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The value relevance of environmental emissions

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A B S T R A C T

This study examines whether environmental performance has value relevance by investigating the relations between environmental emissions and stock prices for the U.S. public companies. The previous studies argued that the conjectured relations between accounting performance measures and environmental performance do not have a strong theoretical basis, and the modeling of relations between market performance measures and environmental performance do not adequately consider the relevance of accounting performance to market value. Therefore, this study examines whether publicly reported environmental emissions provide incremental information to accounting earnings in pricing companies' stocks. It is done among the complete set of industries covered by Toxics Release Inventory (TRI) reporting for the period 2007 to 2010. Using Ohlson model but modified to include different types of emissions, it is found that ground emissions (underground injection and land emissions) are value relevant but other emission types (air and water and transferred-out emissions) appear to not provide incremental information in the valuation model. The result in this study raise concerns that different types of emissions are assessed differently by the market, confirming that studies should not aggregate such measures.

A B S T R A K

Studi ini mengkaji apakah kinerja lingkungan memiliki relevansi nilai dengan penginvestigasian hubungan antara emisi lingkungan dan harga saham perusahaan-perusahaan di Amerika Serikat. Sebagai argumen, perkiraan yang dikemukakan oleh studi-studi terdahulu menunjukkan bahwa hubungan antara ukuran kinerja akuntansi dan kinerja lingkungan tidak memiliki dasar teori yang kuat, sedangkan pemodelan hubungan antara ukuran kinerja pasar dan kinerja lingkungan tidak cukup hanya mempertimbangkan relevansi dari kinerja akuntansi terhadap nilai pasar. Untuk itu, studi ini mengkaji apakah emisi lingkungan yang dilaporkan kepada publik memberikan tambahan informasi terhadap laba akuntansi dalam menentukan nilai saham perusahaan. Penelitian ini dilakukan pada semua industri yang tercakup dalam pelaporan Toxics Release Inventory (TRI) selama periode 2007 sampai 2010. Menggunakan model Ohlson yang dimodifikasi dengan menambahkan tipe-tipe emisi yang berbeda, ditemukan bahwa emisi tanah memiliki nilai relevansi tetapi hal tersebut tidak ditemukan di antara tipe emisi yang lain. Hasil dari studi ini menunjukkan bahwa tipe-tipe emisi yang berbeda dinilai secara berbeda oleh pasar, sehingga terbukti bahwa penggabungan emisi sebagai ukuran kinerja lingkungan tidak seharusnya dilakukan oleh studi-studi yang ada.

1. INTRODUCTION

This study revisits the relationship between environmental and financial performance by investigating the value relevance of environmental emissions. Information is deemed to be value relevant if it has a significant association with market value. This study examines whether the market considers emissions to add information beyond that of accounting performance when valuing companies. It used the theorized relation between accounting performance and market value, as well as the value relevance of non-financial information.

Most of the extent research in environmental accounting focuses on the relationship between environmental performance and environmental disclosure (e.g. Cho, Patten, & Roberts 2006; Clark-

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son, Li, Richardson, & Vasvari 2008; Clarkson, Overell, & Chapple 2011). Although some studies explore the possible links between environmental and financial performance—which is also the focus of this study—the results are still inconclusive. It appears that the different measures of financial performance and environmental performance employed in those studies contribute to these mixed results. In addressing the main research question whether environmental emissions are value relevant to the market, this study argues that the conjectured relations between accounting performance measures and environmental performance do not have a strong theoretical basis, and the modeling of relations between market performance measures and environmental performance do not generally consider the relevance of accounting performance to market value.

Furthermore, this study argues that the theorized relation between accounting performance and market value may be deficient to the extent that conventional accounting does not account for external costs of environmental activities. Even costs that may be expected to be internalized, such as the costs of cleaning up the environment, are disclosed only in the notes to financial statements as contingencies under the U.S. generally accepted accounting principles (U.S. GAAP). However, these and undisclosed potential costs may be considered value relevant by investors.

