td>Q_{t-1}</td>
<td>0.088***</td>
<td>0.082***</td>
<td>0.077***</td>
<td>0.072***</td>
<td>0.072***</td>
</tr>
<tr>
<td>Q_{t-1}</td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Sales</td>
<td>0.010***</td>
<td>0.011***</td>
<td>0.010***</td>
<td>0.009***</td>
<td>0.009***</td>
</tr>
<tr>
<td>Sales</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Cash</td>
<td>0.015*</td>
<td>0.015 (0.010)</td>
<td>0.016*</td>
<td>0.007 (0.007)</td>
<td>0.004</td>
</tr>
<tr>
<td>Cash</td>
<td>(0.009)</td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Cash Flow_{t-1}</td>
<td>-0.025 (0.021)</td>
<td>-0.029 (0.022)</td>
<td>-0.024 (0.020)</td>
<td>-0.029 (0.020)</td>
<td>-0.029 (0.021)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.097***</td>
<td>0.211***</td>
<td>0.088***</td>
<td>0.098***</td>
<td>0.087***</td>
</tr>
<tr>
<td>Constant</td>
<td>(0.030)</td>
<td>(0.030)</td>
<td>(0.030)</td>
<td>(0.027)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.380</td>
<td>0.333</td>
<td>0.381</td>
<td>0.393</td>
<td>0.391</td>
</tr>
<tr>
<td>N. of observations</td>
<td>2786</td>
<td>2786</td>
<td>2785</td>
<td>2784</td>
<td>2780</td>
</tr>
</tbody>
</table>

Notes: Table III presents the regression results on the effects of passage of laws on investment-cash flow sensitivity. The dependent variable Investment is measured as capital expenditures (item 128). PostLaw equals one after the passage of the antitakeover law for certain firm and zero otherwise. Treat equals one if a firm is incorporated in a state that passed antitakeover laws; otherwise zero. Cash Flow is measured as the sum of earnings before extraordinary items (item 18) and depreciation (item 14). Q is measured as the market value of assets divided by the book value of assets (item 6), where the market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity (item 60) and balance sheet deferred taxes (item 74). All variables mentioned above are scaled by capital of the preceding year (item 8). All regression equations include firm and year effect and report robust standard errors that also incorporate clustering around each firm. Robust standard errors clustered by firm in parentheses; *represents significant at 10 per cent level; **represents significant at 5 per cent level; ***represents significant at 1 per cent level.
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash Flow</strong></td>
<td>0.134***</td>
<td>0.051 (0.031)</td>
<td>0.201** (0.084)</td>
<td>0.127*** (0.033)</td>
<td>0.119*** (0.030)</td>
</tr>
<tr>
<td><strong>Treat*Cash Flow</strong></td>
<td>-0.067*** (0.028)</td>
<td>0.000 (0.000)</td>
<td>-0.151* (0.088)</td>
<td>-0.083* (0.047)</td>
<td>-0.081* (0.045)</td>
</tr>
<tr>
<td><strong>PostLaw*Cash Flow</strong></td>
<td>0.033*** (0.013)</td>
<td>0.048* (0.026)</td>
<td>0.048* (0.026)</td>
<td>0.050*** (0.019)</td>
<td>0.047*** (0.015)</td>
</tr>
<tr>
<td><strong>Q_{t-1}</strong></td>
<td>0.095*** (0.012)</td>
<td>0.088*** (0.013)</td>
<td>0.089*** (0.013)</td>
<td>0.092*** (0.014)</td>
<td>0.101*** (0.015)</td>
</tr>
<tr>
<td><strong>Sales</strong></td>
<td>0.012*** (0.003)</td>
<td>0.012*** (0.004)</td>
<td>0.012*** (0.004)</td>
<td>0.011*** (0.003)</td>
<td>0.010*** (0.003)</td>
</tr>
<tr>
<td><strong>Cash</strong></td>
<td>0.025** (0.012)</td>
<td>0.018* (0.009)</td>
<td>0.017* (0.009)</td>
<td>0.015 (0.009)</td>
<td>0.013 (0.008)</td>
</tr>
<tr>
<td><strong>PostLaw</strong></td>
<td>-0.019 (0.015)</td>
<td>-0.047** (0.022)</td>
<td>-0.039** (0.020)</td>
<td>-0.031 (0.020)</td>
<td>-0.035* (0.020)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>0.078*** (0.025)</td>
<td>0.094*** (0.035)</td>
<td>0.086*** (0.034)</td>
<td>0.035 (0.027)</td>
<td>0.007 (0.026)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.384</td>
<td>0.382</td>
<td>0.381</td>
<td>0.376</td>
<td>0.380</td>
</tr>
<tr>
<td>N. of observations</td>
<td>2786</td>
<td>2492</td>
<td>2716</td>
<td>2388</td>
<td>1990</td>
</tr>
</tbody>
</table>

**Notes:** Table IV presents the regression results on the effects of passage of laws on investment-cash flows sensitivity with different specifications. (1) All variables are winsorized. (2) Only firms in antitakeover states are included. (3) Firms in Texas and California are excluded. (4) The sample period is 1982-1993. (5) The sample period is 1983-1992. The details of definitions of all the other variables are reported in Table III. All regression equations include firm and year effect and report robust standard errors that also incorporate clustering around each firm. Robust standard errors clustered by firm in parentheses. *represents significant at 10 per cent level; **represents significant at 5 per cent level; ***represents significant at 1 per cent level.
performance of the firms incorporated in Texas and California. In columns (4) and (5), we change sample period to 1982-1993 and 1983-1992 to ensure that our sample selection did not bias our results. Our results are still robust.

To summarize, we find robust evidence of a rise in investment-cash flow sensitivity when managers are insulated from takeovers. These results imply that costly monitoring of managerial actions can cause financing frictions, which correspondingly affect investment-cash flow sensitivity.

4.2.2 Effects of accounting information environment. Asymmetric information may result in external financing being overly expensive (Myers and Majluf, 1984). As management has superior information about a firm compared to outside investors, outside investors will demand a premium on the capital provided based on the level of asymmetric information. Further, this asymmetry will cause financing frictions, i.e. there is a difference in the costs between internal financing and external financing, and investment-cash flow sensitivity is higher. Thus, the effects of the passage of antitakeover laws should be more pronounced for firms with a poor accounting information environment because outside investors will incur greater monitoring costs for firms with a poor accounting information environment.

To measure the level of firms’ accounting information environment, we collect analysts’ current-fiscal-year earnings per share (EPS) forecast data from the I/B/E/S database. We call this variable Analyst Forecast Dispersion and define it as the standard deviation of analysts’ current-fiscal-year EPS forecasts scaled by the absolute value of the mean forecast. To make our results more robust, we also define the variable Analyst Forecast Dispersion as the standard deviation of analysts’ current-fiscal-year EPS forecasts scaled by fiscal year share price, and we find that our results do not change qualitatively. We define the variable Analyst Forecast Number as the number of analyst forecasts for a certain firm. Due to data limitations, we can only match half of our sample firms with these two variables. Based on these two variables, we construct two accounting information environment variables. AIE_1 is equal to one if Analyst Forecast Dispersion is lower than the median value and zero otherwise. AIE_2 is equal to one if Analyst Forecast Number is higher than the median value and zero otherwise.

To test the effect of the accounting information environment on the relationship between the passage of antitakeover laws and investment-cash flow sensitivity, we split our sample based on accounting information environment variables. In Table V, we partition the sample based on the variable AIE_1. We find that the effects of the passage of antitakeover laws are more pronounced for firms with a poor accounting information environment. In Table VI, we partition the sample based on the variable AIE_2. We still obtain the same results.

4.2.3 Effects of agency problems. Another test is related to the interaction effects between the passage of antitakeover laws and the level of firms’ agency problems. According to the above arguments, investment-cash flow sensitivities may be higher for firms with more agency problems. Therefore, we expect that investment may be more dependent on internal cash flow for firms with more agency problems.

We use free cash flow to measure agency problems, as more free cash flow may indicate more severe agency problems (Jensen, 1986). We follow Lehn and Poulsen (1989) to measure a firm’s free cash flow as follows:

\[
Free\ Cash\ Flow_t = Income\ before\ Dep_t - Income\ Taxes_t - Interest\ Expenses_t - Preferred\ Stock\ Dividend_t - Common\ Stock\ Dividend_t
\]

(2)

where Income before Dep equals operating income before depreciation (item 13), Income Taxes_t is equal to the difference between total income taxes (item 16) and the
### Table V.

Effects of accounting information environment, as measured by $AIE_1$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good accounting information environment ($AIE_1 = 1$)</th>
<th>Poor accounting information environment ($AIE_1 = 0$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Flow</td>
<td>0.143*** (0.022)</td>
<td>0.141*** (0.021)</td>
</tr>
<tr>
<td>Treat*Cash Flow</td>
<td>-0.086*** (0.038)</td>
<td>-0.086** (0.037)</td>
</tr>
<tr>
<td>PostLaw*Cash Flow</td>
<td>0.044 (0.044)</td>
<td>0.046*** (0.011)</td>
</tr>
<tr>
<td>$Q_{t-1}$</td>
<td>0.087*** (0.010)</td>
<td>0.088*** (0.013)</td>
</tr>
<tr>
<td>Sales</td>
<td>0.011*** (0.002)</td>
<td>0.012*** (0.002)</td>
</tr>
<tr>
<td>Cash</td>
<td>0.016 (0.016)</td>
<td>0.014 (0.013)</td>
</tr>
<tr>
<td>PostLaw</td>
<td>-0.024 (0.023)</td>
<td>-0.025 (0.022)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.069*** (0.022)</td>
<td>0.088*** (0.022)</td>
</tr>
<tr>
<td>$R^2$-squared</td>
<td>0.381</td>
<td>0.382</td>
</tr>
<tr>
<td>N. of observations</td>
<td>560</td>
<td>559</td>
</tr>
</tbody>
</table>

**Notes:** Table V presents the regression results on the effects of accounting information environment. The two subsamples are partitioned by $AIE_1$. $AIE_1$ is equal to one if Analyst Forecast Dispersion has lower than the median value and zero otherwise. Analyst Forecast Dispersion is the standard deviation of analysts’ current-fiscal-year EPS forecasts scaled by the absolute value of the mean forecast. The details of definitions of all the other variables are reported in Table III. All regression equations include firm and year effect and report robust standard errors that also incorporate clustering around each firm. Robust standard errors clustered by firm in parentheses; *represents significant at 10 per cent level; **represents significant at 5 per cent level; ***represents significant at 1 per cent level.

### Table VI.

Effects of accounting information environment, as measured by $AIE_2$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good accounting information environment ($AIE_2 = 1$)</th>
<th>Poor accounting information environment ($AIE_2 = 0$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Flow</td>
<td>0.140*** (0.011)</td>
<td>0.143*** (0.020)</td>
</tr>
<tr>
<td>Treat*Cash Flow</td>
<td>-0.082*** (0.022)</td>
<td>-0.083*** (0.012)</td>
</tr>
<tr>
<td>PostLaw*Cash Flow</td>
<td>0.040 (0.039)</td>
<td>0.044*** (0.013)</td>
</tr>
<tr>
<td>$Q_{t-1}$</td>
<td>0.077*** (0.009)</td>
<td>0.085*** (0.010)</td>
</tr>
<tr>
<td>Sales</td>
<td>0.012*** (0.002)</td>
<td>0.011*** (0.002)</td>
</tr>
<tr>
<td>Cash</td>
<td>0.014 (0.013)</td>
<td>0.015 (0.014)</td>
</tr>
<tr>
<td>PostLaw</td>
<td>-0.023 (0.022)</td>
<td>-0.024 (0.022)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.099*** (0.031)</td>
<td>0.096*** (0.032)</td>
</tr>
<tr>
<td>$R^2$-squared</td>
<td>0.379</td>
<td>0.382</td>
</tr>
<tr>
<td>N. of observations</td>
<td>560</td>
<td>559</td>
</tr>
</tbody>
</table>

**Notes:** Table VI presents the regression results on the effects of accounting information environment. The two subsamples are partitioned by $AIE_2$. $AIE_2$ is equal to one if Analyst Forecast Number has higher than the median value and zero otherwise. Analyst Forecast Number is the number of analyst forecast for a certain firm. The details of definitions of all the other variables are reported in Table III. All regression equations include firm and year effect and report robust standard errors that also incorporate clustering around each firm. Robust standard errors clustered by firm in parentheses; *represents significant at 10 per cent level; **represents significant at 5 per cent level; ***represents significant at 1 per cent level.
annul change in deferred taxes (item 35). Interest Expenses, is measured as gross interest expense on short-term liability and long-term debt (item 15). Preferred Stock Dividend, is equal to total preferred dividend (item 19). Common Stock Dividend, equals total common stock dividend (item 21). The variable Free Cash Flow, is scaled by the book value of common equity.

Based on the variable Free Cash Flow, we construct a dummy variable to measure the level of firms’ agency problems. High Agency Problem is equal to one if Free Cash Flow has a higher than the median value and zero otherwise. In Table VII, we partition the sample based on the variable High Agency Problem to test the effect of agency problems on the relationship between the passage of antitakeover laws and investment-cash flow sensitivity. We find that the effects of the passage of antitakeover laws are more pronounced for firms with more agency problems.

4.2.4 Effects of cross period. We also examine whether the effect of the passage of antitakeover laws varies over time. First, we examine whether the passage of antitakeover laws is exogenous. If the passage of antitakeover laws is not exogenous, investment-cash flow sensitivity may decline before the passage of antitakeover statutes. We add two dummy variables, PostLaw(−1) and PostLaw(0), following Bertrand and Mullainathan (1999). PostLaw(−1) is equal to 1 for one year before the passage of antitakeover laws and 0 otherwise. PostLaw(0) equals 1 for the year of the passage of antitakeover laws and 0 otherwise. As shown in column (1) of Table VIII, the coefficients on PostLaw(−1) and PostLaw(0) are not statistically significant. The results suggest that the passage of antitakeover laws is not endogenous.

To test whether the effects of the passage of antitakeover laws are short term or long term, we break apart the PostLaw dummy into several dummy variables. Specifically, PostLaw(+1) is equal to 1 for one year after the passage of antitakeover laws and 0 otherwise. PostLaw(+2) is equal to 1 for two years after the passage of antitakeover laws and 0 otherwise. PostLaw(>2) is equal to 1 for more than two years after the passage of

<table>
<thead>
<tr>
<th>Dependent variable = investment</th>
<th>High agency problem (High Agency Problem = 1)</th>
<th>Low agency problem (High Agency Problem = 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow</td>
<td>0.141*** (0.010)</td>
<td>0.143*** (0.020)</td>
</tr>
<tr>
<td>Treat*Cash Flow</td>
<td>−0.082*** (0.021)</td>
<td>−0.083*** (0.012)</td>
</tr>
<tr>
<td>PostLaw*Cash Flow</td>
<td>0.040*** (0.008)</td>
<td>0.043 (0.031)</td>
</tr>
<tr>
<td>Q,1</td>
<td>0.078*** (0.008)</td>
<td>0.085*** (0.009)</td>
</tr>
<tr>
<td>Sales</td>
<td>0.011*** (0.002)</td>
<td>0.012*** (0.002)</td>
</tr>
<tr>
<td>Cash</td>
<td>0.013 (0.013)</td>
<td>0.014 (0.014)</td>
</tr>
<tr>
<td>PostLaw</td>
<td>−0.024 (0.022)</td>
<td>−0.025 (0.022)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.098*** (0.031)</td>
<td>0.095*** (0.032)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.378</td>
<td>0.383</td>
</tr>
<tr>
<td>N. of observations</td>
<td>560</td>
<td>559</td>
</tr>
</tbody>
</table>

Notes: Table VII presents the regression results on the effects of accounting information environment. The two subsamples are partitioned by High Agency Problem. High Agency Problem is equal to one if Free Cash Flow has higher than the median value and zero otherwise. Free Cash Flow is defined in equation (2). The details of definitions of all the other variables are reported in Table III. All regression equations include firm and year effect and report robust standard errors that also incorporate clustering around each firm. Robust standard errors clustered by firm in parentheses; *represents significant at 10 per cent level; **represents significant at 5 per cent level; ***represents significant at 1 per cent level.
antitakeover laws and 0 otherwise. As reported in columns (2) and (3) of Table VIII, the coefficient on PostLaw(+1) is positive and statistically significant. In contrast, the coefficients on PostLaw(+2) and PostLaw(>2) are insignificant. The results suggest that the effects of the passage of antitakeover laws are short term.

