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Never Stand Still
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Value Relevance of Greenhouse Gas (GHG) Emissions Disclosures on Stock Market Performance: An International Study

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Research question & Contribution

- Investigates the value relevance of voluntary disclosure of GHG emissions to investors in capital markets
 - Worldwide: 38 countries
 - Over five years from 2006 to 2010

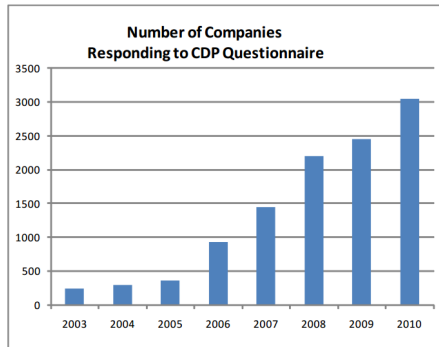
- Large sample of voluntary disclosures with increase in companies responding to the CDP questionnaire over the period 2006 to 2010
 - Extend the existing evidence, which is limited to three countries, to from 38 countries which report to the CDP
 - Considers the change over time in the informational value of GHG disclosures as businesses and investors learn to adapt to the new information.

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Background: Carbon disclosure project (CDP)

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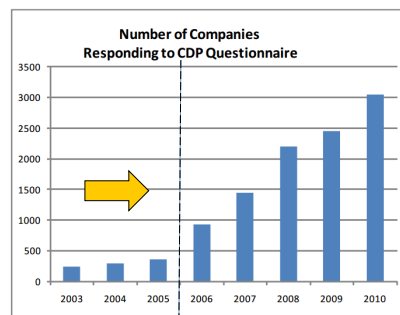
- Founded in year 2000
- Main purpose: to collect GHG emission disclosures from companies about total GHG emissions (scope 1 and 2), emission reduction targets, climate change risk and management strategies
- Holds the largest database
- Increasing voluntary disclosure by companies

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Global initiatives before 2006

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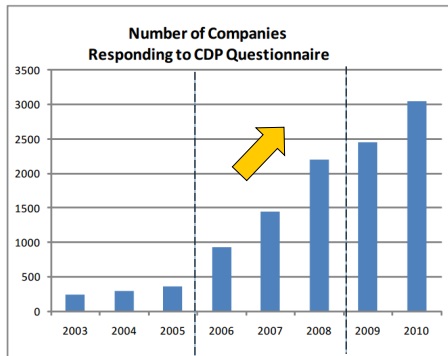
- First World Climate Conference (WCC) in 1979
- Second WCC 1990
- Carbon taxes were implemented in certain countries in early 1990s
- United Nations Framework Convention on Climate Change (UNFCCC) in 1992
- Kyoto Protocol 1997
- Marrakesh Accord in October/ November 2001

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Global initiatives 2006-2008

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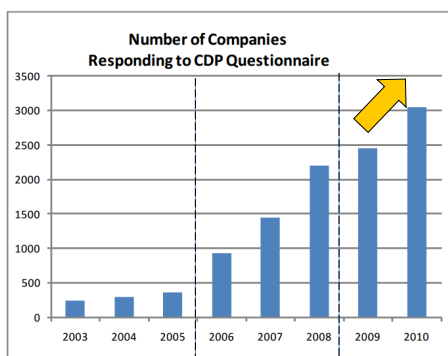
- European Union Emissions Trading Scheme (EU ETS)
- Kyoto Protocol came into force on Feb 15, 2005
- Australia signs the Kyoto Accord in 2007
- United States established state-wide regulations since 2007

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Global initiatives 2009 and after

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- Copenhagen Accord in 2009
- Investors' concern to climate change increase slightly, (Nielsen Report, 2011)

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Literature review: North American studies

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- Hughes (2000): 1986-1993, 44 utilities targeted (46 non-targeted) as high polluting
 - Non-financial pollution proxy value relevant
- Johnston Sefcik & Soderstrom (2008): 1995-2000, 58 firm-years, 58 US electric utilities
 - Emission allowances have asset or real option value priced into firm value
- Griffin Lont & Sun (2011): 2006–2009: 825 S&P, 259 Toronto SE firm-years
 - GHG emission negatively associated with firm value for both disclosers and non-disclosers (used model to predicted GHG)
- Matsumura Prakash & Vera-Muñoz (2011): 2006–2008: 1443 S&P firm-years
 - Firm value negatively associated with carbon emission levels