Particular shareholders (i.e. institutional investors) have recently shown greater concerns regarding environmental issues. The growing importance of socially responsible investment shows that investors are more interested in corporate social and environmental practices. This shows that investors become more interested in whether corporate environmental performance can increase their wealth.

Environmental performance in the form of emissions can be indicator of the corporation's exposure to future environmental costs or liabilities. Lower emissions may indicate better management of production process and waste. Although managing the production process to reduce emissions can be costly and reduce current earnings, in the future a company may be better off by having cleaner production and outputs, attracts more environmentally concerned customers, as well as gaining good environmental reputation. All these things can be respected as securing corporate legitimacy, enhancing competitive advantages and increasing corporate value. To the investors, this value creation improves the expected future cash flows and causes them to adjust positively the share prices.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

The previous studies supported the argument that environmental performance information is value relevant in limited contexts (e.g. Clarkson et al. 2004; Hamilton 1995; Hassel et al. 2005; Hughes 2000; Moneva & Cuellar 2009). Clarkson et al. (2004) study the value relevance of environmental capital expenditure for the U.S. pulp and paper industry in the period of 1989 to 2000. To distinguish between good and poor environmental performers they employ simple dummy variables based on aggregated emissions by separating them on the median. From this they classified firms with emissions more than the median as high polluters and those that emit less than the median as low polluters.

This study asserted that aggregating the emissions can be misleading because different emissions types may provide different information thus could have different relevance to the market. Similarly, Hughes (2000) ducts a study that is also confined to single industry (i.e. electric utility), besides only examines the value relevance of environmental performance based on Sulphur Dioxide emissions. Hamilton (1995) reports an event studies of how the market reacts to the first set of TRI data published in June 1989. By disaggregating the emissions his study suggests that the emissions do not meaningfully additive. Hassel et al. (2005) examine the value relevance of environmental performance indices for Swedish companies and Moneva and Cuellar (2009) examine the value relevance of financial and non-financial related environmental performance of Spanish companies. Hassel et al. (2005) use qualitative measure of environmental performance which is considered more subjective, while the valuation model used by Moneva and Cuellar (2009) appears to be misspecified in which the variables are not independent.

Accounting earnings is an indicator of how efficient a company manages past business/financial activities (Nichols & Wahlen 2004). It may reflect the actual financial performance that can be used to predict the company's future economic condition and provide opportunities to involve in new business projects. Supposedly, accounting earnings can be regarded as providing a non-biased indicator of future performance, thus they are value relevant for investors in making investment decisions (Banker et al. 2009; Venter et al. 2014).

However, accounting earnings can be unreliable information to the market. Yet, earnings disaggregation shows that accruals, relative to cash flows, provide better indication of firms' future performance,

they may have embedded problem that is it can be manipulated by management. This is because companies have incentives to manage their earnings; for example, to avoid political costs (e.g. Patten & Trompeter 2003; Wilson & Shailer 2007; Yip et al. 2011), to prevent wealth transfers (Johnston & Rock 2005), or to meet other particular goals (Peltier-Rivest & Swirsky 2000). Yet, share prices may impound information provided by accounting earnings, this information is incomplete because accounting conventions inadequately account for future uncertainty costs or contingencies.

Accordingly, not all the information about companies' economic activities is fully captured by the accounting earnings although they may also be value relevant. However, the information that is not reflected on accounting earnings may be available to the market and share prices may impound this information. A valuation model developed by Ohlson (1995) highlights the value relevance of accounting numbers and other information. This model suggests that other information is value relevant to the market, therefore may complement the information provided by accounting earnings.

TRI provides information about on-site and off-site disposal or releases and transferred of emissions. Whenever the emissions reach or exceed the specified threshold, the U.S. Environmental Protection Agency (hereafter U.S. EPA) enforces that facilities in selected industries should report their emissions on the TRI. This opens the companies to more scrutiny in particular by the capital market participants. To the investors, high emitters might be considered as bad environmental performers and investors may penalize them by discounting the share prices.