5. Conclusion
In our paper, we find that investment-cash flow sensitivities statistically and economically increase after managers become more insulated from hostile takeovers. We also find that such effects are more pronounced for firms with a poor accounting information environment and severe agency problems.

We acknowledge that the evidence shown in this study underestimates the adverse effects of agency problems on corporate investment because our sample is dominated by large firms. Consequently, these firms have better corporate governance and tend to operate in a better external financing environment. Thus, it is reasonable to expect that the effects of antitakeover protection on investment behavior would be more pronounced for small firms. We encourage future research to investigate this argument.

Table VIII. Effects of cross period

<table>
<thead>
<tr>
<th>Dependent variable = investment</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow</td>
<td>0.141*** (0.022)</td>
<td>0.180*** (0.027)</td>
<td>0.138*** (0.021)</td>
</tr>
<tr>
<td>Treat*Cash Flow</td>
<td>-0.087*** (0.038)</td>
<td>-0.108*** (0.043)</td>
<td>-0.083*** (0.036)</td>
</tr>
<tr>
<td>PostLaw(-1)*Cash Flow</td>
<td>0.005 (0.006)</td>
<td></td>
<td>0.004 (0.004)</td>
</tr>
<tr>
<td>PostLaw(0)*Cash Flow</td>
<td>0.006 (0.006)</td>
<td></td>
<td>0.005 (0.005)</td>
</tr>
<tr>
<td>PostLaw*Cash Flow</td>
<td>0.044*** (0.009)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PostLaw(+1)*Cash Flow</td>
<td></td>
<td>0.051*** (0.010)</td>
<td>0.045*** (0.009)</td>
</tr>
<tr>
<td>PostLaw(+2)*Cash Flow</td>
<td></td>
<td>0.001 (0.001)</td>
<td>0.004 (0.006)</td>
</tr>
<tr>
<td>PostLaw(&gt;2)*Cash Flow</td>
<td></td>
<td>0.006 (0.007)</td>
<td>0.044 (0.046)</td>
</tr>
<tr>
<td>$Q_{t-1}$</td>
<td>0.089*** (0.014)</td>
<td>0.090*** (0.013)</td>
<td>0.082*** (0.013)</td>
</tr>
<tr>
<td>Sales</td>
<td>0.010*** (0.002)</td>
<td>0.011*** (0.002)</td>
<td>0.011*** (0.002)</td>
</tr>
<tr>
<td>Cash</td>
<td>0.015 (0.011)</td>
<td>0.015 (0.010)</td>
<td>0.016 (0.014)</td>
</tr>
<tr>
<td>PostLaw(-1)</td>
<td>-0.022 (0.021)</td>
<td></td>
<td>-0.023 (0.022)</td>
</tr>
<tr>
<td>PostLaw(0)</td>
<td>-0.012 (0.011)</td>
<td></td>
<td>-0.011 (0.010)</td>
</tr>
<tr>
<td>PostLaw</td>
<td>-0.023 (0.021)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PostLaw(+1)</td>
<td></td>
<td>-0.009 (0.012)</td>
<td>-0.005 (0.011)</td>
</tr>
<tr>
<td>PostLaw(+2)</td>
<td></td>
<td>-0.022 (0.023)</td>
<td>-0.005 (0.012)</td>
</tr>
<tr>
<td>PostLaw(&gt;2)</td>
<td></td>
<td>-0.009 (0.008)</td>
<td>-0.012 (0.011)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.098*** (0.029)</td>
<td>0.212*** (0.031)</td>
<td>0.089*** (0.021)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.381</td>
<td>0.333</td>
<td>0.380</td>
</tr>
<tr>
<td>N. of observations</td>
<td>2786</td>
<td>2786</td>
<td>2786</td>
</tr>
</tbody>
</table>

Notes: Table VIII presents the regression results on the effects of cross period. PostLaw(-1) is equal to 1 for one year before the passage of antitakeover laws and 0 otherwise. PostLaw(0) equals 1 for the year of the passage of antitakeover laws and 0 otherwise. PostLaw(+1) is equal to 1 for one year after the passage of antitakeover laws and 0 otherwise. PostLaw(+2) is equal to 1 for two years after the passage of antitakeover laws and 0 otherwise. PostLaw(>2) is equal to 1 for more than two years after the passage of antitakeover laws and 0 otherwise. The details of definitions of all the other variables are reported in Table III. All regression equations include firm and year effect and report robust standard errors that also incorporate clustering around each firm. Robust standard errors clustered by firm in parentheses. *represents significant at 10 per cent level; **represents significant at 5 per cent level; ***represents significant at 1 per cent level.
Our results have important policy implications for policymakers and regulators. Indeed, there are several ways to improve a firm’s financing and investment environment. One of them is to improve the firm’s corporate governance and thereby reduce financing frictions. The effects are more significant for firms with a poor accounting information environment and more agency problems.

Notes
1. The literature has also investigated the effects of agency and information asymmetry problems on other issues such as audit quality, merger and acquisition and earnings management (e.g. Khan et al., 2016; Lim et al., 2015; AL-Dhamari and Ismail, 2014; Astami et al., 2017; Liu et al., 2014).
2. One problem associated with these studies is the endogeneity problem. Firms with different levels of corporate governance may also differ on other dimensions because changes in governance may be associated with other unobservable changes (Bertrand and Mullainathan, 2003).
3. More detailed descriptions about antitakeover laws can be found in existing studies (e.g. Bertrand and Mullainathan, 1999, 2003 and Cheng et al., 2005).
4. We include firms with two-digit SIC code between 20 and 39.
5. As a robustness test, we change our sample period, and our results do not change qualitatively.

References


Further reading


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Real earnings management and financial statement fraud: evidence from Malaysia

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Abstract

Purpose – We examine whether the fraud firms are engaged in real earnings management and accrual earnings management prior to the fraud year in the Malaysian context.

Design/methodology/approach – Our sample comprises of 65 financial statement fraud and 65 non-fraud firms over a period of eight years from 2001 to 2008.

Findings – Using the abnormal cash flow from operations (CFO) and abnormal production costs as the proxies for real earnings management, we find that financial statement fraud firms engage in manipulating production costs during preceding two years of the fraud event. However, our results show that financial fraud firms engage in manipulating CFO prior to the fraud event. Additionally, we find that financial statement fraud firms prefer to manipulate earnings using accruals relative to real earnings prior to the fraud year.

Originality/value – Our results demonstrate that real earnings management is more aggressive in financial statement fraud firms compared to the non-fraud firms in the four years prior to fraud.

Keywords Malaysia, Earnings management, Financial statement fraud, Accrual manipulation, Real activity manipulation

Paper type Research paper

1. Introduction

The rising number of cases involving financial statement fraud have received considerable attention following the collapse of a number of firms in Malaysia (Malaysian Institute of Accountants, 2012)[1]. In 2009, KPMG Malaysia estimated that financial statement fraud valued RM63.5 million each year. Financial statement fraud is a type of fraudulent financial reporting. We examine firms that are convicted for fraudulent financial reporting primarily resulted from delays in disclosing information, failure in disclosing information, and
fabrication of accounting details. In addition to the direct impact on the financial statement fraud firms, Perols and Lougee (2011) state that financial statement fraud affects employees, creditors, and investors. The incidence of financial statement fraud also weakens the reliability of corporate financial statements and confidence in financial markets. The severity of financial statement fraud in manipulating accounting information has influenced the ability of financial statement users in decision making processes. These concerns have generated social attention and economic concern in the country. Hence, this paper attempts to examine the incidence of real earnings management around the financial statement frauds in Malaysian context.

Akers, Giacomino, and Bellovary, (2007) argue that financial statement fraud has implications for earnings management. A firm’s earnings management practices can be considered as unethical (Dugan and Gary, 2016). Previously, studies on earnings management have used accounting accruals as the proxy for earnings management. For example, Liu and O’Farrell, (2011) provide evidence that the magnitude of accruals have decreased in China since 2007 after the introduction of new set of accounting standards. Perols and Lougee (2011) investigate relationship between earnings management in fraud firms in the US. Our paper is different from this study because we test whether fraud firms manipulate real activities in developing countries, particularly, Malaysia where institutional arrangements governing corporate reporting different from those in the US.

Recently, Liu et al. (2014) find significantly higher earnings management for the IAS/IFRS firms. Lee and Choi (2015) observe that firms manage bad debt expense downward to avoid Losses. Zarzedi (2016) finds that greater volatility of sales, cash flow, accruals and earnings provide a lower accrual quality. Xu and Ji (2016) document that the top Chinese firms engage in earnings management in the pre-post GFC. Lau and Ooi (2014) show that the motives of fraudulent financial reporting for firms to manipulate their financial statements include capital raising exercises, closeness to defaulting on debt repayments and sustaining equity overvaluations. However, existing literature provides evidence that it is more favourable for firms to manipulate their real activities (Ball and Shivakumar, 2005; Graham, Harvey and Rajgopal, 2005; Hashemi and Rabiee, 2011; Joosten, 2012). Further, Zang (2011) and Pincus and Rajgopal (2002) highlight that real earnings management activities occur prior to accruals earnings management. Real earnings management includes the alterations of activities through adjusting the timing and scale of underlying real business activities (Xu, Taylor and Dugan, 2007). Examples of real earnings management include providing excessive sales discounts, offering too lenient credit terms and increasing production to manipulate the value of current earnings. Given these conditions, real earnings management is more difficult for outsiders to detect compared to accruals earnings management (Ball and Shivakumar, 2005; Graham et al., 2005; Schipper, 1989) and hence, may turn out to be the preferred form of earnings management. As far as we know, to date no studies have examined the practice of real earnings management of fraud firms prior to the financial statement fraud year in emerging economies, especially, Malaysia.

The justification for choosing firms in Malaysia as the context for this study is due to several reasons. Malaysia is one of the prominent growing economies in the world. Malaysia’s GDP has risen about 6 per cent per year, which is higher than the US, UK and Europe (Department of Statistics Malaysia, 2013). Malaysia’s total trade has also increased from RM685 billion in 2000 to RM1,168 billion in 2010. Moreover, its capital market has also grown rapidly in the last decade.[2] the government has shown awareness by appointing a number of agencies to address the subject related to financial reporting quality such as the Companies Commission of Malaysia (CCM), Securities Commission of Malaysia (SCM), Bursa Malaysia and Malaysian Institute of Accountants (MIA). These agencies are formed
to ensure that financial reporting in Malaysian firms reflect acceptable global standards in order to retain and attract potential investors.

However, there is also a growing concern for the reported increase in financial statement fraud in Malaysia. Almost 30 per cent of enforcement actions taken by the Securities Commissions of Malaysia (SCM) are due to financial statement fraud activities[3]. Financial statement fraud leads to issues such as weakening the reliability of corporate financial statements and lowering the confidence in the financial markets.

Our study contributes to the literature in several ways. First, to date, limited studies have examined the real earnings management activities prior to the occurrence of financial statement fraud. Our study examines the occurrence of real earnings management activities in the period leading up to the financial statement fraud event. According to Perols and Lougee (2011), real earnings management precedes incidents of financial statement fraud. Previous earnings management studies primarily focused on accruals[4] and it is only recently real earnings management activities has drawn increased interest. Hence, we explore the real earnings management activities by financial statement fraud firms prior to the financial statement fraud year. Second, much of the evidence on financial statement fraud pertains to developed countries where the capital markets are mature and the levels of awareness and demand for quality financial reports are high. Evidence from our study improves the analysts’ and investors’ ability to detect early warning signs of financial statement fraud. This is a significant contribution since no research on the involvement of Malaysia’s financial statement fraud firms in real earnings management activities prior to financial statement fraud event has ever been conducted. Finally, our study offers benefits through a number of practical implications. The outcomes of this study may be used to assist regulators, especially the SCM and Bursa Malaysia, to improve the accounting reporting quality and protect firms from financial statement fraud. Investors may also benefit from this study through a better investment decision made from a reliable corporate financial statement.

2. Extant research and hypotheses development
2.1 Real earnings management and financial statement fraud
Extant literature provides evidence that financial statement fraud firms are involved in accruals earnings management prior to fraud occurrence (Dechow et al., 1996; Perols and Lougee, 2011). However, it is evident that earnings management is not limited to accrual manipulations only. Managers may engage in real earnings management through altering normal activities to manipulate the reported earnings (Roychowdhury, 2006). Existing literature also provides evidence that it is more conducive for firms to manipulate real activities compared to the accruals (Ball and Shivakumar, 2005; Graham et al., 2005; Hashemi and Rabiee, 2011; Joosten, 2012).

Perols and Lougee (2011) argue that firms are involved in financial statement fraud because fraudulent firms have limited earnings flexibilities due to preliminary aggressive earnings management activities. Joosten (2012) and Zang (2011) advocate that firms in such cases engage in higher real earnings management. Sun (2011) finds that firms engage in real earnings management activities in an attempt to meet analysts’ earnings forecasts and avoid losses. Furthermore, Enomoto et al. (2012) emphasise that real earnings management activities are preferred over accruals earnings management in countries with stronger investor protection, such as, Malaysia. In this study, we focus on two types of real earnings management, which are the cash flow from operations and production costs.
2.1.1 Abnormal cash flow from operations and financial statement fraud. It is argued that firms are involved in financial statement fraud because they fail to achieve the earnings benchmark (Graham et al., 2005; Jungeun, Jaimin, and Jaehong, 2012). Therefore, it is possible that financial statement fraud firms intend to report higher income through higher sales revenue. Dechow et al. (2011) conclude that the amount of sales significantly increase in the financial statement fraud year. By giving discounts on the selling price, the firm accelerates the sales volume in the current year, which causes the earnings for the current year to increase (Roychowdhury, 2006). However, this causes the cash inflow per sale item to decrease. Therefore, as the financial statement fraud year approaches, any excessive sales discount and lenient credit terms will consequently result in lower CFO level in financial statement fraud firms. The lower level of abnormal CFO means that the earning quality is also lower in financial statement fraud firms compared to non-fraud firms. This leads to the following hypothesis:

\[ H1a: \] Prior to the financial statement fraud year, financial statement fraud firms are likely to have lower abnormal cash flow from operations compared to non-fraud firms.

2.1.2 Abnormal production costs and financial statement fraud. Apart from managing cash flow from operations, Roychowdhury (2006) and Gunny (2010) classify manipulating production costs as another form of real earnings management activity. Production costs are measured as the sum of cost of goods sold (COGS) and change in inventory. In managing the production costs, the firm increases the volume of production more than normal levels. This activity causes production costs to increase but the fixed cost per item reduces because it is spread to the larger volume of productions. Consequently, the COGS per unit decreases and profit margin per sale item increases (Thomas and Zhang, 2002). However, overproduction will lead to higher total production costs than normal production costs for a given level of sales. By doing this, firms succeed in improving their profitability margins but at the same time incur production costs to be abnormally high.