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Literature review: Australian studies

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- Chappel Clarkson & Gold (2013)
 - 2007, 58 firms expected to be affected by proposed ETS
 - Market penalizes high carbon intensive firms
- Coulton Green & Tao (2012): mandatory disclosure setting, National Greenhouse & Energy Reporting (NGER) Act
 - 2010, 75 firms:
 - VR: reported GHG emissions priced negatively for companies with relatively small scale of operations and low carbon intensity
 - Event study: companies with relatively low GHG emission & highest GHG experienced significant price declines
 - 2011, 85 firms:
 - VR: only companies with relatively greater exposure to climate change risks are being priced negatively
 - Event study: no significant results

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Extension of prior research & Hypothesis

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- Extends existing research **geographically** to cover the 38 countries in the large CDP dataset to hypothesize:

H1: *Companies with higher GHG emissions (scope 1 or 2 emissions or total emissions) have poorer stock market performance.*

- Extends existing research to consider investor adapting **over time** with higher awareness to GHG disclosure:

H2: *The association of GHG emissions and stock market performance will be more negative in Period II as compared to Period I.*

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Data

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- Sample Selection:
 - CDP respondents from different countries
 - 2645 (1867) firm-years
- Time Period Selection:
 - 2006 (CDP 2007) to 2010 (CDP 2011)
 - Prior to 2006, CDP data is qualitative
- Partitioning period into time periods: 2006 to 2008; 2009 to 2010
 - 2006-2008: Inconsistency in abatement action between countries, CDP data quantitative
 - 2009-2010: Lack of strong efforts due to massive lobbying activities, CDP data quantitative

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Research design

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- Return-specification model (Easton and Harris, 1991):

$$EQ1: RET_{it} = \alpha_0 + \alpha_1 \frac{EARN_{it}}{MVE_{it-1}} + \alpha_2 \frac{\Delta EARN_{it}}{MVE_{it-1}} + \alpha_3 \frac{GHG_{it}}{TA_{it-1}} + \alpha_4 \frac{\Delta GHG_{it}}{TA_{it-1}} + \alpha_k dum_year + \varepsilon_{j,t}$$

$$EQ2: RET_{it} = \alpha_0 + \alpha_1 \frac{EARN_{it}}{MVE_{it-1}} + \alpha_2 \frac{\Delta EARN_{it}}{MVE_{it-1}} + \alpha_3 \frac{GHG_{it}}{TA_{it-1}} + \alpha_4 \frac{\Delta GHG_{it}}{TA_{it-1}} +$$

$$\alpha_5 \frac{GHG_{it} * dum_P2_t}{TA_{it-1}} + \alpha_6 \frac{\Delta GHG_{it} * dum_P2_t}{TA_{it-1}} + \alpha_7 dum_P2_t + \varepsilon$$

RET_{it} : Firm's cumulative simple buy-and-hold daily return from the beginning of the financial year t to the date of announcement of annual earnings, adjusted for equally-weighted market return over the same period;

$Earn_{i,t}$: Earnings before extraordinary items in financial year t ;

$\Delta Earn_{i,t}$: Change in $Earn_{i,t}$ from that of previous financial year t-1;

$MVE_{i,t-1}$: Stock price multiplied by the outstanding amount of common shares used to calculate the basic earnings per share at the beginning of the financial year t;

$GHG_{i,t}$: The level of emission disclosed in the financial year t;

$\Delta GHG_{i,t}$: Change in the level of emission disclosed in financial year t (CDP: % reduction from year t - % reduction from year t-1).