Managing environmental impacts such as corporate emissions is becoming a significant issue that could affect business performance. Through most of production processes companies discharge toxic emissions or hazardous materials to the environment. The ability of companies to plan, execute and control their production processes to manage subsequently their emissions determine how they affect investors' decision-making. The study of Clarkson et al. (2004) show that good environmental performers are favorably priced by the market. As companies need financial resources (i.e. capital) to survive and given that investors have power to demand companies to be more environmentally responsible (Magness 2006), those that can minimize their negative environmental impacts (e.g. emissions releases or disposal) might have better access to financial resources besides obtain a good reputation and corporate legitimacy.

Early studies by Porter and Linde (1995) as well as Russo and Fouts (1997) asserted that corporate efforts to manage emissions affect its financial condition in regards to how much money is willingly to be sacrificed or invested on adopting cleaner production. To some extent, investors might be interested whether a better financial condition gives a company the ability to bear environmental costs today and to avoid future costs or environmental liabilities. According to Porter and Linde (1995) adopting a more proactive environmental practice such as pollution prevention is arguably more beneficial to corporations. Yet, Russo and Fouts (1997) state, a better environmental performance may enhance corporate reputation and create competitive advantages that are inimitable to competitors which extensively improves future financial performance. Besides able to anticipate more stringent environmental regulation in the future, corporations will also be more skillful on their practices in which the benefits are most likely to outweigh the costs. Consequently, a company that can reduce emissions although has to bear costs of compliance might have better future profitability from avoiding clean-up costs or liabilities. In fact, more recent study by Lin et al. (2014) shows that firms exposed to international trade and foreign investment tend to be more environmentally concern. This supports the notion that financial performance and environmental performance are tied together (Bosworth & Clemens 2011).

Emissions information can be value relevant if it provides additional information to accounting numbers and helps investors to value companies' future financial performance. Drawing from previous discussions, companies that release or dispose fewer emissions may financially benefit from the avoidance of future environmental costs or liabilities. Companies may also benefit from less waste and better production outputs to the extent that they can reduce emissions along and/or after the production process. Being a better environmental performer, a company may be regarded as environmentally legitimate, possess better reputation, enhance competitive advantages, and experience better future profitability.

Since emissions levels may be an indicator of future profitability, it is hypothesized that information about environmental emissions (measured by toxic chemical releases or disposal) is value relevant to the capital market, which is stated, in alternative form as:

H1 : Environmental emissions are value relevant to the market.

Table 1
Sample Selection

	2007	2008	2009	2010	Total
Initial sample on the TRI database after facilities are merged	3,882	3,969	4,012	4,158	16,021
Minus: non-COMPUSTAT firms	3,322	3,403	3,443	3,589	13,757
Minus: not available financial and share price data	109	58	51	47	265
Firm-years available	451	508	518	522	1,999
Unique firms					569