Charitou, Neophytou, and Charalambous (2004) argue that healthy firms have less intention to manipulate earnings compared to unhealthy firms. Since it is argued that firms will engage in financial statement fraud to achieve targeted earnings, financial statement fraud firms are likely to report higher production cost overall. Therefore, the following hypothesis is generated:

\[ H1b: \] Prior to the financial statement fraud year, financial statement fraud firms are likely to have higher abnormal production costs compared to non-fraud firms.

3. Research methodology

3.1 Data collection

We examine financial statement fraud firms registered as public firms with the Company Registrar of Malaysia. This is similar to Agrawal and Chadha (2005) where their sample firms are listed and unlisted public firms. Financial statement fraud is a type of fraudulent financial reporting. The main violations here include delays in disclosing information, failure to disclose information, and fabrication of accounting details. Firms are classified as delaying information disclosure when they are involved in late announcement of purchase and sales activity and also fail to disclose significant transactions within the stipulated period. Failure to disclose information refers to activities such as concealment of share acquisitions and disposal as well as concealment.
of purchasing and sales activity. In the matter of fabricating accounting details, firms fail to provide factual, clear, unambiguous, accurate, succinct and sufficient financial statement information. Table I summarises the nature of financial statement fraud activities in Malaysia.

We use two sources to identify financial statement fraud firms. First, the data are retrieved from the Securities Commissions of Malaysia (SCM)’s enforcement releases. Since the information from the SCM is only available starting from 2001, we select firms that commit financial statement fraud from 2001 to 2008 and detailed information up to 2009. This is essential because the variables used in our study are based on the year the fraud occurred. Later, a list with more financial statement fraud firms is collected from SCM press releases. In most cases, the firms identified in the SCM press release are also reported in the SCM enforcement release. Consequently, the financial statement fraud firms reported in the SCM press release, but not in SCM enforcement release, are added to the sample of financial statement fraud firms.

The second source of financial statement fraud firms list is the Bursa Malaysia enforcement release. Each announcement made by the Bursa Malaysia from 2001 to 2009 is reviewed to identify firms that are convicted with financial statement fraud. Similar to the method used regarding the SCM data to retrieve the sample, the Bursa Malaysia enforcement releases are examined to identify firms that commit financial statement fraud from 2001 to 2008. We cautiously examine each SCM and the Bursa Malaysia report to ensure the sample firms fit the definition of financial statement fraud as used in this study (refer to Table II). Similar to Beasley (1996), in the case where a firm is found to commit financial statement fraud more than once in the study period, only the first case is counted in the sample. Following Feroz, Park, and Pastena (1991) and Farber, (2005), if the year of fraud committed is not indicated, we used the SCM and Bursa Malaysia reporting date as the proxy for the detection date. We also excluded samples with incomplete variables or no matching controlling firms. Table II shows 65 firms that are identified as final financial statement fraud sample.

Table III shows the number of financial statement fraud firms that commit financial statement fraud between 2001 and 2008. The table also shows that financial statement fraud incidents increased towards the final years of this study. The year 2007 marks the highest number of financial statement fraud cases in Malaysia.

Table IV summarises the financial statement fraud sample based on the industry and fraud year. The table shows that the manufacturing industry has the highest financial statement fraud cases. According to KPMG Malaysia, this sector generates annual revenues ranging from RM100 million to RM500 million, which is the highest annual turnover compared to other industries examined in this study. For that reason, it is expected that financial statement fraud is higher within the manufacturing sector because it relates to significant amounts of wealth being used for financial manipulation activities.

<table>
<thead>
<tr>
<th>Table I. The Nature of financial statement fraud activities in Malaysia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delays to disclose information</td>
</tr>
<tr>
<td>Failure to disclose information</td>
</tr>
<tr>
<td>Fabrication of accounting details</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
The sample size of our study is almost similar to the previous studies[5]. The small sample size is a common feature of financial statement fraud studies. The small sample is probably due to sensitiveness of fraud matters where the convicted firm normally attempts not to expose the financial statement fraud issue to the public. It is perceived that financial statement fraud firms attempt to manage and resolve the issue within the firm itself. Following Agrawal and Chadha (2005), we minimise the issue of unavailable data by collecting all possible sources through manual hand collection in order not to further eliminate the number of sample firms. In this study, we also use 65 control firms as a matching sample, which is described below.
3.2 Control samples

Each financial statement fraud firm is matched with a firm that is not convicted in financial statement fraud and hence, a purposive sampling method is employed in our study. The control samples are used in the analysis of real earnings management activities by the financial statement fraud firms prior to the year of fraud. Following Beasley (1996), the control samples are identified as follows:

- **Industry code**: If no four-digit SIC code firm match is identified, the three-digit SIC code is used followed by a two-digit SIC code;
- **Firm size**: Firms are considered similar in size if the total assets are within ±30 per cent of the total assets for the fraud firm in the year preceding the financial statement fraud;
- **Listing group**: The common stock of the financial statement fraud firm and its matched non-financial statement fraud firm trade on similar listing group (public or non-public) and the same stock exchange (Main Market or ACE Market); and
- **Time period**: Each non-financial statement fraud firm identified in steps 1 to 3 is matched with the year of the fraud firm commit in financial statement fraud.

In addition to the above criteria, the control firms are only selected if they have no record of a financial statement fraud offense. However, there are concerns with the possibilities of selecting non-financial statement fraud firms with an undetected financial statement fraud cases. To overcome this problem, our study further excludes distressed firms from the control samples.

Firms in distress are argued to have financial problems that lead to a greater tendency to manipulate financial reports (Summers and Sweeney, 1998) and are suspected of implementing more aggressive earnings management practices (García Lara et al., 2009). Over the decades, researchers use financial ratios as a tool for predicting firm in distress. The most commonly used models for predicting bankruptcy are developed by Altman (1968), Beaver (1966), Charitou et al. (2004), Ohlson (1980) and Zmijewski (1984). In particular, the multivariate discriminant analysis by Altman (1968) provides a high predictive accuracy of 95 per cent in determining firm failure. Altman’s model is also known as the Z-score model, and it has been used extensively in prior research in Malaysia to examine firms in distress (see Abdullah and Ahmad 2008; Sori, Hamid, Nassir, and Mohamad, 2001; Sulaiman, Jili, and Sanda, 2001). Z-score model employs a multiple discriminant analysis approach and incorporates the context of liquidity, profitability, leverage, efficiency and market dimension. However, the Altman (1968) test requires information regarding market capitalization in order for the model to succeed.

### Table IV.
Financial statement fraud firms by industry and year

<table>
<thead>
<tr>
<th>Industry</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry and fishing</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Construction</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>9</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>Mining</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Real Estate</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Services</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Transportation and public utilities</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>17</td>
<td>15</td>
<td>65</td>
</tr>
</tbody>
</table>
It is found that the OSIRIS database does not provide the market value of some sample firms because a number of financial statement fraud firms have been delisted from the listing group. Therefore, we used Charitou et al. (2004) failure prediction model for this study. Their model is designed as follows:

\[ P_{it}(Y = 1) = \frac{1}{(1 + e^{-z})} \]

\[ -z = -7.1786 + 12.3826 \frac{\text{Liability}_{it}}{\text{Asset}_{it}} - 20.9691 \frac{\text{EBIT}_{it}}{\text{Liability}_{it}} - 3.0174 \frac{\text{CFO}_{it}}{\text{Liability}_{it}} \]

where:
- \( P_{it}(Y = 1) \) = probability of failure in year \( t \) for the firm \( i \);
- EBIT = earnings before interest and tax in year \( t \) for the firm \( i \); and
- CFO = Cash flow from operations in year \( t \) for the firm \( i \).

The failure prediction model by Charitou et al. (2004) uses a logit function in determining the probability of a firm’s failure. Our study uses the score created by Charitou et al. (2004) to determine whether a firm is healthy or weak in the selected fraud year and the year before. In the final analysis of Charitou et al. (2004)’s model, only healthy firms are selected as the matched control firm.

Table V profiles the financial statement fraud firms and matching control firms. The 65 financial statement fraud firms are matched with 65 firms not faced financial statement fraud charges and risks. As mentioned earlier, these firms are matched closely based on the firm’s size, industry and time period. Table V shows that the financial statement fraud and non-fraud firms do not differ significantly based on the total assets and revenue.

<table>
<thead>
<tr>
<th>Ringgit Malaysia (RM) in thousands</th>
<th>65 Fraud firms</th>
<th>65 Non-fraud firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (Median) (Standard Deviation)</td>
<td>Mean (Median) (Standard Deviation)</td>
<td>t-stat</td>
</tr>
<tr>
<td>Min [Max]</td>
<td>Min [Max]</td>
<td>z-value</td>
</tr>
<tr>
<td>Total Assets</td>
<td>371,372 (201,267)</td>
<td>400,683 (217,550)</td>
</tr>
<tr>
<td></td>
<td>{358,787}</td>
<td>{418,256}</td>
</tr>
<tr>
<td></td>
<td>32,357</td>
<td>69,592</td>
</tr>
<tr>
<td></td>
<td>[1,153,128]</td>
<td>[1,435,307]</td>
</tr>
<tr>
<td>Revenue</td>
<td>199,779 (128,562)</td>
<td>163,526 (100,088)</td>
</tr>
<tr>
<td></td>
<td>{187,265}</td>
<td>{157,762}</td>
</tr>
<tr>
<td></td>
<td>1,014</td>
<td>11,369</td>
</tr>
<tr>
<td></td>
<td>[656,987]</td>
<td>[518,215]</td>
</tr>
</tbody>
</table>

Financial statement fraud firms are matched with control firms on the basis of year, total assets, SIC code, and listing group. The t-statistic is for the difference between the means of the matched pairs. The z-value is for the Mann-Whitney signed rank test to evaluate differences in medians.

Table V. Matching of total assets, revenue and SIC code between financial statement fraud and Non-Fraud firms.
3.3 Real earnings management measures

Roychowdhuury, (2006) identifies three types of real earnings management activities, namely, the cash flow from operations (CFO), production costs and discretionary expenditure. We employ abnormal CFO and abnormal production costs as measures of real earnings management since the information for research and development costs required to calculate the discretionary expenditure is not available for most of the sample firms used in our study. We test our hypotheses by calculating the real earnings management activities for four consecutive years prior to a financial statement fraud event. García Lara et al. (2009) and Dechow et al. (1996) have shown that firms managed earnings up to four and three years, respectively, prior to the fraud conviction. Furthermore, Copeland (1968) suggests that a time horizon of four years is adequate to minimise any classification error.

Many studies have used the mean value of earnings management proxy to determine earnings management level. However, in order to mitigate the effect extreme values, we use the median value of real earnings management to define earnings management level following (Dechow et al., 1996).

We employ the Dechow, Kothari, and Watts (1998) models to estimate the normal CFO and normal production costs. These models are also used by García Lara et al. (2009), Roychowdhuury (2006), and Zang (2011). The normal level of CFO is estimated using Model (1) and normal level of production costs is estimated using Model (2).

Normal level Cash Flow from Operations (Model 1)

\[
\frac{\text{CFO}_{it}}{A_{i,t-1}} = \alpha_0 + \alpha_1 \left( \frac{1}{Ati - 1} \right) + \beta_1 \left( \frac{S_{it}}{Ati - 1} \right) + \beta_2 \left( \frac{\Delta S_{it}}{Ati - 1} \right) + \beta_3 \left( \frac{\Delta S_{it-1}}{Ati - 1} \right) + \varepsilon_{ti}
\]

where:
- \( \text{CFO}_{it} \) = Cash flow from operations in year \( t \) for firm \( i \);
- \( A_{i,t} \) = Total asset in year \( t \) for firm \( i \);
- \( S_{it} \) = Total sales in year \( t \) for firm \( i \);
- \( \Delta S_{it} \) = Sales in year \( t \) less sales in year \( t-1 \) for firm \( i \); and
- \( \varepsilon \) = Error terms.

Xu et al. (2007) indicate that firms with abnormally low CFO are more likely to be involved in real earnings management through excessive sales discount offers. Similarly, García Lara et al. (2009) argue that failing firms will exhibit low abnormal CFO levels while giving more lenient credit opportunities to increase sales volume. García Lara et al. (2009) also contend that over the years, the continuous manipulation of real earnings activities will cause a firm’s cash flows to decline. It is expected that the financial statement fraud firms exhibit poor earnings quality pattern and increasingly lower abnormal CFO towards the fraud years compared to the matching firms.

Normal Level of Production Costs (Model 2)

\[
\frac{\text{PROD}_{it}}{A_{i,t-1}} = \alpha_0 + \alpha_1 \left( \frac{1}{Ati - 1} \right) + \beta_1 \left( \frac{S_{it}}{Ati - 1} \right) + \beta_2 \left( \frac{\Delta S_{it}}{Ati - 1} \right) + \beta_3 \left( \frac{\Delta S_{it-1}}{Ati - 1} \right) + \varepsilon_{ti}
\]

where:
- \( \text{PROD}_{it} \) = Total production costs measured as sum of cost of goods sold and change in inventory;
- \( A_{i,t} \) = Total asset in year \( t \) for firm \( i \);
- \( S_{it} \) = Total sales in year \( t \) for firm \( i \);
- \( \Delta S_{it} \) = Sales in year \( t \) less sales in year \( t-1 \) for firm \( i \); and
- \( \varepsilon \) = Error terms.
Manipulating production costs is involved with manipulating the reporting of cost of goods sold by increasing the production. By introducing more units of produced goods, firms can spread the fixed cost over a larger number of units; thus can lower fixed costs per unit. The decrease in reported COGS makes the reported operating margins look larger. Therefore, it is expected that financial statement fraud firms will exhibit abnormally higher production costs due to excessive overproduction.

Model (1) and Model (2) are estimated cross-sectionally for each industry in each year to generate the coefficient estimates in deriving the normal CFO and normal production cost, respectively. The residuals between the actual values and estimated normal levels become the abnormal CFO and abnormal production costs. The actual amount of CFO and actual values of production costs are retrieved from the financial statement in the annual report of the sample firms. The abnormally lower CFO than the estimated normal level indicates the lower earnings quality of a firm since it represents the real earnings management. On the other hand, production costs abnormally higher compared to the estimated normal level is assumed to be an exhibition of real earnings management.

3.3.1 Additional analysis – Accruals Earnings Management measures. We further examine whether financial statement fraud firms are also involved in accruals earnings management prior to the financial statement fraud event. We use the cross-sectional Modified Jones Model (Dechow et al., 1995) to estimate the abnormal accruals.

The following Model 3 is estimated for each industry year in cross-section.

\[ \frac{TA_{it}}{A_{it-1}} = \alpha_1 \left( \frac{1}{A_{it-1}} \right) + \alpha_2 \left( \frac{\Delta S_{it} - \Delta AR_{it}}{A_{it-1}} \right) + \alpha_3 \left( \frac{PPE_{it}}{A_{it-1}} \right) \]

where:
- \( TA_{it} \) = Total accruals measured as the difference between earnings before interest and taxes (EBIT) and cash flows from operations (CFO) in year \( t \) for firm \( i \);
- \( A_{it} \) = Total asset in year \( t \) for firm \( i \);
- \( \Delta S_{it} \) = Sales in year \( t \) less sales in year \( t - 1 \) for firm \( i \);
- \( \Delta AR_{it} \) = Accounts receivable in year \( t \) less accounts receivable in year \( t - 1 \) for firm \( i \) and;
- \( PPE_{it} \) = Gross Property, plant and equipment in year \( t \) for firm \( i \);
The estimated coefficients from Model 3 are used to estimate the non-discretionary accruals (NDA) for each firm in our sample with the following Model 4.

$$NDA_{it} = \alpha_1 \left( \frac{A_{it}}{A_{it-1}} - 1 \right) + \alpha_2 \left( \frac{\Delta S_{it} - \Delta AR_{it}}{A_{it-1}} - 1 \right) + \alpha_3 \left( \frac{PPE_{it}}{A_{it-1}} - 1 \right)$$

We finally compute the Discretionary accruals (DA) as the difference between total accruals (TA) and the fitted non-discretionary accruals as follows: $DA_{it} = (TA_{it}/A_{it-1}) - NDA_{it}$.

