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Relation between Environmental Impact and Financial Structure of Cement Industry

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ABSTRACT

This study aims to investigate financial structure of cement firms, which facing environmental regulations and impacts. In this study financial ratio of 16 cement firms that are listed in Istanbul stock exchange analyzed for the years 2011-2013. The key concept of this research is related to which debt ratios and financial structure are mainly affected by environmental data at cement firms on an emerging market. We developed two equations in order to analyze the relation between environment and financial structure. We found that there is a significant relation on emission levels while there is no significant relation on carbon dioxide levels with financial ratios. Sales, gross profit margins, current ratios have positive impact on industry emission levels. Moreover, earnings before interest and tax, liquidity ratio, financial leverage ratio and accounts receivable turnover ratios have negative impact on industry emission levels.

Keywords: Cement Industry, Environmental Impact, Financial Ratio, Panel Data Models
JEL Classifications: C23, G30, L61

1. INTRODUCTION

Cement is one of the most polluting industries: 5% of the world's total emission of greenhouse gases is caused by cement production (Loreti Group, 2008), (Selim and Salem, 2010). This means that the developing world and emerging markets increasingly bears the environmental burden. Cement production releases the nitrogen oxides, carbon dioxide (CO_2), and sulphur dioxide. When we focus on environmental impact, cement is the second largest anthropogenic emission source that contributes approximately 7% of global CO_2 emissions (Li et al. 2013). International energy agency considers CO_2 capture and storage technology as an essential technology capable of reducing CO_2 emissions in the cement sector by 56% by 2050. Concerning the prospects for financing cement plant CO_2 capture, large cement manufacturers on average have a higher return on equity (ROE) and lower debt ratio, thus a higher discount rate should be considered for the cost analysis than in power plants. According to Li et al. (2013), stronger financial support should be provided for CO_2 capture pilot and demonstration projects in the cement industry.

Cement industry provides raw materials to the essential growth sectors like construction, transportation, etc. and there has been a rise in the demand for these products thanks to the rapid economic growth; (Dutta and Mukherjee (2010). There is wide variety of research for this industry at different economic zones. Raventos and Zolezzi (2016) discuss the origins of cement operations in Central America between 1994 and 2001. This case explains the manufacturing process of cement and discusses the main drivers of cost, together with data on prices, production and trade. Branger and Quirion (2015), analyze variations of carbon emissions in the European cement industry from 1990 to 2012, at the European level (EU 27), and at the national level for six major producers. They found that, apart from a slow trend of emission reductions coming from technological improvements, most of the emission change can be attributed to the activity effect.

Emissions reduction is also related to productivity, regulations, research and development, alternative fuels and row materials. Long et al. (2015), mainly compares total factor productivity and eco-efficiency in China's cement manufactures from 2005 to 2010. Their study suggested that per labor cement industry value has U-shape relationship with both Malmquist and Malmquist–Luenberger productivity index. It is necessary to adopt advanced technology to reduce pollutant emissions. In addition to that it is significant for China to strengthen environmental regulation to abandon high-pollution traditional cement kilns. Also strict environmental regulation can simulate related corporations to increase research and development expenditure. Oggioni et al. (2011), analyze the cases where CO_2 emissions can either be considered as an input or as an undesirable output. According to this research, countries without strong or mandatory environmental regulations (like the USA, Turkey, Brazil, and Canada) were the worst-performing during the considered period between years 2005 and 2008 and had a negative trend, except for China and India. Another research from Riccardi et al. (2012), show that the inclusion or the exclusion of undesirable factors (CO_2) influence efficiency levels as well as the investments in new technologies and the utilization of alternative fuels and raw materials in the cement and clinker production processes. According to efficiency scores of this study the worst performing countries are Brazil, Turkey, Australia and Italy. Australia and Turkey show to be inefficient in almost all cases in the same research too. Also, Dutta and Mukherjee (2010), analyze on steel, aluminium and cement manufacturing industries energy consumption in India. They propose a projection scenario for 2001-2031. The analysis suggests the existence of some plausible energy efficiency enhancing techniques in these industries. Another research from Chien and Peng (2012), uses mandatory disclosures of environmental expenditures for public companies in Taiwan, to examine the impact of investment in pollution control on long-run financial performance. They found that firms moving forward proactively with pollution prevention investments have significantly outperformed their counterparts who react sluggishly with end-of-pipe solutions. The results suggest that pollution control investments, taken as a whole, decrease short-run financial performance. Their results also indicate that pollution prevention investment is positively associated with the long-run financial performance.