Table 2
Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max	Median
Panel A: Unscaled Variables						
MVE	1999	9,169.789	28,551.820	-10.619	452,505.300	1,790.261
BV	1999	4,135.180	12,611.110	-17,311.000	157,318.000	898.845
AE (r=5%)	1999	434.772	2,048.505	-14,962.400	39,131.900	44.949
EPair	1999	0.488	2.152	0.000	38.500	0.013
EPwater	1999	0.102	1.257	0.000	31.600	0.000
EPunderground	1999	0.104	1.336	0.000	27.500	0.000
EPland	1999	0.824	10.200	0.000	394.000	0.000
EPtransfdisp	1999	0.346	3.103	0.000	83.100	0.001
EPtransfrmgt	1999	1.532	7.449	0.000	166.000	0.064
Panel B: Scaled Variables						
SP	1999	35.916	120.051	-3.085	4,472.900	26.410
BV/Share	1999	131.993	3,014.851	-31.826	84,472.940	13.176
AE/Share (r=5%)	1999	3.872	119.581	-673.112	5,033.624	0.885
EPair	1999	0.161	0.614	-0.720	11.964	0.009
EPwater	1999	0.018	0.147	-0.025	2.996	0.000
EPunderground	1999	0.343	7.443	0.000	187.939	0.000
EPland	1999	0.579	7.965	0.000	201.310	0.000
EPtransfdisp	1999	0.237	3.300	-0.034	93.900	0.001
EPtransfrmgt	1999	0.665	2.590	-0.084	56.328	0.039
Panel C: Control Variables						
CAPINT	1999	0.064	0.130	0.001	3.084	0.034
LEVERAGE	1999	0.553	0.204	0.066	1.581	0.555
ASSET_AGE	1999	0.508	0.154	0.073	0.968	0.486
LIQUIDITY	1999	0.113	0.103	-1.616	0.946	0.104
SALES_GROWTH	1999	6.341	27.923	-73.401	273.388	4.999

Source: Processed Data.

3. RESEARCH METHOD

Sample of the Study

This study employs a panel data approach for the sample firms across the period of 2007 to 2010 and uses secondary data for the U.S. public companies from 2007 to 2010. The sample period is considered reasonable to isolate them from the data prior to the global financial crisis period. Additionally, in 2006 the U.S. EPA made a major change in TRI industry classification to the NAICS codes. Thus it would be problematic to match the sample before 2007. From 2007 to 2010 there were no changes in the lists of the toxic chemicals, however, after 2010 facilities were required to report on 16 additional toxic chemicals. Therefore, using data from 2007 to 2010 is appropriate for this study. The initial sample consists of all facilities that reported their toxic chemical release on the TRI database. The sample selection process for 2007 to 2010 is summarized in Table 1.

The sample selection on Table 1 shows that the sample is unbalanced. To test whether the results are robust for identical firms across the observation years the balanced panel data analysis was also conducted.

The emissions data to proxy for environmental performance were taken from the TRI database. TRI aggregates emissions in four on-site categories: air, water, underground, and land; and two off-site cate

Table 3
Factor Analysis of Six Emission Types

Variables	Ground Emissions	Transferred-Out Emissions	Air & Water Emissions
Panel A: Factor Analysis of Scaled Emissions			
EPair	0.0021	0.1465	0.2797
EPwater	-0.0055	-0.0051	0.2710
EPunderground	0.9320	-0.0067	-0.0018
EPland	0.9320	0.0034	0.0013
EPtransfdisp	-0.0007	0.7929	0.0413
EPtransfmgt	-0.0038	0.7857	-0.0144
Eigenvalues: Factor 1 is 1.7374, Factor 2 is 1.2709, and Factor 3 is 0.1502			
Panel B: Factor Analysis of Unscaled Emissions			
EPair	0.0920	0.0622	0.1871
EPwater	-0.0027	0.0007	0.1640
EPunderground	0.2643	-0.0127	-0.0206
EPland	0.2887	0.0054	0.0541
EPtransfdisp	0.0033	0.6729	0.0109
EPtransfmgt	-0.0014	0.6714	-0.0009
Eigenvalues: Factor 1 is 0.1686, Factor 2 is 0.9081, and Factor 3 is 0.0580			

Source: Processed Data.

gories: transferred to disposal, and transferred for further management. Unlike Clarkson et al. (2004) this study uses continuous measures of environmental performance by utilizing six types of emissions reported on the TRI database. In this study the measure of the environmental performance is improved by scaling each of the emissions type with the cost of goods sold plus the changes in inventory, to capture the throughput of production.

The financial data of this study were taken from Wharton Research Data Services (WRDS). Specifically, the accounting data were from COMPUSTAT, and the share prices information is from the Center for Research in Security Prices (CRSP).