4. Results

4.1 Real earnings management and financial statement fraud

Figure 1 shows graph for the abnormal CFO for financial statement fraud and non-fraud firms. The median of abnormal CFO is plotted up to four years before the financial statement fraud event. Firms that manipulate their financial statements attempt to exhibit favourable financial conditions. Dechow et al. (2011) provide evidence that the amount of sales significantly increases as the financial statement fraud year approaches. It is argued that firms are involved in financial statement fraud because they fail to achieve targeted earnings. Therefore, it is possible that financial statement fraud firms intend to report higher incomes in terms of larger sales revenue.

In managing CFO, the attempt to increase current period earnings will require firms to accelerate their sales from the next fiscal year. This is similar to when firms offer customers more lenient credit terms and the buyer will treat this offer as a sales discount. This will cause earnings in the current period to rise temporarily due to increased sales volume. However, this occurs at the expense of declining margins due to lower cash inflow per sale item. The low margins due to price discounts will cause cash flow to decline relative to sales and changes in sales will be abnormally low.

The plot in Figure 1 shows no specific pattern as the alleged year of financial statement fraud event approaches. The lowest abnormal CFO recorded is during four years before the financial statement fraud event ($t-4$), and it is not much different from the abnormal CFO two years before the fraud event ($t-2$), one year before the fraud event ($t-1$) and the year of the fraud event ($t-0$). The plots demonstrate that financial statement fraud firms have lower level of abnormal CFO compared to non-fraud firms, thus, suggesting lower earnings quality. As mentioned by Garcia Lara et al. (2009) and Xu et al. (2007), firms with abnormally low CFO manage their earnings by offering excessive sales discounts and lenient credit terms. Nevertheless, the difference in abnormal CFO between the financial statement fraud firms and control firms is insignificant throughout the year of analysis, thus, H1a is rejected. The potential cause for this insignificant result is that financial

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**Notes:** **Significant at 5 per cent level where: AbCFO = the abnormal cash flow from operation computed using Dechow et al. (1998) model; AbProd = the abnormal production costs computed using Dechow et al. (1998) model; AbAcc = the abnormal accruals computed using the Modified Jones Model**
statement fraud firms are likely to be involved in other types of earnings management activities, such as accruals, which is shown in Table VI. The next section discusses financial statement fraud firms and their involvement in managing production costs as real earnings management activity.

We analyse abnormal production costs to evaluate whether financial statement fraud firms are engaged in manipulating production costs prior to the financial statement fraud event. As mentioned earlier, financial statement fraud firms experience distress and hence, may attempt to inflate earnings by spreading fixed costs prior to the event of financial statement fraud.

Managing production costs involves increasing the volume of the inventory (or service) more than necessary. This causes production costs to increase but by doing this, the fixed cost per item is lower because the costs are spread over a larger number of units. As a result, the value for cost of goods sold (COGS) declines. Accordingly, firms report better operating margins. Production costs higher than the expected normal level indicates that the earnings quality in financial statement fraud firms is lower than those of the non-fraud firms. Estimated abnormal production costs are the difference between the actual production costs and normal level of production costs, where the normal level is estimated by using the Dechow et al. (1998) model. It is predicted that before the fraud year, financial statement fraud firms have higher abnormal production costs compared to non-fraud firms.

The abnormal production costs of financial statement fraud firms are then compared to the level of abnormal production costs of the non-fraud firms. The median of abnormal production costs is plotted up to four years before the financial statement fraud event. Figure 2 shows the level of abnormal production costs for financial statement fraud firms prior to the fraud year is higher than non-fraud firms.

Overall, the plots indicate that financial statement fraud firms have abnormally high production costs compared to non-fraud firms, suggesting lower earnings quality. The highest abnormal production costs are recorded in two years before the fraud event ($t - 2$). The reduction in abnormal production costs in one year before the fraud event ($t - 1$) and the year of the fraud event ($t - 0$) is perhaps due to the reversal of prior abnormal production costs activity. It is consistent with the argument that firms with abnormally high production costs are potentially managing earnings through overproduction (Xu et al., 2007).
Figure 2 shows that the difference in abnormal production costs for financial statement fraud and non-fraud firms is statistically significant during the year before the fraud event \((t - 1)\) and two years before the fraud event \((t - 2)\). With regard to H1b, it is hypothesised that financial statement fraud firms are likely to have higher abnormal production costs compared to non-fraud firms. Based on the results, the H1b is only accepted for the periods of one year before the fraud event \((t - 1)\) and two years before the fraud event \((t - 2)\). It may be concluded that financial statement fraud firms engage in real earnings management through overproduction in the two years period prior to financial statement fraud occurring. According to Sun (2011), the alterations in real earnings management activities are done to meet short-term goals. Consequently, the results indicate that financial statement fraud firms overproduce so that they can quickly boost their earnings close to the financial statement fraud year.

We extend our analysis by examining the correlation between abnormal CFO and abnormal production costs. Table VI reveals the correlation analysis between earnings management proxies (i.e. abnormal accruals, abnormal CFO and abnormal production costs). Similar to Cohen and Zarowin (2010), our finding suggests that abnormal CFO and abnormal production cost are negatively associated. Since lower values for abnormal CFO and higher values for abnormal production costs indicate real earnings management, the negative significant correlation suggests simultaneous application of these real earnings management. The manipulation of both the real activities is perhaps due to achieve overall higher profits. Moreover, this negative correlation is also in line with the notion that overproduction has an adverse impact on the contemporaneous abnormal operating cash flows (Cohen and Zarowin, 2010).

Prior studies show that in addition to using real earnings management to manipulate financial statement figures, firms are also involved in accruals management. Cohen et al. (2008) and Zang (2011) argue that real earnings management and accruals earnings management are substitutes. Table VI also shows that the correlations coefficient between abnormal CFO and abnormal accruals is positive. This indicates that the higher level of abnormal accruals corresponds to higher level of abnormal cash flows from (lower real earnings management) or vice-versa. Cohen et al. (2008) find a significant negative relationship between abnormal production costs and abnormal accruals, suggesting that
firms use them as substitute. Similarly, we find a negative relationship between abnormal production costs and abnormal accruals, meaning that financial statement fraud firms use these two earnings management methods as substitutes. Overall, the two real earnings management are found to be contemporaneous in the Malaysian context for the study period, while their correlation with abnormal accruals indicates that real earnings management and accrual earnings management do not take place at the same time.

4.2 Accruals earnings management and financial statement fraud

In Section 4.1 it is evident that the abnormal CFO is statistically insignificant, although the trend is that financial statement fraud firms were involved in real earnings management. With reference to abnormal production costs (in Section 4.2), it is found that real earnings management using production costs prior to the financial statement fraud year is only significant for two years, that is one year before the fraud event ($t - 1$) and two years before the fraud event ($t - 2$) in the analysis for a four-year period. As mentioned earlier, it is argued that financial statement fraud firms may be involved in accruals earnings management management prior to the financial statement fraud year.

We further examine whether financial statement fraud firms are also involved in accruals earnings management prior to the financial statement fraud event. The primary model for abnormal accruals used is the Modified Jones Model (Dechow et al., 1995). The value for abnormal accruals is retrieved from the residual of total accruals and normal accruals. The median of abnormal accruals scaled by lagged asset is plotted up to four years before the financial statement fraud event.

Figure 3 shows the level of abnormal accruals of both financial statement fraud and non-fraud firms up to four years before the fraud year. The median of abnormal accruals is plotted up to four years before the financial statement fraud event. It is presented that the highest abnormal accruals level recorded is two years before the financial statement fraud event ($t - 2$). The difference in abnormal accruals between financial statement fraud and non-fraud firms is statistically significant for all periods being analysed, except during one year before the fraud event ($t - 1$). These significant findings answer the question concerning weak results emerging from the analysis of abnormal CFO. The significant correlation between abnormal accruals and abnormal CFO corroborates that firms use accruals earnings management and real earnings management through sales manipulation as substitute. Moreover, this test provides evidence of the fact that financial statement fraud firms prefer to manipulate their earnings using abnormal accruals prior to the financial statement fraud event. The finding is consistent with Dechow et al. (1996) who conclude that financial statement fraud firms have higher abnormal accruals in the first three years prior to the fraud year.

The possible cause for insignificant difference in abnormal accruals levels between the financial statement fraud and non-fraud firms during the one year prior to the fraud event ($t - 1$) is perhaps due to financial statement fraud involvement in other type of earnings management, which is an abnormal production cost. This is confirmed by the significant findings in the one-year period before the fraud event ($t - 1$) when the difference in abnormal production costs between financial statement fraud firms and non-financial statement fraud firms is analyzed (refer to Figure 2). Furthermore, Table VI demonstrates a negative relationship between abnormal accruals and abnormal production costs, which implies that firms use these two types of earnings management as substitute of each other. Overall, the plots in Figure 3 demonstrate that the financial statement fraud firms have higher abnormal accruals level compared to the non-fraud firms. Consequently, financial statement fraud firms have lower earnings quality compared to the non-fraud firms.
5. Conclusion

In this study we examine whether the fraud firms are engaged in real earnings management and accrual earnings management prior to the fraud year in the Malaysian context. Our sample comprises of 65 financial statement fraud and 65 non-fraud firms over a period of 8 years from 2001 to 2008.

Using the abnormal cash flow from operations (CFO) and abnormal production costs as the proxies for real earnings management, we find that real earnings management is more aggressive in financial statement fraud firms compared to the matching control firms in the four years prior to fraud. However, the difference in abnormal CFO between the financial statement fraud and control firms is insignificant throughout the four years of analysis. In addition, the differences in abnormal production costs between the financial statement fraud and non-fraud firms are only statistically significant in the one year before the fraud event ($t - 1$) and two years before the fraud event ($t - 2$). Our results support the contention that financial statement fraud firms are engaged in real earnings management activities prior to the financial statement fraud year.

Additionally, we find that the difference in abnormal accruals between the financial statement fraud and non-fraud firms is statistically significant throughout the years being analysed, except for one year before the fraud event ($t - 1$). This additional test draws attention to the fact that financial statement fraud firms prefer to manipulate earnings using abnormal accruals prior to the financial statement fraud occurring. This is perhaps due to the substitute nature of two forms of earnings management. Overall, the results of our study show evidence that financial statement fraud firms have lower earnings quality compared to non-fraud firms. We report the prevalence and direction taken in earnings management up to four years prior to the financial statement fraud event.

The finding of our study is useful to policy makers, regulators, firms, academia and other financial statement users (e.g. investors, analysts and creditors). The SC and Bursa Malaysia require to monitor whether companies are providing adequate disclosure and fabricating accounting information in their company annual reports. Our findings also likely help academia to identify various aspects of financial statement of frauds and contribute to the accounting literature. The level of pervasiveness of earnings management practices in Malaysian firms may assist investors and analysts to look for early warning signs of financial statement fraud. Other financial statement users such as financial institutions and creditors may benefit from our study because they rely on financial statement information in their decision-making processes.

Our study is not without its limitations. Our study is based on only one emerging country, Malaysia. Therefore, caution must be taken in generalizing the findings to other countries that have different marketplace and economic environments. The investigation of real earnings management and financial statement fraud in Malaysia is limited to the examination of data published in annual reports for 2001 to 2008, therefore, future research is warranted using more recent data and should test whether corporate governance plays any mitigating earnings management for financial statement fraud firms.

Notes

1. Examples of high profile firms that are recently convicted for financial statement fraud in Malaysia are Gula Perak, MEMS Technology, Puncak Niaga, Golden Land and Actacorp.

2. The market capitalization per GDP has increased to RM938 billion in 2012 compared to RM350 billion in 2000.
3. Through a survey report conducted in 2009, the KPMG Malaysia estimated that financial statement fraud were valued at RM63.5 million per year. Nevertheless, KPMG Malaysia indicates that the actual value of financial statement fraud is higher due to unreported fraud cases.


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**Further reading**


Companies Act, 125 Stat (1695)

Constitution of Malaysia (1957), Government of Malaysia.


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Malware at its worst: death and destruction

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Abstract

Purpose – Most people are probably aware of malware, but they may not be aware of malware in what may be its most dangerous form, i.e. causing physical harm, even death, to individuals. This paper aims to document how software can cause malicious harm to individuals by attacking modern systems that appear to be neglected and under-researched.

Design/methodology/approach – This paper will review some of the most significant areas of concern with respect to end of days malware, i.e. malware that has a dangerous intent. The areas included are automobiles, medical devices and air traffic control systems.

Findings – The potential harmful effects of malware are often not well known by consumers and businesses around the world. These issues are not limited to just financial harm. Lives can actually be in danger. Underestimating the importance of cybersecurity and understanding the dangers that are associated with advancing technology are global issues that will continue unless there is enough awareness to force businesses and governments to address these issues. It is critical that safeguards are established.

Originality/value – While many papers have been written about malware and the implications of having malicious software infect a computer or a network, little attention has been paid to “end of days” malware. With advancing technology, malware now has the ability to cause serious injury or death to individuals who have minimal or no knowledge of the potential consequences of, for example, driving in an automobile, wearing or having an internal medical device or flying on an airplane. It is up to businesses and governments to address these issues.

Keywords Death, Malware, Physical harm, Security vulnerabilities

Paper type General review

Introduction

Malware, by definition, is short for malicious software and is used to infiltrate and damage computer systems. When one thinks about malware, the attention usually turns to issues relating to money or lack of access to data. Has someone taken over my computer and is now demanding money to “fix” it? Are fake advertisements being sent to me that will result in my purchase of counterfeit goods? Is my identity being stolen? These issues have financial and business implications. While these problems can be serious and costly, new forms of malware go well beyond financial concerns; in fact, you may wish that you “only” had financial issues as these new forms of malware may actually result in serious injury or even death. This emerging “end of days” malware is a significant threat that many are not aware of and while it seems to be more of a Hollywood horror movie, it is real and worthy of our attention. As our awareness increases, more resources may flow to preventing, detecting and responding to these terrifying threats.
Malware in action

On October 21, 2016, there was a massive cyberattack on Dyn DNS, a New Hampshire-based firm that operates as a major internet switchboard hub. Twitter, Spotify and Netflix’s websites became temporarily inaccessible. “The weapons amassed for this attack were, literally, toys—baby monitors, music servers, web cameras, and other home devices that connect to one another, automatically sending and receiving data through the internet [...] The saboteur had hacked into hundreds of thousands of these devices and infected them with malware, so that at a designated moment, all of them sent messages to the real target – in this case, Dyn DNS – and shut it down” (Kaplan, 2016, para. 3). These “Internet of Things” devices are generally always on and even tech-savvy users are not able to monitor the machines’ activities because there is no user interface. This is a prime example of malware and how even in its simplest form, it can cause problems to major modern servers. Fortunately, in this case, the goal of the hacker was simply to shut down the Dyn DNS system and not inflict actual harm on users.

Malware can currently take control over computers, cellphones and e-commerce servers. It can be used in various forms to accomplish various objectives by the software programmer/hacker. One form malware can take is spyware. Spyware is uniformly used with adware to track your internet activities and, in turn, subsequently use that information to send adware back to your system to entice you to buy the counterfeit goods the adware is presenting. In a more severe form, malware can be formatted as ransomware by holding certain files hostage until a fee/ransom is paid. This type of malware is the most lucrative form of malware. It is simple to implement, like adware, but the returns relative to the cost of development are the highest. Just like any ransom, hackers may or may not give the files back to the victim or victims (Van Alstin, 2016). In its most dangerous form, malware possesses the ability to cause malicious harm to victims, and/or victim systems.