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Research design

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- Price-specification model (Barth and Clinch, 2009, 2011):

$$EQ3: P_{it} = \beta_0 + \beta_1 \frac{BVE_{it}}{Share_{it-1}} + \beta_2 \frac{EARN_{it}}{Share_{it-1}} + \beta_3 \frac{GHG_{it}}{TA_{it-1}} + \beta_k dum_year + \varepsilon$$

$$EQ4: P_{it} = \beta_0 + \beta_1 \frac{BVE_{it}}{Share_{it-1}} + \beta_2 \frac{EARN_{it}}{Share_{it-1}} + \beta_3 \frac{GHG_{it}}{TA_{it-1}} + \beta_4 \frac{GHG_{it}}{TA_{it-1}}$$

$$* dum_P2 + \beta_5 dum_P2 + \varepsilon$$

Variables are as defined before, plus:

$P_{i,t}$: Closing stock price 3 months after FYE;

$BVE_{i,t}$: Book value of equity in financial year t ;

$Share_{i,t}$: Shares outstanding;

$MVE_{i,t-1}$: Stock price multiplied by the outstanding amount of common shares used to calculate the basic earnings per share at the beginning of the financial year t;

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Results:
Returns specification

Table 4

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	(1)	(2)	(3)	(4)
$EARN_{it}/MVE_{it-1}$	0.0085	0.0085	0.0085	0.0085
$\Delta EARN_{it}/MVE_{it-1}$	0.0265*	0.0265	0.0265	0.0265*
GHG_T_{it}/TA_{it-1}	0.0000	0.0000	0.0000	0.0000
GHG_T_{it}/TA_{it-1}	0.0000	0.0000	0.0000	0.0000
<i>dum_2007</i>	-0.1986***	-0.1986***	-0.1986***	-0.1986***
<i>dum_2008</i>	-0.5288***	-0.5288***	-0.5288***	-0.5288***
<i>dum_2009</i>	0.3169***	0.3169***	0.3169***	0.3169***
<i>dum_2010</i>	-0.0623*	-0.0623***	-0.0623**	-0.0623*
Constant	0.2139***	0.2139***	0.2139***	0.2139***
Fixed effect				
Country	No	Yes	Yes	No
Industry	No	Yes	No	Yes
Firms	No	No	Yes	Yes
N	1867	1867	1867	1867
adj. R-sq	0.3050	0.3050	0.3050	0.3050
F	101.7	15.19	32.08	177.9

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Results:
Returns specification

Table 4

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- $\Delta EARN$ ($p < 0.10$)
- GHG , ΔGHG not sig.
- Results dominated by GFC
 - 2007, 2008 market collapse
 - 2009, 2010 market rebound

	(1)	(2)	(3)	(4)
$EARN_{it}/MVE_{it-1}$	0.0085	0.0085	0.0085	0.0085
$\Delta EARN_{it}/MVE_{it-1}$	0.0265*	0.0265	0.0265	0.0265*
GHG_T_{it}/TA_{it-1}	0.0000	0.0000	0.0000	0.0000
GHG_T_{it}/TA_{it-1}	0.0000	0.0000	0.0000	0.0000
<i>dum_2007</i>	-0.1986***	-0.1986***	-0.1986***	-0.1986***
<i>dum_2008</i>	-0.5288***	-0.5288***	-0.5288***	-0.5288***
<i>dum_2009</i>	0.3169***	0.3169***	0.3169***	0.3169***
<i>dum_2010</i>	-0.0623*	-0.0623***	-0.0623**	-0.0623*
Constant	0.2139***	0.2139***	0.2139***	0.2139***
Fixed effect				
Country	No	Yes	Yes	No
Industry	No	Yes	No	Yes
Firms	No	No	Yes	Yes
N	1867	1867	1867	1867
adj. R-sq	0.3050	0.3050	0.3050	0.3050
F	101.7	15.19	32.08	177.9

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Results: Return specification , 2 time periods	Table 5				Australian School of Business
	(1)	(2)	(3)	(4)	
	$EARN_{it}/MVE_{it-1}$	0.0039	0.0039	0.0039	0.0039
▪ $\Delta EARN$ ($p < 0.05$)	$\Delta EARN_{it}/MVE_{it-1}$	0.0412***	0.0412**	0.0412**	0.0412***
	GHG_T_{it}/TA_{it-1}	0.0001**	0.0001***	0.0001**	0.0001**
	GHG_T_{it}/TA_{it-1}	-0.0001	-0.0001	-0.0001	-0.0001***
▪ GHG +ve ($p < 0.05$)	GHG_T_{it}/TA_{it-1}	-0.0001***	-0.0001	-0.0001***	-0.0001***
▪ ΔGHG -ve ($p < 0.01$) (4)	GHG_T_{it}/TA_{it-1}	-0.0001	-0.0001	-0.0001	-0.0001
▪ In 2009–10, GHG more negative ($p < 0.05$)	dum_P2	0.1810***	0.1810***	0.1810***	0.1810***
	Constant	0.0094	0.0094	0.0094	0.0094
	Fixed effect				
=>	Country	No	Yes	Yes	No
	Industry	No	Yes	No	Yes
▪ Investors price GHG negatively in the latter period	Firms	No	No	Yes	Yes
	N	1867	1867	1867	1867
	adj. R-sq	0.0216	0.0216	0.0216	0.0216
	F	6.525	4.702	18.48	493.3