Ohlson (1995) develops a valuation model which considers the informativeness of earnings and book value. Compared to other valuation models, this model also discloses that information other than earnings and book value may be value relevant to the market and have influence on expected future earnings. This other information may not be reflected on the accounting information, and thus should be taken into consideration because it may convey useful information to the market. Therefore, following Clarkson et al. (2004) the Ohlson (1995) model is modified by including environmental performance as one of the indicator variables to test the hypothesis. Using alternative expressions the modified (Ohlson 1995) models is stated as follows:

$$SP_{it} = \delta_0 + \delta_1 BV_{it} + \delta_2 AE_{it} + \Sigma\delta_j EP + \Sigma\delta_j Control\ Variables\ . \quad (1)$$

Where,

SP_{it} = total market value of equity for company at time *t*.

BV_{it} = book value of equity of company I at time *t*.

AE_{it} = abnormal earnings at time *t*; measured by earnings available to common stockholders minus assumed cost of capital times book value of equity at the beginning of period.

$EPair_{it}$ = total air emissions discharged on-site for company *i* for the year ended at time *t*.

$EPwater_{it}$ = total surface water emissions discharged on-site for company *i* for the year ended at time *t*.

$EPunderground_{it}$ = total underground emissions discharged on-site for company *i* for the year ended at time *t*.

$EPland_{it}$ = total land emissions discharged on-site for company *i* for the year ended at time *t*.

$EPtransfdisp_{it}$ = total emissions transferred off-site to disposal for company *i* for the year ended at time *t*.

$EPtransfmgt_{it}$ = total emissions transferred off-site for further management for company *i* for the year ended at time *t*.

$CAPINT_{it}$ = capital intensity is a control variable measured by ratio of capital expenditure to sales for company *i* at time *t*.

$LEVERAGE_{it}$ =leverage is a control variable measured by ratio of total debt to total assets for company *i* at time *t*.

$ASSET\_AGE_{it}$ =the age of firms' fixed assets is a

control variable measured by net property, plant and equipment divided by gross property, plant and equipment for company *i* at time *t*.

$SALES\_GROWTH_{it}$ = revenue growth is a control variable measured by ratio of changes in sales for company *i* at time *t*.

$LIQUIDITY_{it}$ = firms liquidity is a control variable measured by cash flows from operation to sales for company *i* at year *t*.

There are some limitations regarding the TRI. The U.S. EPA only requires U.S. facilities to report their emissions on the TRI database. This renders a potential bias against companies with foreign facilities because their emissions information might not represent the actual emissions performance. If investors have all the information available to them including foreign facilities' emissions they may value a company differently.

There are some emissions measurement issues in the TRI. Some reporting facilities based their emissions reports on direct monitoring data; however, others may report based on estimation data whenever there are no monitoring data. This had been identified by Hamilton (1995) and it has not changed. He asserts that under the Emergency Planning and Community Right-to-Know Act (EPCRA) corporations are allowed to use different methods of calculating their emissions. Potentially, different estimation techniques provide market participants with non-comparable information, which will affect how they value a company and their decisions afterwards.

Another issue with the TRI database concerns the non-availability of chemical toxicity information. Because it would be difficult for investors to obtain information about chemical toxicity, they might not be able to value the company based on the actual impacts to the environment.

4. DATA ANALYSIS AND DISCUSSION

Descriptive Statistics and Classical Assumptions of Regression

The descriptive statistics is reported in Table 2. Panel A presents the descriptive statistics of unscaled variables. On average, market value of equity exceeds book value of equity by approximately 2.22 times. The mean of abnormal earnings is $434.772 million. This study tested percentages of cost of capital from 0% to 12%. It found that 5% gives the stronger results hence the results reported are based on 5% assumed cost of capital. Panel A also shows that on average the emissions on land is the highest among other emissions (0.824 million pounds). This possibly indicates that investors might be more concerned if companies emit more of these emissions.