Neglected systems

Actual cases and incidents related to hacking, vulnerabilities and preventative measures of modern systems, computers, cellphones and e-commerce servers are regularly brought up by the media, bloggers, security experts and others. However, manufacturing plants, power plants, trains, prisons, etc. rely heavily on automated systems and, thus, are also susceptible to devious malicious software. Three of the modern systems often used and under-researched are automobiles, hospital systems and air traffic control (ATC) systems. These neglected systems have remained under the radar in security and software awareness/development. However, they are currently being tested by “white hat” (ethical) hackers due to the significant implications of what a successful malicious hacker would be able to accomplish. These three systems are the primary focus on this paper.

“White hat” is internet slang for an ethical hacker. These hackers specialize in searching for vulnerabilities in information systems and electronic devices before “black hat” hackers (that is, unethical hackers) can find them. If left unattended, black hats could, for example, hack into a moving automobile and control the brakes, steering and acceleration, leaving the driver helpless. They could also hack into medical equipment and negatively alter the settings which are necessary to keep a patient alive or alter the administration of medication vital to keeping the patient stable. If used with malice, malware possesses the ability to cause harm and possibly fatal outcomes. These are but a few options for skilled black hat hackers to carry out with potentially life-threatening results.
Automobiles
Michael Hastings was a prominent American journalist, a contributing editor to Rolling Stone and a reporter for BuzzFeed. Leading up to his death in 2013, he was a thorn in the side of the government as a vocal critic of the Obama Administration, Democratic Party and surveillance state. Right before his death, he was working on and preparing articles profiling Central Intelligence Agency (CIA) Director John Brennan and the CIA’s operative rule. One afternoon he sent an email to colleagues stating that he was onto a big story that he needed to go off the radar for a bit and that the Federal Bureau of Investigation (FBI) might interview them. The next morning, Hastings died in a single automobile crash in his new coupe. Witnesses to the crash were reported as saying the car seemed to be traveling at maximum speeds before crashing into a palm tree. The Los Angeles Police Department declared that there were no signs of foul play. However, “former USA National Coordinator for Security, Infrastructure Protection, and Counter-terrorism, Richard A. Clarke, said that what is known about the crash is, ‘consistent with a car cyberattack’” (Hogan, 2013, para. 2). Clarke was quoted as saying, “There is reason to believe that intelligence agencies for major powers, including the USA, know how to remotely seize control of a car. So, if there were a cyber-attack on Hastings’ car, and I’m not saying there was, I think whoever did it would probably get away with it” (Hogan, 2013, para. 3, 5). While Michael’s older brother believed that he was experiencing a drug-induced “manic episode,” friends believed that his line of work led to a paranoid state and that he was worried his work was being surveilled by the government. The FBI denied Hastings was the target of any investigation, yet a Freedom of Information Act request later unearthed an FBI file on Hastings. Hastings also told a neighbor he thought someone had been tampering with his car (Papenfuss, 2015). Could it be that his vehicle was hacked for special interest reasons or was he on drugs like his brother thought? If the former case is true, then the information superhighway and actual highways have merged dangerously.

Not too long ago, securing a car meant taking the faceplate off the CD deck, securing a club over the steering wheel and locking the doors. To effectively spot vulnerabilities in earlier vehicle systems, researchers had to master and reverse-engineer those systems. Today, however, automobiles are requiring the same protection as laptop computers and e-commerce servers. Does this mean that there are similar methods/pathways malware can infect the vehicle? Once inside, what systems can malware control? Are there vehicle related software security products out there to prevent hostile takeovers? What are the car manufacturers doing to prevent/prohibit others from gaining access to vehicles?

Malware and automobiles are an exceptionally tricky business as there are various ways to hack into a vehicle and many systems that make up vehicles for them to function. Modern vehicles can have anywhere from 40 to over 100 different electronic control units (ECUs) controlling all functions of a vehicle. For example, an ECU controls the engine, the transmission, the wheels, the doors, etc. “These computers have sensors and switches wired in to detect variables such as temperature, pressure, voltage, acceleration at different angles, braking, yaw and roll of the vehicle, steering angle and many other signals. When an ECU needs a signal from a sensor connected to an ECU elsewhere in the car, that’s where the CAN Bus comes in” (Wojdyla, 2012, para. 2). The CAN Bus, or Control Access Network, links up and controls these ECUs and the thousands of data signals that traverse the network at any given time. The CAN Bus is all of the interlinking connections. Once the CAN Bus is compromised, attackers can send valid commands to other ECUs that will be accepted and executed because “CAN packets contain no authenticator fields – or even any source identifier fields – meaning that any component can indistinguishably send a packet to any other component. This means that any single compromised component can be used to
control all of the other components on that bus, provided these components themselves do not implement defenses” (Koscher et al., 2010, p. 452).

While the CAN Bus is located deep within the vehicle and is in charge of all systems, it is vulnerable through two key entry points, the latter of which can be accessed in various ways. The first entry point is the most direct and easiest point of entry into a vehicle’s CAN Bus. Entry is by way of the OBD-II port, located under the driver’s side dash. The OBD-II port, or on-board-diagnosics port, is a physical means to efficiently connect to all of the ECU sensors for self-diagnosis when servicing at a dealership or vehicle emissions testing.

“Security consultant Craig Smith presented a tool designed to find security vulnerabilities in equipment that’s used by mechanics and dealerships to update car software and run vehicle diagnostics, and sold by companies like Snap-On and Bosch. Smith’s invention, built with around $20 of hardware and free software [...] is designed to seek out and hopefully help fix bugs in those dealership tools that could transform them into a devious method of hacking thousands of vehicles” (Greenberg, 2015, para. 2).

This homemade software would essentially throw random data at the target diagnostic tool to find any flaw in the dealership tool. “In one instance, one of the diagnostics tools didn’t check for the length of a vehicle’s identification number. Rather than a VIN of 17 digits, his car spoofing device shows that infected vehicles could send in much longer numbers to break the diagnostics tools software and allow a malware payload to be delivered” (Greenberg, 2015, para. 6). If a bug were exploited through those tools, any car ever connected to it would be compromised and an attack could turn dealership wide. Versions of Smith’s tool can also be inserted discretely under the dash to connect to the CAN Bus. Once connected, a hacker can potentially sit in their house or access a mobile Wi-Fi hotspot and remotely take control of the vehicle. At this point, the hacker can execute any task they wish whether it be, for example, to cause the car to accelerate or disable the breaking system. While ransomware is typically the more viable path for hackers to take, malicious software is the more dangerous and life-threatening route of the hacking software family. The number one method to defend against unauthorized access to the OBD-II port is to simply keep the vehicle locked.

The second entry point is perhaps the more difficult and devious point of hacking as entry is gained via the vehicle’s telematics system. Most of us know this as General Motor’s OnStar connect or Chrysler’s Uconnect. These telematics systems are ECUs in and of themselves. They can wirelessly notify police in the event of a crash, disable the vehicle if stolen and interface with most all of the vehicle’s systems. They are also responsible in the handling of Wi-Fi capability, Bluetooth connectivity, managing and downloading applications and downloading other file forms. After gaining access to the CAN Bus through these vulnerabilities, attackers can send and carry out valid commands to any ECU in the vehicle. “Security researchers Charlie Miller and Chris Valasek did this last year when they demonstrated an attack against infotainment systems found inside the Jeep Cherokee and other Fiat Chrysler vehicles. Their exploit, which was executed over the internet using a mobile data connection installed in a car, gained access to the CAN Bus and sent commands to the car’s ECUs to remotely disable its brakes or control its steering” (Constantin, 2016, para. 6-7). Additionally, in 2016 security researchers were able to hack into a Mitsubishi Outlander plug-in hybrid electric vehicle (PHEV) and were able to perform “a man-in-the-middle attack between the PHEV’s mobile app and the PHEV’s Wi-Fi access point (AP). After replaying various messages from the mobile app, they figured out the binary protocol used for messaging. Consequently, they were able to turn the lights on and off and disable the whole theft alarm system, leaving the vehicle vulnerable to more attacks” (Eiza and Ni, 2017, p. 46). This allows the combination of traditional carjacking techniques and modern
hacking tactics to be used by hackers to leave the system vulnerable and steal the afflicted automobile.

In a comparative context, Greenberg (2013, para. 5) stated, “Practically every American carmaker now offers a cellular service or Wi-Fi network like General Motors’ OnStar, Toyota’s Safety Connect and Ford’s SYNC. Mobile-industry trade group GSMA estimates revenue from wireless devices in cars at $2.5 billion today and projects that number to grow tenfold by 2025. Without better security, it is all potentially vulnerable and automakers are remaining mum or downplaying the issue.” This is leaving a grand window of opportunity for private firms and software developers to create vehicle security products.

Although it may seem that altering the settings of a car may require significant work and reverse engineering, many of them “do not require a complete understanding or reverse-engineering of even a single component of the car. In fact, because the range of valid CAN packets is rather small, significant damage can be done by simple fuzzing of packets” (Koscher et al., 2010, p. 454). Many components of an automobile can be taken over via fuzzing such as the engine, brakes, HVAC systems and body components, which is disheartening as they are crucial to the operation of an automobile. To exemplify the severity of these issues, Koscher was able to create “a ‘Self-Destruct’ demo in which a 60-s count-down is displayed on the Driver Information Center (the dash), accompanied by clicks at an increasing rate and horn honks in the final few seconds. In our demo, this sequence culminated with killing the engine and activating the door lock relay (preventing the occupant from using the electronic door unlock button). This demo, which we tested on both cars, required fewer than 200 lines of code added to CARSHARK, most of them for timing the clicking and the count-down” (Koscher et al., 2010, p. 458).

The self-destruct demo certainly suggests that it is a distinct possibility that Michael Hastings was, in fact, a victim of a hacking attack. Koscher and his team were easily able to alter the behavior of the car in their demo without that many lines of code so it is not that far-fetched that Hastings’ vehicle may have been hacked. Although no attacks on driving systems have been reported (or proven) outside of a lab testing environment, a problem looms in the near future. As we get closer to autonomous vehicles with more integrated technology, we get closer to vehicles becoming even more susceptible to hacking. “The less the driver is involved, the more potential for failure when bad people are tampering with it,” says Gartner Group analyst Thilo Koslowski (Greenberg, 2013, para. 10). In the meantime, a new market for car-related software security products and patches will continue to evolve as demand rises. Miller and Valasek (in Greenberg, 2013) argue that the best way to pressure car companies to secure their products is to show exactly what can be done with a multi-ton missile on wheels. It would certainly make sense to experience the panic of a digitally hijacked SUV in an experimental setting rather than deal with a real-life situation.

Unsurprisingly, many questions can be raised when evaluating cybersecurity and the liabilities that follow with it. For example, when cars reach their end of life cycle what happens to them? Do you maintain them or junk them? Must automobile companies develop a new OS for cars or is it no longer their responsibility? It is likely that automakers will follow in Microsoft’s footsteps and officially end product support for their older vehicles and their OS like Microsoft has done with their Windows XP and Vista operating systems? However, even if they do this it does not mean that these vehicles and operating systems will necessarily disappear. Currently, Windows XP is the third most popular operating system globally and used by many people and businesses around the world (Ghosh, 2017). Some businesses and consumers still use outdated and vulnerable operating systems and refrain from updating or replacing them out of convenience and/or to save money. If people and business are unwilling to maintain their machines and continue to use them even with the
high-risk of being compromised, the chances that they will be replacing their automobiles is unlikely, especially as automobiles cost significantly more than a computer system. This raises concerns about how to deal with outdated automobiles being on the road as they could be unsafe and create future accidents that could lead to the death of others. Does this liability fall on the auto manufacturer? Does the auto manufacturer have a responsibility to prevent breaches and vulnerabilities and recall their vehicles and force consumers to bring in their vehicles or is it up to the customer to come in and get the updates? Ultimately, if automakers are unable to address these issues, it is likely that the government will step in and develop regulatory actions in hopes of preventing or mitigating the damage of future cyber threats.

Bills for regulatory actions have already started being proposed by the USA government. For example, “a proposed bill that recently passed the House of Representatives and is now headed to the Senate would require automakers to appoint cybersecurity officers and implement plans for detecting and responding to cyberattacks, unauthorized intrusions and false and spurious messages or vehicle control commands” (Dawson, 2017, para. 24). However, 14 automakers are attempting to address these issues and have created the Automotive Information Sharing and Analysis Center, or Auto ISAC, to develop industry best practices so that they can dictate the actions needed rather than having regulatory actions forced upon them (Dawson, 2017).

Medical devices
On an equally alarming scale, hospitals, due to years of neglect to their information technology (IT) infrastructure, are running into similar security problems that vehicle manufacturers are dealing with. Both highly regulated fields have comparable problems of being strenuously governed in some respects while severely lacking guidance in others. Just as white hat hackers like Charlie and Chris are on the forefront of revealing the severity of security flaws in automotive systems, Sergey Lozhkin is paving the way by creating awareness concerning hospital IT systems.

On February 11, 2016, Lozhkin (2016) revealed how easy it was to hack a hospital and gain access to almost everything on the network including: data storage, an expensive tomographic scanner and other important medical devices. The tomographic scanner contained a significant amount of data about the patients along with the most recent images from the final few scans. Stealing patient data and scans from the tomographic scanner, while potentially harmful, were not the most serious issue. When Lozhkin gained access to the network, he had administrative rights to change the settings on most of the machines, which would allow him to alter the settings enough to break the machine. Hospitals could be looking at a considerable amount of money and downtime to replace the tomographic scanner or similar devices. In Lozhkin’s interview, one of the biggest problems he noticed with the hospital security was how easy it was to hack into the Wi-Fi network. This is not due to one major flaw but many small holes in the network and security settings for all of the devices on the network. This, in turn, created a giant hole for Lozhkin to hack the network (Snow, 2016).

Due to the Health Insurance Portability and Accountability Act of 1996, a healthcare facility’s main emphasis for their IT departments is providing data privacy and security pertaining to medical information. This is accomplished by ensuring that patient information is only released to authorized users. The emphasis of meeting these mandated regulations to keep patient information secure has helped create an environment which neglects how the network functions as a whole. This is caused by the emphasis on patient
data and not on the security of the medical devices (Independent Study Evaluators [ISE], 2016).

In today’s age of rapidly advancing electronics, the medical field has never been better equipped to handle life-threatening situations. But with the rapid advancement of medical equipment, fierce competition now exists among developers and manufacturers. Medical equipment developers and manufacturers compete to keep their customers’ confidence and money. One of the ways developers and manufacturers are reaching the market in a timely manner and keeping their products at reasonable prices is by not focusing on cybersecurity aspects. Other aspects that hinder cybersecurity aspects are that there are severe constraints in maintaining implantable medical devices (IMDs). “These devices should not only be smaller in size but should be efficient in its operation […] The security protocols such as cryptographic solutions, machine learning approaches and hashing require enormous processing which drains the battery quickly. Moreover, if the battery is exhausted the whole IMD needs to be replaced which has its own disadvantages” (Rathore et al., 2017 para. 6). Another problem that persists with medical devices is that many of these medical devices have lifecycle mismatches with the operating software. When the operating system software only has a lifecycle of several months, but the medical device has a lifecycle of a decade, it causes severe vulnerabilities as these operating systems become obsolete significantly earlier than the medical devices do themselves (Fu and Blum, 2013). These security gaps create major problems for the patients who are relying on medical equipment to stay alive or get better.