Following on from these studies, this study will analyze the between environment and financial structure. In the remainder of the article, we first indicate the literature as a background of the study. And then we state the developed hypothesis. The methodology part and empirical analysis come after these parts. Lastly, we close the article with the discussion of the empirical findings.

2. LITERATURE REVIEW

In the case of pollution, Hamilton (1995) study investigates the pollution data released by the environmental protection agency in the historical toxic release inventory (TRI). His study results reveal that the higher pollution figures were in a firm's TRI reports, the more likely print journals were to write about the firm's toxic releases. Regression analysis results of a research by Patten (2002) shows that controlling for firm size and industry classification which are two factors that consistently have been shown to be related to the level of environmental disclosure, there is a significant relation between environmental performance and environmental disclosure. Higher levels of toxic releases adjusted for firm size are associated with higher levels of environmental disclosure. Besides, Horváthová (2010), examines the heterogeneity in financial environmental performance nexus, empirically carrying out a meta-regression analysis of 64 outcomes from 37 empirical studies to uncover the underlying factors, which can influence the observed variation in the empirical results. The results suggest that both the empirical method used matters for the nexus and that the likelihood of finding a negative link between environmental and financial performance significantly increase when using simple correlation coefficients instead of more advanced econometric analysis. The results also indicate that the portfolio studies tend to report a negative link between environmental and financial performance.

Von Bahr et al. (2003), indicate that one of the most important factors in achieving high quality and comparable environmental performance indicators is a strong driving force for industry to compile such information. Such a driving force can come from financial stakeholders or the customers who will buy large amounts of industrial goods. It is important to have a better knowledge of what factors make industry aware of the importance of being able to present environmental performance evolution. In relation to that López-Gamero et al. (2010), evaluate the relationship between managerial perception and the different styles of environmental regulations (command-and-control versus voluntary norms) the mediator role of environmental management in the link between environmental regulations and competitiveness, the effect of competitiveness on financial performance, and the two-way relationship between proactive environmental management and financial performance by scrutinizing 208 firms in Spain. They explore that cost and differentiation competitive advantages have a positive impact on financial performance. Also another conclusion is that the proactive environmental management influences financial performance and financial performance influences proactive environmental management.

Russo and Fouts (1997) is important as they indicate that environmental performance and economic performance are positively linked and that industry growth moderates the relationship, with the returns to environmental performance higher in high-growth industries. In addition, Horváthová (2010) analyses the environmental performance effect on financial performance. The results suggest both that a negative link between environmental and financial performance significantly increases when using simple correlation coefficients instead of more advanced econometric analysis. Telle (2006) argues that pooled regression where observable firm characteristics like size or industry are controlled for, confirms a positive effect of environmental performance on economic performance. However, the estimated positive effect could be due to omitted unobserved variables like management or technology. According to Amrina and Vilsi (2015), research focus on key performance indicators which covers economic, environmental and social factors for evaluating the sustainable manufacturing believed to be appropriate to the cement industry based on the triple bottom line of sustainability.

Another research by Supino et al. (2015), outline the characteristics of the European cement industry, and their results indicate that the need for a collaborative approach between the business community, policy makers, and institutions. Hu and Liu (2016) investigate the carbon productivity in Australian construction industry from 1990 to 2012 and they conclude that the improvement in carbon productivity could benefit capital productivity and investment return. Gokmenoglu et al. (2015) examine the long run relationship between industrialization, financial development and carbon emissions by using Granger causality test in Turkey. Research findings indicate the unidirectional relationship from financial development to carbon emissions.

Nakao et al.'s (2007) research concluded that a firm's environmental performance has a positive impact on its financial performance and the opposite situation is statistically supported by Japanese data. They observe that significant positive relationship between financial performance and environmental performance are based on CO_2 emissions. Moya et al. (2011), conduct a detailed analysis at the facility level of many of the commonly cited energy technology improvements that can contribute to decreased energy consumption and CO_2 emissions in the EU's cement industry. Results explore that, independent of the capital budgeting decision criteria used, the number of cost-effective retrofitting possibilities available is large compared to the rate of improvements that the industry undertake annually. This shows the insensitivity of the industry to financial criteria when it comes to making their investment decisions.