Panel B presents the descriptive statistics for scaled variables. The mean of book value equity scaled by common share outstanding is noticeably higher than share prices, and the standard deviation is extremely far from the mean, suggest that there could be extreme observations. Indeed, re-examining the sample reveals that there are four influential observations. These observations only represent one parent company that is Berkshire Hathaway. Given that it is primarily an investment company, most likely in this sample it represents a subsidiary that is required to report on TRI. These four observations were then excluded. Afterwards the un-tabulated descriptive statistics was reproduced to show that on average book value equity per share is lower than share prices (i.e. $15.43 compared to $32.25), consistent with the results from the unscaled data. The book value of equity is ranged from approximately minus $17 billion to almost $147 billion.

The mean of abnormal earnings is $3.872 per share. The environmental performance (scaled by cost of goods sold plus changes in inventory) shows that, on average, emissions transferred off--site for further management are the highest among other types of emissions that is 0.665 pounds per thousand of cost of goods sold plus changes in inventory, followed by land emissions (0.579), underground emissions (0.343), emissions transferred off-site to disposal (0.237), air emissions (0.161), and lastly, water emissions (0.018). Additionally, emissions discharged to underground and land is highly ranged from zero to around 200 pounds per thousand. Higher emissions might be more attractive to investors, concerning the risks for a company to bear future environmental costs or liabilities, whereas lower emissions may have subtle influence on company valuation.

The results for the regressions are presented in Table 4. The regressions run for two sets of data: (1) full sample; and (2) excluding observations with negative equity. The exclusion of negative equity observations is to isolate the potentiality that the negative equity information might differently affect investors' decisions. Unless otherwise stated, all the reported regression results are presented for the two sets of data and used abnormal earnings based on 5% assumed cost of capital.

Based on the un-tabulated correlation analysis some of the emissions are highly correlated, indicating co-linearity problems. Therefore, factor analysis had been performed and it is found that the emissions load in factors as pairs, as reported on Table 3, and the results show that three factors were gene-

Table 4
Regression Results

Variable	Unbalanced Panels		Balanced Panels	
	(1)	(2)	(1)	(2)
BV/Share	1.165***	1.175***	1.168***	1.154***
	(0.000)	(0.000)	(0.000)	(0.000)
AE/Share	2.139***	2.287***	2.243***	2.333***
	(0.000)	(0.000)	(0.000)	(0.000)
Air & Water Emission	-0.742	-0.593	-1.052	0.052
	(0.314)	(0.423)	(0.243)	(0.960)
Ground Emission	-0.056***	-0.056***	-0.053***	-0.052***
	(0.000)	(0.000)	(0.001)	(0.001)
Transferred-Out Emission	-0.075	-0.076	-0.064	-0.080
	(0.117)	(0.112)	(0.142)	(0.091)
CAPINT	3.791	4.178	3.580	1.362
	(0.567)	(0.527)	(0.567)	(0.892)
LEVERAGE	20.556***	20.353***	21.609***	23.986***
	(0.000)	(0.000)	(0.000)	(0.000)
ASSET_AGE	-9.385*	-10.104*	-5.583	-5.704
	(0.036)	(0.026)	(0.308)	(0.334)
LIQUIDITY	44.633***	44.489***	42.262***	42.850**
	(0.000)	(0.000)	(0.001)	(0.002)
SALES_GROWTH	0.072	0.074	0.084	0.095
	(0.130)	(0.117)	(0.191)	(0.187)
Year				
2008	-11.725***	-11.928***	-12.791***	-13.570***
	(0.000)	(0.000)	(0.000)	(0.000)
2009	-2.691*	-2.390	-2.124	-1.990
	(0.028)	(0.052)	(0.210)	(0.308)
2010	-0.503	-0.327	0.369	0.294
	(0.550)	(0.702)	(0.674)	(0.750)
Constant	4.149	4.173	2.159	1.217
	(0.256)	(0.259)	(0.627)	(0.796)
R2	0.585	0.589	0.588	0.587
Adj R2	0.578	0.581	0.579	0.578
N	1995	1948	1612	1548