While Billy Rios, a security researcher, was testing infusion pumps for vulnerabilities, he discovered one where he could change the library for maximum allowed dosages. This would not directly cause harm to the patient as he could not change the administered dose. However, he could upload altered firmware that gave him the ability to change the dosages given to the patient, which could seriously injure or kill the patient. After over a year of waiting for the vendor to complete their own independent tests on this machine and similar machines, Rios took it into his own hands to purchase the other devices in the same product line and test them as well. The tests showed that this whole line of products had the same vulnerabilities as the first one he found (Seals, 2015). “Hackers are acutely aware that medical data (insurance information, social security numbers, etc.) is worth 20-50 times more than credit card data” (Ferran, 2015, para. 5) and because “medical records, especially in the US, are worth much more on the black market than credit card details because they contain multiple permanent identifiers and financial information. Unlike credit cards, these identifiers cannot be reset, and a person’s records might contain enough information to open bank accounts, obtain loans, or acquire a passport” (Martin et al., 2017, para. 4). Thus, hackers tend to target these devices.

Obtaining the patient information on these devices is not the only way to benefit financially because black hats are able to encrypt the data on the machine or disable the machine until the hospital pays a ransom. Some personal medical devices may also be vulnerable. In 2017, the USA Food and Drug Administration announced the recall of 465,000 pacemakers manufactured by St. Jude Medical Hospitals, now known as Abbott Laboratories due to severe vulnerabilities that could compromise their function. These vulnerabilities allowed hackers to gain access to the pacemakers, alter the pacing of the pacemakers and even cause the batteries to drain themselves. Natt Garun of The Verge claims “researchers found that pacemaker programmers could intercept the device using equipment that cost anywhere between $15 to $3,000” (Garun, 2017, para. 4). The alarmingly minimal resources required for such a high-risk breach puts thousands at potentially harmful or life-threatening risk.
For those with these pacemakers, this is a critical flaw as altered pacing or a depleted battery could mean life or death for a patient. “The malevolent manufacturer employee, patient, physician or hospital administrator can get hold of the internal system of IMD and introduce attacks such as calibration failure, battery failure, hardware/connection failure, modification of dosage/data or through malware software” (Rathore et al., 2017, para. 11). A possible method of attack can be done by essentially forcing the devices processor to work on various tasks to overload the memory and cause the device to expend more energy to process those tasks (Rathore et al., 2017, para. 11). The recall required patients to update the firmware on their pacemakers by seeing their medical provider and having them apply the update. The need for an update could prove problematic for any patient unable to visit a primary care provider on short notice. Many patients might doubt the severity of the issue (lacking the technical knowledge/understanding) and fail to take necessary action for the safety of their devices. Furthermore, it is important that medical devices are not completely locked down to prevent all access. “In case of an emergency, health personnel may need to access not only medical records but also medical devices of a person in need, perhaps in a life-threatening situation. Authentication and authorization mechanisms must have a bypass or shortcut for such circumstances. However, these bypasses and shortcuts should not provide a means that enables attackers to gain access to the device” (Sametinger et al., 2015, p. 80). There are several methods being developed to secure medical device, however, the critical challenge of meeting interoperability needs such as the need for these devices to communicate with external devices make it difficult to satisfy. However, there are promising methods that are being developed such as creating better and more efficient firewalls to prevent unauthorized access or by using an externally worn device equipped with a software radio shield that will allow communication with the medical device if the external device is present or prevent unauthorized access if it is not (Sametinger et al., 2015).

Some of the medical devices in hospitals are connected to the internet, and those seem to be well protected, however, they are not guaranteed to be secured. While the number of internet-connected devices is small, they are powerful and provide key information about the patient. A black hat hacker could conduct an internet search and find devices such as “MRI scanners, cardiology equipment, radioactive medical and other related equipment connected to the Internet” (Lozhkin, 2016, para. 6). Some of these devices are still running on outdated unsupported operating systems, like Windows XP. Running unsupported operating systems can cause problems as well because there will always be vulnerabilities in operating systems. As long as the operating system is supported, there will be continuous patches for it to fix the vulnerabilities as fast as the operating system designer can find them. The total number of devices in a hospital that are connected to the local network is much greater than those connected to the internet. This is an issue because many devices on the network are set by default to trust users on the network or have default usernames and passwords. While the black hats are trying to gain access to these devices via the internet, they must first gain remote access to the hospital network through the external firewall and the other layers of security (USA Features Media, 2016).

In the medical industry, the emphasis is on acquiring and retaining the best doctors and nurses so the hospital will have the highest level of consumer confidence. The area of medical employment/recruitment is one area where the hospital will focus most of its budget instead of allocating more to their IT department. “Many NHS organizations spend as little as 1-2 per cent of their annual budget on IT, compared with 4-10 per cent in other sectors” (Martin et al., 2017, para. 9). With how little hospitals are spending on IT, it isn’t surprising to observe that most of the machines being used are outdated, “Indicative of this low level of investment many NHS trusts are still using Windows XP, an operating system that
Microsoft stopped supporting in 2014” (Martin et al., 2017, para. 9). Reputation and potential ramifications for reporting issues with a medical device also serve as deterrents for many healthcare professionals to note potential issues with their medical devices. “Admitting to playing a role in accidentally infecting a medical device would likely lead to consequences ranging from disciplinary action to loss of reputation. Thus, the actual incidence of security failures leading to healthcare delivery failures may be significantly greater than the available statistics suggest […] Reporting must be incentivized rather than penalized” (Fu and Blum, 2013, p. 36). Another issue concerning IT in hospitals is the surprising lack of industry best practices or blueprints to follow in creating a more cybersecurity-centered IT approach. In the UK “Fragmented governance is another big problem, leading to a lack of clarity over who is responsible for securing systems and data” (Martin et al., 2017, para. 10). This leaves each hospital essentially guessing and fending for itself as to whether or not minimum levels of cybersecurity are being reached (ISE, 2016). This could be fixed if the government set industry standards specific to hospital cybersecurity-related issues. This would have to be implemented in a stepped approach to allow hospitals the necessary time to meet each step. There will also have to be a follow up from the government by mandating formal audits, that in turn would require the hospitals to perform recurring self-audits. The hospital itself is only one part of the problem as these medical devices are connected to the network, as well which creates difficulties in securing the IT infrastructure from attacks.

Furthermore, just like automobiles, similar questions can be raised about medical devices. What happens when someone dies from a medical device that was breached? Does that liability fall on the physician, hospital, and/or the medical device manufacturer? Personal medical devices make the perfect target for terrorists. There is a high likelihood that a sick-minded individual or a terrorist group would be able to hack the medical devices and cause mass chaos by changing the settings on the devices. In doing this, they could severely injure the patients or bystanders or break the medical devices if they alter the settings to make that happen. If word about this reached the media, it could cause much of the public to lose trust in all of the medical devices we trust to save our lives when we get hurt, when something unexpected happens or to simply help us stay healthy. Efforts must be made to address this issue before things get out of hand. If these issues are addressed before they happen, there will at least be measures in place that detail how to address attacks and prevent situations where an entire portion of the population is being held ransom by their medical devices.

Air traffic control systems
With the amount of vulnerabilities within car systems and hospitals, it is no surprise that hackers have gone after even bigger targets such as the ATC systems. A USA Government Accountability Office (GAO) report from 2015 states several severe cybersecurity vulnerabilities in current ATC systems. Specifically, these vulnerabilities are “weaknesses in controls intended to prevent, limit, and detect unauthorized access to computer resources, such as controls for protecting system boundaries, identifying and authenticating users, authorizing users to access systems, encrypting sensitive data, and auditing and monitoring activity on FAA’s systems” (Cooper, 2015, para. 3). Many of these vulnerabilities are critical flaws that could lead to disastrous effects if they are compromised.

After the devastating results of 9/11, many would assume that the ATC systems would have reliable cybersecurity protocols to prevent such an incident from occurring again. However, the weaknesses described in the GAO report would allow hackers to access the ATC systems and disrupt flight patterns which, in turn, would cause all flights to be grounded in the USA if the intrusion was detected immediately. While these flights are
grounded, law enforcement and the Federal Aviation Administration (FAA) would have to resolve the vulnerability and understand what occurred. The problem with this is that the report also states that there is not a sufficient monitoring and auditing system. As a result, the FAA would have a difficult time understanding what, who and how their system was breached, as there are limited security logs and network traffic is not always being monitored.

The possibility that the intrusion remains undetected, however, is much more serious as the hacker would be able to endanger the lives of the passengers and the crew. Hackers could direct airplanes with false instructions potentially guiding them away from airports, causing planes to run out of fuel and forcing them to make emergency landings. Even more concerning is the potential for terrorists to use these vulnerabilities to achieve their goals. Fortunately, the GAO has provided recommendations and specific actions to deal with these weaknesses.

**Combatting vulnerabilities**

Companies and organizations have engineered several methods to combat the vulnerabilities within their own systems. One of the main methods is to hire white hat hackers to find vulnerabilities and fix them before black hat hackers discover them and use the opportunity for their own gain. Variations of this strategy of using white hat hackers to secure vulnerabilities exist and there is one promising method that is becoming more widely adopted. This method is known as a “Bug Bounty” which is a reward-based compensation program that allows white hat hackers to gain recognition and monetary compensation for their assistance. A bug bounty encourages white hat hackers to locate any vulnerabilities, breaches, or exploits in a company’s operating system, software, websites, etc. and report it to the company so that the company can address these issues before they are exploited by black hat hackers with malicious intent.

In November 2016, the US Army collaborated with HackerOne, a vulnerability coordination and bug bounty platform, to set up a bug bounty challenge that rewarded those that were able to find severe vulnerabilities within their websites. The “Hack the Army” bug bounty was a success. The Army found many vulnerabilities within their own resources and were able to fix the issues. One discovered vulnerability allowed a hacker to access the Department Of Defense (DOD) internal network through their heavily trafficked public-facing recruiting website without the need for special credentials (Conger, 2017). In addition, there was no alert or indication that the hacker had infiltrated the highly sensitive internal network. Without this hacker letting them know about this vulnerability, there would have been no way they would have known that this breach was possible. This does bring up issues concerning the cybersecurity of the DOD as a potential breach like this one allowed access to the internal network of the DOD. This internal network holds highly classified information often critical to our nation’s safety. One can only imagine how much damage could occur if someone with malicious intent had access to this information.

This is not the first time the DOD has used this strategy to assess their security and fix their vulnerabilities. In fact, the “Hack the Army” bug bounty was driven by the success of the 2016 beta bug bounty program called “Hack the Pentagon.” However, compared to “Hack the Army” the scope of the “Hack the Pentagon” challenge was much more limited. The “Hack the Pentagon” challenge was limited by only allowing access to certain public facing sites. After the success of both of these programs, the DOD created the “Hack the Airforce” bug bounty. According to Marten Mickos, CEO of HackerOne, it was the most successful one yet as it discovered over 90 more flaws than “Hack the Army” and 70 more than “Hack the Pentagon” (Uchill, 2017). The success of the “Hack the Airforce” bug bounty
builds upon the two previous bug bounties and the growing audience that has been accruing from the rising popularity after each version of the bug bounties.

Although bug bounties have been gaining popularity recently, they are not new or even limited to computer systems and networks. Bug bounties show potential in reinforcing vehicle operating systems as well. In 1983, Hunter and Ready, a software development company, organized a bug bounty on their real-time operating system known as the Versatile Real-Time Executive or VRTX that was used on the Volkswagen Beetle. Those finding a bug were rewarded with a Volkswagen Beetle of their own (Conger, 2017). Fiat Chrysler has also followed suit and issued a bug bounty in response to their vehicle vulnerabilities that were exposed in 2015 by Miller and Valasek in hopes of addressing future vulnerabilities before they can cause any harm and damage (Greenberg, 2016). Another example of a bug bounty for automobile operating systems is Tesla which has been using another bug bounty platform known as BugCrowd to enlist white hat hackers to target their websites, mobile applications and vehicles (Fox-Brewster, 2015).

However, even with the great amount of success bug bounties have had they are not a foolproof solution. They are only a part of the solution as bug bounties are limited in that they only provide vulnerability assessments and potential fixes whenever a bounty is set. To maintain a secured system, this would require a perpetual bounty that would inevitably cost a significant and most likely cost prohibitive, amount of money. Additionally, most bounties start with a great deal of interest, but as the bounty continues, many hackers begin to lose interest or forget about the bounty and it becomes ineffective. Further, bug bounties have a high cost associated with them. For example, the “Hack the Airforce” bug bounty cost the DOD over $130,000 in rewards alone (Uchill, 2017). Thus, bug bounties may be viewed as not being cost-effective in many situations.

With such a high cost associated with bug bounties, it is not surprising to see that they are used by corporations and businesses rather than individuals. If bug bounties are not a realistic method for individuals to make use of, how can an individual be safe from these attacks? One of the most important things to prevent most vulnerability breaches is to consistently update the software, firmware and operating systems of all devices. This is a common practice that both individuals and entities should observe. The intent of updates and patches are to address vulnerabilities that can be exploited by malware and fixing them so that they can no longer be breached. The longer users delay in updating their systems, the higher the likelihood that their devices will be attacked and compromised. Once a vulnerability is exposed, it will bring more attention to itself and more black hat hackers may target the same vulnerability or engineer different ways to attack it.

Though there is speculation and controversy related toward vehicles, ATC systems and medical device hacking, proving it beyond a reasonable doubt is exceptionally difficult. One of the most imperative steps to fixing these cybersecurity-related vulnerabilities is to incorporate cybersecurity in the earliest stages of development. This is imperative as updates may not be feasible after these are in use. Some medical devices may be used on a continuous basis with no allowable downtime to update firmware. Similarly, it may not be possible for individuals living in remote locations to visit their dealership for the latest version of their car’s operating system.

Most companies have an IT department to facilitate their systems to provide basic troubleshooting such as updating, developing, backing up data and maintaining computers systems for everyday use. If a company can have a separate cybersecurity department that can handle all their breaches it is ideal, especially as these cybersecurity experts will have more knowledge on dealing with these issues than the general IT technician. The option of hiring a private security company is also a possibility. These companies can be hired to
assess the systems for vulnerabilities, develop ways to combat them, and/or create safeguards to prevent future damaging malicious attacks. The organization’s cybersecurity/IT department can work hand in hand with the private cybersecurity firm to develop best practices and secure systems. The cybersecurity firm may consult the organization on how to set up their computer systems and networks and then train the organization’s cybersecurity/IT department to manage and maintain the system. However, working or hiring a private cybersecurity firm is not necessary. Many dedicated cybersecurity/IT departments can manage and maintain their own systems and secure them from most malicious attacks.

One of the best approaches for dealing with these vulnerabilities or issues is for the cybersecurity/IT departments to adopt a proactive rather than a reactive approach. This is critical because if the cybersecurity/IT departments use a reactive approach they will only be dealing with issues after they have occurred and once a network or system is breached it can affect other connected systems or networks and spread like a wildfire through the whole network. This approach creates a significant amount of work and as a result requires much more man power to isolate and resolve the breach, if they can at all. A proactive approach used by cybersecurity/IT departments would anticipate potential vulnerabilities and breaches and set up safeguards or measures to prevent the breach from occurring. The proactive method would prevent a breach into the system or network which in turn would prevent the vulnerabilities from spreading to other networks or systems. Generally, the proactive approach requires some more work in the beginning compared to a reactive approach and requires the forethought to anticipate problems it is a much more efficient method of securing the network and the systems on it.

Conclusion
The danger of cyber-attacks is constantly growing and with it, the need and importance of cybersecurity as a component within businesses and as a consideration of issues facing end users. While this article focused on three areas that are vulnerable to hackers, they are by no means the only areas of concern. In a recent article by Tim Johnson (2017), there is a discussion of implanting microchips in human beings to “make modern life easier” (para. 4). The article addresses potential medical issues associated with implants but also recognizes that such devices may be vulnerable to hacking, “possibly monkeying with people’s cognition or perception” (para. 21). Future research will determine how safe such implants are and whether or not the benefits exceed the risks.