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Results: Return specification, 2 time periods	Table 5				Australian School of Business
	(5)	(6)	(7)	(8)	
	$EARN_{it}/MVE_{it-1}$	0.0041	0.0041	0.0041	0.0041
▪ $\Delta EARN$ ($p < 0.05$)	$\Delta EARN_{it}/MVE_{it-1}$	0.0409***	0.0409**	0.0409**	0.0409***
	GHG_S1_{it}/TA_{it-1}	0.0000	0.0000	0.0000	0.0000
	GHG_S1_{it}/TA_{it-1}	0.0002	0.0002	0.0002	0.0002
▪ GHG_S1 -ve ($p < 0.05$) in 2009–9	GHG_S2_{it}/TA_{it-1}	0.0005**	0.0005***	0.0005***	0.0005***
	GHG_S2_{it}/TA_{it-1}	-0.0003*	-0.0003**	-0.0003**	-0.0003***
▪ GHG_S2 +ve ($p < 0.05$) but -ve in 2009–10	GHG_S1_{it}/TA_{it-1}	-0.0001	-0.0001**	-0.0001***	-0.0001*
	GHG_S1_{it}/TA_{it-1}	-0.0006	-0.0006	-0.0006	-0.0006
	GHG_S2_{it}/TA_{it-1}	-0.0004	-0.0004	-0.0004**	-0.0004***
	GHG_S2_{it}/TA_{it-1}	0.0003	0.0003	0.0003	0.0003
	dum_P2	0.1994***	0.1994***	0.1994***	0.1994***
	Constant	-0.0142	-0.0142	-0.0142	-0.0142
	Fixed effect				
▪ Investors price both S1 & S2 negatively in the latter period	Country	No	Yes	Yes	No
	Industry	No	Yes	No	Yes
	Firms	No	No	Yes	Yes
	N	1865	1865	1865	1865
	adj. R-sq	0.0222	0.0222	0.0222	0.0222
	F	4.619	21.30	58.31	1528.2

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Results: Price specification

- GHG generally –ve impact on price (i.e. firm value) ($p < 0.05$) (1&4)

Table 6

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	(1)	(2)	(3)	(4)
$BVE_{it}/Share_{it-1}$	0.3204***	0.3204***	0.3204***	0.3204***
$EARN_{it}/Share_{it-1}$	0.8030	0.8030***	0.8030***	0.8030
GHG_T_{it}/TA_{it-1}	-0.1598***	-0.1598	-0.1598	-0.1598***
<i>dum_2007</i>	76.3149	76.3149	76.3149	76.3149
<i>dum_2008</i>	8.8555	8.8555	8.8555	8.8555
<i>dum_2009</i>	134.0765	134.0765	134.0765	134.0765*
<i>dum_2010</i>	70.4435	70.4435	70.4435	70.4435
Constant	211.7924***	211.7924*	211.7924*	211.7924***
Fixed effect				
Country	No	Yes	Yes	No
Industry	No	Yes	No	Yes
Firms	No	No	Yes	Yes
N	2645	2645	2645	2645
adj. R-sq	0.7704	0.7704	0.7704	0.7704
F	63.58	0.264	1272263.3	104.1

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Results: Price specification

- Both S1 & S2 generally –ve impact on price (i.e. firm value) ($p < 0.05$) (5&8)