Source: Processed Data .

rated. The analysis for scaled emissions in Panel A reveals that underground and land emissions load as one factor, the two transferred-out emissions load as one factor, and air and surface water emissions load as another factor. The unscaled emissions factor analysis (Panel B) provides similar outcomes. The factor analysis demonstrates that several types of emissions convey different information, thus should not be cautiously aggregated. This should be a caveat for studies like Clarkson et al. (2004) which aggregate the emissions data was reported on TRI.

Given the similar weights of each pair of variables in each factor, new emissions variables were constructed by simply aggregating the pairs in each factor to obtain three composite variables: ground emissions, transferred-out emissions, and air and water emissions.

In deciding to use fixed or random effect models, Hausman test is performed. When performing the Breusch-Pagan Lagrange multiplier afterwards, there is no significant difference across firms thus OLS regression is used for the analysis. The regression results show that ground emissions are the only significant test variable. One would consider underground and land emissions to be less visible (physically) compared to other on-site releases (Harrison & Antweiler 2003). This less visible discharge pathway is potentially discrete its susceptibility to be mismanaged. However, endorsement of more stringent environmental regulations and the increase of publicity may cause these emissions to receive more attention.

In fact, the Underground Injection Control Pro-

gram becomes more stringent by the enactment of new regulations on injection of CO_2. For several past years discussions about the new regulations should have increased public awareness. As underground injection receives more publication (through recent incidents or endorsement of new regulations), this information would be available to the market and should have affected how the market perceives this matter. Similarly, because the regulations regarding land disposal restrictions are intertwined with Superfund, these emissions might be closely observed by the market.

The negatively significant relation between ground emissions and share prices is consistent with the suggestions that the market views emissions as potentially un-booked liabilities or future remediation costs that may reduce future profitability or survival prospects (Kiel & Zabel 2001; Thomas et al. 2007), or expose corporations to prosecution for environmental crimes (Duncombe et al. 2008).

Additional costs that might incur to deal with the new underground injection practices would undoubtedly affect companies' profitability.

Indeed, examining the trend on environmental costs over the years, Carlin et al. (1992) forecasted that land and underground pollution control costs would exceed pollution control costs of air and radiation, although may not be over that of water. To some extent their estimation is confirmed by the increasing awareness and more stringent environmental regulations, specifically on land and underground injection. As facilities are required to provide more information concerning specific toxic chemical releases, more pressure is expected for corporations to manage their emissions so that the information will not inflict a financial loss.

In contrast with ground emissions, air and water emissions as well as transferred-out emissions are not statistically significant. The insignificance of these emissions might be because they have been extensively scrutinized in earlier years, hence they may have received less attention recently. Around the first release of the TRI, Hamilton (1995) argues that the news about water emissions may be considered less interesting because they have been widely covered by previous clean water programs. Similarly, this study argues that air emissions may have not received much attention lately because they have been widely studied in previous literature (e.g. Becker & Vernon 2000; Hughes 2000; Sueyoshi & Goto 2009; Wilson et al. 2008), and closely monitored through specific programs (i.e. clean air act amendments). Indeed, the first initiative of the TRI reporting was driven by an air pollution incident in Bhopal, India. Supposedly, since then air pollution has become a prevalent issue due to constant public scrutiny.

Among the control variables, only leverage and liquidity are consistently significant. The leverage is positively associated with share prices, which is in contrast with King and Lenox (2002) who found negative association between leverage and ROA. The positive and significant relation between liquidity and financial performance is consistent with other studies. As firms become more liquid they might have more financial capacity to control or process emissions better. This also indicates their capacity to comply with the environmental regulations and to bear environmental cost as it occurs. There is also weak evidence that asset age is negatively significant to the market. This is possibly due to newer equipments with more advanced and cleaner technology are more costly to obtain and subsequently requires additional training costs to be professionally operated. However, this only can be observed on the unbalanced panel data.