As technology continues to become more advanced, the rapidly growing demand for it to become integrated in our lives, whether to improve it or for the sake of convenience, drives manufacturers to push out products before ensuring the safety of the devices. The lack of secure devices or products brings many potential issues that have negative consequences to consumers and businesses. These issues are not limited to just financial harm. Lives can be endangered if medical devices can be altered or if an automobile or airplane is taken over by a hacker. Many ethical quandaries and questions and are left unanswered due to a lack of regulations or formal strategic plans that address cybersecurity threats. The lack of regulations is, in part, due to many people who underestimate the importance of cybersecurity and do not realize the dangers that are associated with advancing technology. These issues will continue to persist unless there is enough awareness to force businesses and governments to address these issues and establish safeguards against these attacks.

On a positive note, there are steps being taken to address these problems such as the government proposing bills, companies hiring security experts and cybersecurity groups/forums being established to determine best practices. Ultimately, cyber threats must be
taken seriously because advancing technologies are becoming more integrated in our lives with every day devices. The more integrated they are, without regulations or safeguards to protect the consumers, the easier it is for hackers to disrupt and harm consumers. While many view financial losses as the worst-case scenario, it is now clear that things can, in fact, get much worse.

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Big Data, digital demand and decision-making

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Abstract

Purpose – This paper aims to discuss the viewpoint that Big Data’s major impacts on the accounting community will be changes in consumers’ demand of accounting data and its impact on decision-making. Big Data is leading consumers to prefer more atomized (not summarized but rather reduced to discrete units), reconfigurable and transparent accounting data that they can combine into their own structures to meet their own decision-making needs. Consequently, consumers will demand digital goods that are less static, and summarized.

Design/methodology/approach – This paper discusses the strategic shift to what is referred to as “indirect data,” and develops a model that helps explain “how” and “why” Big Data may impact this change in consumer digital demand.

Findings – There are many evolving Big Data opportunities associated with the shift in consumer demand for more atomized, reconfigurable and transparent accounting data that are discussed in this paper, including strategic capability, auditing, performance measurement and reporting, standardization and education.

Originality/value – This paper provides a discussion of the evolving opportunities of the relationship that is created by a strategic shift in the type of digital goods consumers of information, specifically decision-makers, will demand, as well as the potential impacts on the accounting community.

Keywords Big Data, Decision-making, Accounting information, Accounting data

Paper type Viewpoint

Introduction

Big Data has quickly been added to our popular business lexicon, perhaps in part because it so vividly describes the vast amount of data that users, or consumers, have available. In fact, some feel that Big Data and its associated analytics have already permeated all aspects of decision-making and strategy (Griffin and Wright, 2015), and will continue to make significant changes to accounting (Warren et al., 2015). Others have focused on the decision-
making process and exploring the correct balance between subjectivity and objectivity when dealing with vast amounts of data (Bertei et al., 2015). For the accounting community, prior to the advent of Big Data, the static and summarized data associated with financial reports and audits have been its primary digital product. As Big Data becomes more commonplace, demand will shift to atomized (not summarized but reduced to discrete units), reconfigurable and transparent accounting data that consumers can use for their specific purposes. Big Data is creating this shift in consumer demand for accounting digital products, and this change will lead to new opportunities for accounting practitioners and scholars.

We are proposing that the advent of Big Data will create an enormous demand by decision-makers for a new type of accounting digital product. We specify the strategic implications of this shift and propose a model that helps explain “how” and “why” Big Data’s may impact this change in consumer demand. We conclude by presenting several possible evolving Big Data opportunities of this change for the accounting community.

Background

Big Data is the result of two trends: the cost of storage has plummeted and 2 revolutionary ways to analyze and interpret data have rapidly emerged. As a result, mind numbing amounts of data are flooding the world. Eric Schmidt, the CEO of Google, said that every 48 h, we create as much data as we did from the dawn of civilization to 2003 (Siegler, 2010). Also, each day, Facebook produces 10 Terabytes (TB) of data, Twitter contributes another 7 TB and Google processes 24,000 TB of data (Bollier, 2010; Delen and Demirkan, 2013). Finally, with the emergence of a wide variety of other types of devices including radio-frequency identification (RFID) chips, smart controls on building and other logistics systems-related interfaces and devices, Big Data implications become vividly apparent (Mishler, 2015).

Big Data has many operational definitions. In general, it often describes the information systems and activities which accumulate, retrieve and examine enormous quantities of data. Big Data has also been defined as, “... dynamic, large and disparate volumes of data being created by people, tools and machines” (Ernst and Young Global Limited (EY), 2014, p. 2). The digital goods associated with Big Data systems are often characterized by huge volume, rapid velocity and great variety (McAfee and Brynjolfsson, 2012; O’Leary, 2013). Many argue that a fourth “v” relating to the veracity, or quality, of the data should also be considered (Mazzei et al., 2015). But whatever definition is used to describe Big Data, most agree that it not only looks at classic concepts of accounting data such as transactions but also includes a “new world of interactions and observations” that are forcing decision-maker to change their perspective (Setty and Bakhshi, 2013, p. 1).

While the data available are growing at almost inconceivable rates, the main sources have remained relatively the same over that past decade – from scientific advances such as the mapping the human genome and global climate; from communications such as every tweet, post, click, like, email, comment, search and digital media files; and from the healthcare industry with blood tests, MRIs and hospital visits. However, a fourth source of data may make the others seem almost insignificant. Estimates suggest that the number of devices that generate or store data, e.g. mobile devices, RFID chips or sensors, will soon total more than several trillion (Nedeltchev, 2015). An evolving concept that captures these disparate types of data is often referred to as the “Internet of Things,” which promises to make Big Data even more relevant to decision-makers. While many definitions of the Internet of Things are being offered, it is often associated with the vast amount of structured, semi-structured and unstructured data in the form of image, textual, social media and even behavioral data that we continue to collect, disseminate or store. Another indicator
of the true potential impact of the Internet of Things is that some predict that the world-wide market for addressing it has been estimated to reach $7.1tn by 2020 (Press, 2014).

While it appears clear that the era of Big Data has arrived, its implications and opportunities for accounting are much less clear. We suggest that accounting will continue to produce static, and summarized accounting data, but that consumer demand for accounting data that is atomized, reconfigurable and transparent will grow much more rapidly. To frame the relationship between Big Data and the many different consumers of accounting information, we have developed a model that addresses direct and indirect digital goods. We also recognize that there are a variety of different internal and external stakeholders that have a vested interest in the quality and quantity of data and information. But we feel regardless if they use accounting data static and summarized, or dynamic and atomized, their ultimate goal is enhanced decision-making and the ongoing changes in the Big Data landscape is ushering in new and different demands for accounting digital goods.

We see this impact of Big Data on accounting as similar to the disruptive impact of information technology (IT) on other industries where well-trained professionals create digital goods for a very large consumer marketplace; professions such as music, journalism, advertising, television and healthcare (Bhattacharjee et al., 2011; Dolata, 2011). A classic example of a disruptive technology was the iPod. Prior to the iPod, consumers had little choice in the structure of the music produced by the recording industry – songs were made available in a particular order on one product – the long play (LP) music album followed by the compact disk. After the iPod’s widespread adoption consumption of music output changed, consumers had the opportunity for self-service and created their own structures, their own playlists. While other factors also contributed to major changes in the industry, the iPod changed the relationships among providers and consumers in the music marketplace.

There are other examples of a technology that supported end-user self-service, which have had a similar impact on the relationship between producers and consumers of digital products. It is common knowledge that the new digital photography options changed the relationships between producers and consumers in the photography industry, Web aggregators changed the relationships among producers and consumers in the news marketplace, search engines changed the relationships in the advertising marketplace, video streaming changed the relationship between producers and consumers of video entertainment and electronic healthcare changed relationships within the healthcare marketplace. In each domain, a new technology fundamentally changed consumer demands, often nullifying incumbents’ competitive advantages (Sabatier et al., 2011; p. 42, 78). While these changes have unique elements, collectively they suggest that technology can unexpectedly disrupt relationships between consumers and producers of digital goods. But while these examples illustrate the impact of Big Data on the changing demands of various layman consumers of digital goods, experts may be more agile in capitalizing on the changes. For example, professional accountants may exhibit more adaptive capacity, and be much more facile in using atomized Big Data for their specific uses and are much better postured to create information that will enhance internal and external decision-making.

With this background, we proceed to develop a model that helps explain “how,” “what” and “why” Big Data will lead to a shift in consumer demand for indirect accounting digital goods.

**How: accounting output will shift to indirect data**

To understand how Big Data is changing consumer’s demand, we need to adopt a customer’s viewpoint and consider how the quantitative output of accounting activities, which we refer to as accounting digital goods, are used and labeled. Historically these digital goods, including numbers on financial statements, were the results of internal financial
activities, the aggregation of transactional records and adjustments made both internally and externally were direct inputs to decision-making. The consumers of these direct digital goods include a variety of both internal and external stakeholders. Internally, the financial accountants that record transactions, track payables, receivables and capital assets, manage cash, address taxes and eventually prepare financial reports all will experience changing digital goods demands. Also, internally, managerial accountants, as direct users of accounting information, will be affected by Big Data as they accumulate costs, manage cost behavior, measure performance, set prices and assist in internal strategic decision-making. Externally there are countless consumers of these direct static digital goods and Big Data will affect the demands of all of them, including investors, competitors and the various different government agencies and regulators. Currently these internal and external stakeholders predominately consume digital goods that are summaries of activities and are treated as static, finished information. We refer to this direct use of digital goods as the direct accounting process in Figure 1.

With the inception of modern quantitative and statistical analysis, as well as data analytics, a second, indirect, use of accounting digital goods is becoming more significant. In this second method, the quantitative output of accounting activities is not directly used for decision-making, but instead it was manipulated and combined in data analysis prior to decision-making. This indirect use of accounting output is shown in the bottom row of Figure 1. Figure 1 also indicates how the data associated with non-accounting Big Data enters the indirect method and is analyzed in the indirect process.

In the top row of Figure 1, the direct use is a simplified representation of the process of activities where financial transactions are transformed, or stored, into accounting data then summarized into accounting information to be used directly by individuals to make decisions. The most common examples of accounting output as information that is directly used in decision-making are the well-accepted financial statements, such as balance sheets, statements of cash flows and income statements. Our consumers use these static and summarized finished goods without extensive reconfiguration of the accounting data. It is static, not dynamically reconfigured by analysis, and it is summarized, not atomized (reduced to discrete units) in nature.

In the bottom row of the model in Figure 1, the accounting data are stored in a database and subsequently analyzed. This analysis is often an interactive self-service where the data are reconfigured by filtering, sorting, reclassifying, combining and other analytic activities. New data are created. When stored as data, these accounting digital goods can be the input to many subsequent analyses. The result of the analysis activity is information because it is used for decision-making. In this final information step in the bottom row of the model in Figure 1, consumers put the data “into formation.” In other words, they create their own

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**Figure 1.** Accounting output model – two most common accounting processes using accounting digital goods
information for decision-making. These data in the bottom row, before it is put into formation, are atomized, transparent and reconfigurable.

For example, the digital goods in the bottom row may begin in the left box of accounting data as a list of exceptions in an audit. These data are then subsequently, and perhaps repeatedly, analyzed looking for patterns that may indicate fraud. If the data can be put into a conclusion that fraud exists, that is information and the decision-making process begins. Prior to this decision-making, the data are atomized – it is not summarized, is as specific and narrow as possible and it is simply the original details of the transaction. The data are reconfigurable because it can be transformed into more meaningful measures or combined with other sources of data to create more helpful insights. Finally, the data are transparent because it is atomized (not summarized but rather reduced to discrete units) and the process to create it is likely self-evident, not obscured behind layers of summary.

In the top row of the model in Figure 1, the quantitative output of accounting activities is not subsequently recombined, restructured and analyzed, as was the case in the bottom row. In the top row, accounting professionals did most of the processing of data, and in the bottom row, the consumer is doing most of the processing of data.

While both processes have been in use for many years, the storing and analyzing activities in the bottom row have become so efficient with Big Data systems that the result is a far greater demand for accounting output as data that can be stored and analyzed. Big Data has rapidly accelerated the trend toward the indirect use of accounting output.

Our position is not that all the output of accounting activities will follow the bottom row process, that this is a zero-sum game, or that the top row will occur less often than in the past. Rather, we propose that the advent of Big Data will rapidly increase the demand for accounting digital goods that are atomized, reconfigurable and transparent. As a result, the emphasis in accounting will shift from the top-right side of Figure 1 supporting decision-making to now include an equal emphasis on the bottom-left side – creating valuable digital goods that can ride the wave of Big Data.

Figure 1 also highlights a distinction we make between data that enter the model on the left and information that leads to decision-making on the right. If an output of an accounting activity is further manipulated by a machine, we call this data. If the output of an accounting activity is used by an individual to create meaning for decision-making, we call this information. Information is shown in Figure 1 in the final box before decision-making. This distinction is analogous to the distinction between raw materials and finished goods – accountants produce both raw data material, and finished information goods.

Before considering the implications and opportunities of a shift of accounting information from finished information goods to raw data material, it is helpful to consider the etymological distinction between information and data as used in the model in Figure 1. Most accountants, like others that produce data or information, assume the common definitions of these terms; data are captured facts and processed data become information. Accounting digital goods judged by individuals in the activity of making a decision are appropriately referred to as accounting information.

By this definition accounting produces information. Here, we suggest that accountants take the point of view of the consumer and impose a useful distinction between the data that the end user receives from accountants and the information they create for their own decision-making. From the accounting perspective, the accounting output that is the result of their activities is often called accounting information. Advancements in IT, and particularly accounting IT which is also commonly referred to as accounting information systems (AIS), have made data not only more available but also more malleable. But the lack
of precise definitions for IT, AIS, data and information has restricted the potentially rich research area of the intersection of accounting and IT (Murthy, 2016).

If we become more consumer-centric, it becomes apparent why accountants should prefer to call it data. In common use, data are facts, or numbers, or news regarding some differences or, more simply, a lack of uniformity (Floridi, 2005). In scientific use, data are defined as facts (Galland, 1982; Laudon and Laudon, 2012), numbers that stand for an object or event (Knight and Silk, 1990), measures, or symbols that relate to events (Martin and Powell, 1992).

To accountants who want to store, recombine, restructure and analyze output, the output appears to be accounting data. The key is to see the relationship from the consumers’ perspective. For people inside the accounting profession using their own labels, the distinction between data and information is much less apparent. Financial data that are used directly in decision-making are information; these data play a semantic role, accounting output is information because they are processed data that are meaningful; financial statement data are meaningful to stakeholders who use that information to make decisions. In other words, if a decision is being made, information is being considered. But many organizations lack the resources to efficiently exploit these new available data and often conclude that Big Data is too expensive to use, and turn to data warehouses or cloud databases as alternatives (Smith, 2016).

Finally, not only is the term data theoretically correct for the bottom row of the model in Figure 1, it is also increasingly used in the accounting community. Recent Big Data accounting-related research almost exclusively refers to accounting output as data (Nixon and Burns, 2012; Al-Khoury, 2012; Van Harmelen and Workman, 2012). Also, current Big Data books (Franks, 2012; Sathi, 2014) refer to accounting output as data. Regardless of what semantic label is attached to it, indirect, direct, information or data, accounting output has meaning and value because of the potential to enhance decision-making.

Why: Big Data will lead to more frequent indirect use

In Figure 1, our model of direct and indirect use of accounting information is offered to explain how customer demand is changing; here we consider why Big Data will accelerate this change in demand. In short, this change in consumer demand is due to accounting digital goods increasingly taking on the characteristics of Big Data.