=>

- Investors price GHG S1 & S2 negatively

Table 6

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	(5)	(6)	(7)	(8)
$BVE_{it}/Share_{it-1}$	0.3202***	0.3202***	0.3202***	0.3202***
$EARN_{it}/Share_{it-1}$	0.8034	0.8034***	0.8034***	0.8034
GHG_S1_{it}/TA_{it-1}	-0.1192***	-0.1192	-0.1192	-0.1192***
GHG_S2_{it}/TA_{it-1}	-0.6290***	-0.6290	-0.6290	-0.6290**
<i>dum_2007</i>	46.5981	46.5981	46.5981	46.5981
<i>dum_2008</i>	-22.2264	-22.2264	-22.2264	-22.2264
<i>dum_2009</i>	99.4563	99.4563	99.4563	99.4563
<i>dum_2010</i>	37.8376	37.8376	37.8376	37.8376
Constant	255.9427***	255.9427*	255.9427*	255.9427***
Fixed effect				
Country	No	Yes	Yes	No
Industry	No	Yes	No	Yes
Firms	No	No	Yes	Yes
N	2640	2640	2640	2640
adj. R-sq	0.7704	0.7704	0.7704	0.7704
F	55.49	0.255	1349233.1	149.3

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	Table 7				Australian School of Business	
	(1)	(2)	(3)	(4)		
<p>Results: Price specification, 2 time periods</p> <ul style="list-style-type: none"> GHG generally –ve impact on price (i.e. firm value) ($p < 0.05$) (1&4) Investors price GHG negatively 	BVE/Share _{<i>it-1</i>}	0.3203***	0.3203***	0.3203***	0.3203***	
	EARN/Share _{<i>it-1</i>}	0.8041	0.8041***	0.8041***	0.8041	
	GHG_T _{<i>it</i>} /TA _{<i>it-1</i>}	-0.1188***	-0.1188	-0.1188	-0.1188**	
	GHG_T _{<i>it</i>} /TA _{<i>it-1</i>} * <i>dum_P2</i>	-0.0700	-0.0700	-0.0700	-0.0700	
	<i>dum_P2</i>	46.4336	46.4336	46.4336	46.4336	
	Constant	248.5421***	248.5421	248.5421	248.5421***	
	Fixed effect					
	Country	No	Yes	Yes	No	
	Industry	No	Yes	No	Yes	
	Firms	No	No	Yes	Yes	
N	2645	2645	2645	2645		
adj. R-sq	0.7706	0.7706	0.7706	0.7706		
F	68.32	0.430	231245.4	59.02		

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	Table 7				Australian School of Business	
	(5)	(6)	(7)	(8)		
<p>Results: Price specification, 2 time periods</p> <ul style="list-style-type: none"> Both S1 & S2 generally –ve impact on price ($p < 0.05$) (5&8) – S2 particularly so in 2009–10 Investors price GHG S1 & S2 negatively, especially in the latter period 	BVE/Share _{<i>it-1</i>}	0.3200***	0.3200***	0.3200***	0.3200***	
	EARN/Share _{<i>it-1</i>}	0.8049	0.8049***	0.8049***	0.8049	
	GHG_S1 _{<i>it</i>} /TA _{<i>it-1</i>}	-0.0948***	-0.0948	-0.0948	-0.0948**	
	GHG_S1 _{<i>it</i>} /TA _{<i>it-1</i>} * <i>dum_P2</i>	-0.0396	-0.0396*	-0.0396	-0.0396	
	GHG_S2 _{<i>it</i>} /TA _{<i>it-1</i>}	-0.3143**	-0.3143	-0.3143	-0.3143*	
	GHG_S2 _{<i>it</i>} /TA _{<i>it-1</i>} * <i>dum_P2</i>	-0.6898***	-0.6898	-0.6898	-0.6898*	
	<i>dum_P2</i>	60.5348	60.5348	60.5348	60.5348	
	Constant	256.6439***	256.6439	256.6439	256.6439***	
	Fixed effect					
	Country	No	Yes	Yes	No	
Industry	No	Yes	No	Yes		
Firms	No	No	Yes	Yes		
N	2640	2640	2640	2640		
adj. R-sq	0.7705	0.7705	0.7705	0.7705		
F	48.44	0.359	155172.8	367.7		

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Conclusion

- GHG emissions disclosures affect both stock prices and stock returns.
- Scope 1 emissions have a significant negative association with stock prices and stock returns
 - Scope 1 emissions signify the operational inefficiency and thus a potential environmental liability for the emitters in the coming future.
- Scope 2 emissions have a significant negative association with stock prices, but a positive association with stock returns.
 - Scope 2 emissions being priced more negatively over time and hence they are less positively associated with stock returns in 2009–10
 - An increasing awareness among investors over time of cost of Scope 2