Overall, the explanatory power of the regressions increases to around 59% (from approximately 53% of the un-tabulated original regression using only accounting variables). Thus, it is evident that environmental emissions are value relevant and is useful for equity valuation.

5. CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

It can be generalized that value relevance theory posits a negative relation between environmental emissions and market performance to the extent that superior current environmental performance increases the expected future cash flows of a company, holding other factors constant. Therefore, this study focused on the value relevance of environmental emissions, and whether this information adds valuable incremental information to that of accounting numbers in pricing equity. Furthermore, it shows some environmental emissions to provide additional information to corporate accounting performance in pricing equity. In terms of disaggregating the emissions, only ground emissions are negatively and significantly associated with share prices, suggesting that investors recognize only particular emissions as systematically relevant to future cash flows.

This study has several limitations. First, the TRI reports used are subject to comparability and reliability issues. Facilities variously report their emissions based on monitored and estimated emissions and, while the emissions reported of some companies reflects their real emissions performance, others

may reflect only estimated performance. Estimated emissions may be relatively problematic for company valuation if they are more subject to company discretion, although it can be argued that the estimated data is relatively accurate since the information is still being utilized up unto today. As a caveat, the reported emissions are not audited by the U.S. EPA. This may reduce the reliability of reported emissions, thus reducing its potential value relevance. This bias is against the finding of any emission to be value relevant.

Second, the mapping of each facility in the TRI database to its parent company is challenging and susceptible to error. Parent company names are not uniformly entered and many variations are evident. Although this study employs multiple matching checks there is still the possibility of incorrectly omitted unmatched facilities.

Third, the manufacturing industry accounts for almost 90% of the sample, with chemical manufacturing being the largest and this may inhibit detection of significant effects for other industries. However, industry specific factors are controlled in all regressions, which is most likely minimized this risk.

The implications of this study are as follows. First, the evidence that only particular types of emissions are value relevant suggests the emissions aggregation in environmental accounting research could be misleading. Second, the differences in emissions types value relevance indicates they may also have different expected political or remediation costs. Third, given some emissions types receive more attention because of increasing regulations stringency and media exposures, investors should expect corporate emissions practices would be more directed towards managing these emissions with the consequences of ignoring other types of emissions. Fourth, researchers interested in examining the value relevance of emissions data should consider regulations and media exposures on intensified corporate practices and possible moderating effects of compliance costs.

Further research, the researchers can develop this study as the followings. First, they can do it by adding more variables to control for corporate political, regulatory, and media visibility. Second, the value relevance of environmental performance information can be enhanced by testing the value relevance of qualitative measure of environmental performance (e.g. environmental ratings) to examine whether a more subjective measure of performance add information to that of accounting numbers.

This study suggests more actions for further research. First, besides addressing some of the limitations of this study, further research can explore the impact of value relevance of earnings disaggregation, particularly accruals, to investigate whether the existence of this information moderate the value relevance of environmental performance information. Earnings management may be an indicator of less capability of corporations to comply with stringent environmental regulations, which requires further investigation. Second, given the global financial crisis (GFC) may affect corporate environmental focus on waste management, it would be interesting to observe the value relevance of environmental performance information before and after the GFC, as well as to investigate whether there are changes in corporate underlying motives to report on the TRI. Differences in corporate emissions practices before and after GFC warrant further research. Third, the value relevance of emissions data to the market could be further investigated by examining whether financial analysts specifically use this information to develop their forecasts. Good environmental performers might attract more analysts following; on the contrary, corporate environmental practices may be based on the motivation to be more desirable for analysts, therefore deserve further investigation.

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