One characteristic of Big Data that will increase indirect use is velocity. Some experts predict that Big Data will enable every financial transaction in the USA to be recorded and analyzed in real time (Liu, 2013; Titera, 2013). Not only can all the transactions be evaluated, an audit can happen in real time as the transactions are occurring, not at the end of a month or year. If discrepancies are occurring, a real-time assessment can identify them. Real-time analyses of large volumes of financial transactions are already occurring (Moffitt and Vasarhelyi, 2013; Zhang et al., 2015). Credit card companies detect unusual card use on the spot and require consumers to personally verify the purchase on the telephone or in some other way before it will accept the charge. In sum, the velocity of Big Data will increase demand for atomized real-time data, waiting for the end of the month or end of the quarter to roll up accounting data into summarizes will be in less demand. Enabled by IT, companies now have available accurate financial performance reports (Smith, 2016).

A second characteristic of Big Data that will increase demand for indirect use is variety. Big Data comes from a variety of sources and in a wide variety of formats (McAfee and Brynjolfsson, 2012). In contrast to traditional data systems, Big Data is designed to accommodate unstructured text, sensor data, audio, video, click streams and log files as data. Big Data systems can handle dates in different formats, different rules about missing
data values, and free-form text and audio, video, graphic data, social media, product reviews, quality standards, consumer sentiment and even political risk data. In the past, some accounting data were not easily stored and analyzed, as different rules, different meanings and different methods were used to produce them. O’Leary (2013) suggested that Big Data will be able to integrate financial data from blogs, message boards and social media discussions with traditional accounting data to create more accurate assessments of financial performance or condition and to enhance audits. The development and use of XBRL (eXtensible Business Reporting Language) is an example. In an effort to make data machine readable, XBRL standards enable atomized accounting data to be created and recombined on a large scale. With the capacity of Big Data to store and analyze unstructured data, such as notes, textual assumptions and methods used, accounting data, including the notes and assumptions recorded by accountants in the process of creating the data, will be stored and analyzed more than ever before.

Finally, Big Data systems are designed to support self-service end user analysis. Historically, data systems that supported analysis typically required an IT analyst to create queries and structured reports (Lycett, 2013). In contrast, Big Data systems typically feature drag and drop, simple interfaces and intuitive objects and operations. Big Data systems are designed and sold on this self-service interface. Removing the IT analyst and getting the domain expert to interact with data is an explicit strategy to enhance interaction with the data that will lead to more frequent and pronounced discovery (Mullich, 2013). This self-service aspect of Big Data systems will increase the demand for more reconfigurable and transparent data that can be mixed and matched with other sources of data by the end-user without extensive knowledge about how the accounting data were created or summarized.

Evolving Big Data opportunities
There are many evolving opportunities associated with the shift in consumer demand for more atomized (not summarized but rather reduced to discrete units), reconfigurable and transparent accounting data. We are not proposing that demand for traditional direct structured accounting output will cease, in fact it might not even be reduced. Our position is that the shift to more indirect use will generate new opportunities for accounting in the areas of strategic capability, auditing, performance measurements and reports, standardization and education. These general areas are offered as a sampling of the possibilities of how the shift will affect accounting, not a comprehensive collection of expectations derived from published studies.

Strategic capabilities
The growing demand for raw data goods will transform the accounting and IT functions in an organization into dynamic capabilities and become a source of competitive advantages for an organization (Teece et al., 1997; Zahra et al., 2006). This is in part because the internal analysis of accounting data is unique to the organization and cannot be purchased from factor markets or easily replicated by other organizations (Helfat and Peteraf, 2009). The unique characteristics and resources of these accounting and IT functions offer opportunities for performance advantages because of the unique combinations and depictions of accounting data they offer decision-makers that are only available within the organization. This exclusiveness can provide the basis for performance advantages which are not easily replicated.

To the extent that these functions are unique to their organization and create opportunities to process data, they represent opportunities for competitive advantage (Zollo
and Winter, 2002), making the accounting function an essential dynamic capability (Teece et al., 1997).

**Auditing**
As Big Data fuels growth of demand for accounting data, we feel there will also be a growing demand to verify the data. This in part describes the audit function. The accounting community has become increasingly concerned about the quality of audits, especially regarding risk assessment standards (Barlas, 2016). It could be argued that the huge volumes of often unverifiable data that are associated with Big Data could exasperate the concern for the quality of audits because accounting data are increasingly more ubiquitous, more complex in structure and increasingly enabled with the ability to interact with the many different Web-based entities (Vasarhelyi, et al., 2015).

Big Data provides the opportunity to greatly expand this and affords assurance on other types of data. According to Gazzaway (2014), this new data environment should lead accounting to consider changing audit standards to give investors and creditors what they really need – verified data. This perspective views Big Data as a valuable compliment to traditional audit evidence (Yoon et al., 2015) while helping auditing with assessing risk (Cao et al., 2015).

As the demand for accounting data that are atomized (not summarized), reconfigurable and transparent, new auditing opportunities will occur in a variety of contexts. For example, the prospect of continuous auditing offers a particularly interesting potential implication for this growth in demand (Baksa and Turoff, 2011). The Institute of Internal Auditors (IIA) views the purpose of continuous auditing as providing roughly simultaneous assurance that can significantly increase efficiency and insight gained through audits (IIA, 2015). Some feel the demand for real-time financial reporting coupled with the emergence of real-time IT capabilities and analytic software are all influencing the adoption of continuous auditing (Brannen, 2006; Kuhn and Sutton, 2010). Continuous auditing also holds the promise of more effectively addressing fraudulent activities.

Finally, Alles (2015) reinforced our position that auditing will be affected by the Big Data-driven increase in demand for raw accounting data calling it a “strategic necessity for business” which is becoming “[…] equally essential for auditors […]” (Alles, 2015, 442). Alles (2015) continued to mirror our position by describing that the demand for indirect dynamic unstructured data will drive Big Data adoption by auditors by stating that there exists, “[…] a demand rather than supply side argument for why auditors will end up using Big Data – not because they necessarily value the analytical power of Big Data, but because their clients do” (Alles, 2015, p. 442).

**Performance measurements and reporting**
Consumers will increasingly rely on atomized (not summarized but rather reduced to discrete units), reconfigurable and transparent data to create their own unique measures of individual performance and reporting requirements, rather than use summarized and static reports. Krahel and Titera (2015) suggested, “Aggregation and arbitrary allocations made on static, paper-based financial statements are artifacts of a bygone era of high transmission costs and slow data collection speeds” (Krahel and Titera, 2015, p. 410).

As participants in the data marketplace exchanging digital goods, accountants will have many new opportunities to create innovative reports. These reports will surely require customized or nontraditional measures of business output or success. When accounting outputs are stored as data they can more readily be used for reports alongside the plethora of other business data. For example, accounting output can be combined and enriched with
new potentially low-cost, high-value measures such as type of product in inventory, location of inventory, supplier and age of the inventory (Moffitt and Vasarhelyi, 2013). These new report formats and new data visualization techniques might feature dynamic slice and dice aspects, drill down capabilities and even three-dimensional formats (Titera, 2013).

Raw accounting data will play a key role in measuring and reporting performance. Big Data is making available huge amounts of real-time structured and unstructured data that are atomized and reconfigurable that meets the demand for custom developed performance measures. Ideally, these performance metrics should be aligned with organizational goals. One performance measurement framework, the Balanced Scorecard (Kaplan and Norton, 1996), is a time-proven widely accepted performance measurement and management control system that identifies and measures financial and non-financial performance. The Balanced Scorecard’s effectiveness can be greatly enhanced by leveraging the use of atomized, reconfigurable and transparent accounting data in all four of its major categories of measurement; financial, internal processes, learning and growth and customer perspective (Kaplan and Norton, 1996) Malleable indirect data would allow more precise, relevant and customizable reports for a host a different metrics in all four major categories.

Another example of an increasing internal demand for atomized, reconfigurable and transparent accounting data to support performance measurement involves budgeting. Budgets have been criticized for being too intra-organizational with their data use, hampering accurate forecasting. Many companies are turning away from traditional budgeting techniques and toward what some refer to as beyond budgeting which reconfigures enterprise resource planning data enhanced by Big Data (Bourmistrov and Kaarboe, 2013).

Finally, as the demand for atomized (not summarized), reconfigurable and transparent data increases, the potential for accountants to be involved in organizational performance assessment increases as well. Some argue that Big Data has placed accountants in an excellent position for strategic performance analysis via what he refers to as recursive partitioning (Cokins, 2014; Pickard and Cokins, 2015). This assessment technique uses customer cost and profit data to determine patterns of profitability of existing customers to identify the characteristics of potentially more profitable future customers (Pickard and Cokins, 2015).

Standardization

Our model in Figure 1 suggests that with the advent of Big Data, there will be a great deal of raw atomized (not summarized but rather reduced to discrete units), reconfigurable and transparent data, much of it will be considered non-standard.

Teaching accountants how to address and use this new onslaught of non-standard data may prove to be challenging. While the academic community has recognized the need to integrate Big Data and related IT and AIS topics into the curriculum, few instructional resources are currently available (Sledgianowski et al., 2016).

Creating new reliable and robust standards will be increasingly significant to the accounting community. They will need to help provide standards for this new atomized data and make it more useful while keeping the constraints and possibilities of existing and future IT capabilities in mind. We feel the value that accountants can create via standardization is illustrated through two domains; international reporting standards, and reporting language standards. In each of these domains, raw data – data that are atomized (not summarized), reconfigurable and transparent – are already rapidly emerging.

Internationally, the ability of accountants to effectively analyze data across countries for global firms demonstrates the value accountants can produce via standardization. Analysts
will require greater comparability and consistency in working with accounting data involving new raw data across national boundaries. For example, while the Cost of Goods Sold has a generic definition, it has different meanings in different countries, different languages and for different organizations. To address this concern, the global accounting community has set out to create a single global-wide accounting standard referred to as the International Financial Reporting Standards (IFRS). For a host of technical and political reasons, there have been substantial roadblocks toward accomplishing this goal of adopting a single international accounting standard. However, there has also been considerable progress made toward global financial report comparability (Barth, Landsman, Lang, and Christopher, 2012). The problem arises when standards setters approach the difficult task of determining the appropriate level of detailed guidance to achieve sufficient comparability and consistency for financial statements. In other words, as more data become atomized, and as analysts seek to reconfigure those with other data, this may only exasperate this major international issue.

The shift in customer demand that we describe will increase the need for a reporting language standard. As our model in Figure 1 demonstrates, producers and consumers of accounting data are all looking for competitive advantage through increased efficiency. We feel as the demand for atomized (not summarized), reconfigurable and transparent data grows, and expands globally, perhaps the implications involve the individual data, themselves. In part, this is because to create traditional summarized and static financial reports, which are still in great demand, there are increasing costs associated with manual processing of the individual data. Following this reality, Big Data will only increase those costs because of the onslaught of the additional accounting data demanded which will eventually require more labor. Christopher Cox, former SEC Chairman, describes this situation:

“Right now, thousands of people in financial firms across America are going through the time-consuming, laborious task of sifting through paper, text, and HTML reports. They’re keyboarding data from static SEC reports into more useful formats, so they can actually use it [...]. It is so 20th century” (Cox, 2005).

The accounting and IT professions’ answer to this dilemma is in part XBRL. XBRL is a business reporting “markup” system similar to the UPC code on labels that add contextual information to business data (XBRL International, 2016). The power of XBRL in this context is that it provides financial reporting that is agile and reconfigurable while offering increased transparency and control (XBRL International, 2016). Using XBRL allows consumers of accounting data to analyze and compare apparently static financial statements with those of other XBRL-formatted statements in any format the consumer prefers because the data are actually “intelligent” or interactive (XBRL International, 2016). For example, many current static reports are all merely different versions of a paper document. But interactive XBRL data can increase internal control and reporting efficiency, while improving external analysts’ options by instantly making the data searchable and retrievable using any software desired. Also, according to the SEC Chairman Cox, “Interactive data can make the SEC a far more effective regulator, by helping us focus on preventing fraud, not just reacting to it” (Cox, 2005).

But XBRL is not a panacea or without controversy. Successful XBRL adoption will depend upon the development and acceptance of a comprehensive and robust XBRL taxonomy, which will serve as a dictionary to define the accounting terms used to tag the data found in financial statements (Brands, 2011, 2012). Similar to its negative impact on IFRS, the vast size of Big Data will exasperate XBRL implementation issues. Yet with
regard to standardization, we feel that the widespread adoption of XBRL with a comprehensive taxonomy shows incredible promise to organizations trying to gain competitive advantage by recognizing the dynamic capability associated with best addressing the increase in demand for accounting data that are atomized, reconfigurable and transparent.

**Education**
To better prepare students and professionals to succeed in a Big Data-rich business environment, both formal academic education and continuing professional education will need to be updated or upgraded. Recognizing this need, there are ongoing research efforts that are investigated integrating Big Data and IT into the accounting curriculum (Sledgianowski et al., 2016).

We feel that one change should focus on the difference between data and information, as shown in our model. The disconnect between knowing the data is available and making good information for decisions from it can create a type of information anxiety (Wurman, 1989, p. 34). Students need curricular changes that can help them understand how data become information for decision-making and how to have confidence in their ability to create this information.

Also, the potential flood of Big Data will create other issues that will be particularly difficult to address in the classroom. Vasarhelyi et al. (2015) felt that assurance will require “audit by exception” and consequently will require accounting students to develop a higher tolerance for ambiguity. In addition, Vasarhelyi et al. (2015) felt that Big Data will precipitate substantive change in accounting education to include an increase in the statistical and IT curricula. Cao et al. (2015) called for students to receive more training in data analytics.

Students will also need more education and training with IT fundamentals to better understand how databases are directly and indirectly constructed so they can be audited, edited and manipulated in response to various requirements and opportunities. In addition, students will need training in a broader skill-set including the ability to recognize “false positives,” measurement theory, induction, technical skills and the role of professional judgment in statistical and data-driven analysis (McAfee and Brynjolfsson, 2012). Koch (2015) believed that students will also need to develop “Big Empathy Skills” that compliment Big Data technical skills. Big Empathy means learning to understand the relationships and impacts of change on the decision-making process (Koch, 2015, p. 62).

Frustrating improvement efforts in these types of student-centric improvement efforts are that universities tend to lack the IT infrastructure and human resources required to align improvement efforts with hard to measure outcomes and problematic objectives such as critical thinking and employability (Dede et al., 2016).

Also, Big Data that is reconfigurable has lowered the cost and raised the rewards for experimentation that result from manipulating data and other analytics. As a result, education and training will need to include principles of data experimentation and how to make careful and reasoned analysis of promising implications and opportunities. This includes the ethical considerations that might arise while investigating with, or using Big Data. Higher education must stay vigilant to the fact Big Data research may reveal human information, behaviors and practices that may have compounded unintended, but potentially damaging, implications including privacy and consent concerns usually addressed at Institutional Review Boards (Tijerina, 2016).

Finally, we feel accounting education will need to emphasize critical thinking skills. These skills include the ability to understand the limits of measurement, representation, indetermination and induction on analysis.
Conclusion
In this paper, we discuss a strategic shift in the type of digital goods consumers of information, specifically decision-makers, will demand. We suggested a model that helps explain “how” and “why” Big Data’s may impact that shift to what we call indirect data. We feel with the arrival of Big Data, customers of accounting output will increasingly seek atomized (not summarized but rather reduced to discrete units), reconfigurable and transparent data rather than finished information goods. This shift in preference will significantly change the relationship between producers of accounting data and their consumers. Decision-making consumers of accounting data will increasingly demand indirect raw data goods that they can combine into their own structures to perform their own analysis and analytics.

The impact of Big Data on the accounting community is just beginning and more research is needed to better understand the implications and opportunities. Research involving the measurement of actual practices and the attitudes of the various internal and external consumers of direct and indirect digital goods, as well as the impacts of various stakeholders including investors and regulatory agencies, should be conducted. We recognize that each of the opportunities we discuss will generate more questions. But if we take the perspective that consumers are shifting their demands, we can better understand and improve how we adapt and address these changes.

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