In relation to same topic, Benhelal et al. (2013), examine the global strategies and potential CO_2 emissions in cement industry. According to their observations technical, economical and legal challenges still play a role as remarkable obstacles against implementation of CO_2 reduction implementations.

Another research showings the impact of the variation in CO_2 emissions on financial and operational performance comes from Gallego-Alvarez et al. (2015). By using international data consisting of 89 companies for the period 2006-2009, the findings show a reduction in emissions that generates a positive impact on financial performance. Using panel data methodology on their research, they indicate that companies promote greater environmental behavior in order to obtain higher financial performance. However, the findings do not show evidence for operational performance.

Financial data that used on comparing environmental performances, researches mainly focus on return on assets (ROA), ROE, return on sales (ROS), return on capital employed (ROCE), Tobin's q ratios. ROE, ROA and Market to Book ratios are used by Prado-Lorenzo et al. (2009) study for 101 companies. Nakao et al. (2007) also used ROE and ROA on Japanese firms. Hart and Ahuja (1996), used ROS with ROE and ROA. ROCE, ROE and ROS are used by Wagner et al. (2005) for European paper industry. S&P 500 US firms ROA and ROE ratios are used by Cohen et al. (1995) research.

3. HYPOTHESIS

In this study we aim to investigate the impact of cement industrial process emissions levels and industry CO_2 levels on cement firm's financial performance. Financial ratios mainly indicate the firms' performance, which may affect environmental indicators. Cement firms are crucial economic unit in the case of environmental impact. The question of which financial ratio or financial variable mainly related to environmental pollution in that industry is the key concept for this study. What we are looking for is that whether cement firms which have better financial performance causes less environmental pollution or whether there is any relation between financial ratios and environmental pollution or not. As a pollution indicator we choose cement industry emissions levels and total industry CO_2 levels. Financial ratios and pollution indicators are yearend values but there may long term consequences on environment.

Thus the following hypotheses are raised:

H1: Industry emissions levels has a positive impact on financial ratios and financial performance.

H2: Industry CO_2 levels has positive impact on financial ratios and financial performance.

The study deals with which financial ratio affected most on environmental impact or in other words there any relation on emission levels and CO_2 levels related with financial success. Environmental impact can be seen long term but we would like to enlighten its effect on financial indicators. Another question is whether successful financial performance causes better environmental values or which financial ratio affects positively on environmental outcomes.

4. RESEARCH METHODOLOGY

4.1. Description of the Data

Panel data is used from Istanbul stock exchange (ISE) indexed cement firm's financial statements in order to analyze models. Sample period covers the years from 2011 to 2013. The first step of the time series analysis is the determination of stability.

In order to test our research, firm financial data were collected from ISE Corporate Data (www.borsaistanbul.com/en/data) and public disclosure data (www.kap.gov.tr). Non-metallic mineral products sector firms are selected from ISE. There are 28 firms listed in that index and we select 16 cement firms for analysis because of complete variables on public disclosure data for selected years. Fist we collect each firm year-end financial statements analyzed the financial ratios. Selected financial ratios are sale, earnings before interest and tax (EBIT), gross profit margin, current ratio, liquidity ratio, financial leverage, fixed assets/equities, asset turnover rate, ROA, ROE, accounts receivable turnover ratio (ARTR), earnings per share.

Selected dependent variables are for model estimations are CO_2 levels and total industrial processes emissions levels. This research uses selected independent variables which are EBIT, gross profit margin, current ratio, liquidity ratio financial leverage, fixed assets/equities, asset turnover rate, return on total assets, ROE, ARTR, earnings per share. All financial ratios are calculated from year-end balance sheets and income statements of cement firms listed on ISE. Table 1 shows the summary statistics for our sample and Table 2 provides the description and measurement of key variables used in the analysis.

Table 3 presents the pooled data correlation matrix of the key valuables. Strong positive correlation between logarithm of sales values and logarithm of earnings before tax values can be seen on results. Second high correlation can be seen between current ratio and liquidity ratios. Also ROA and gross profit margin, fixed assets/equity ratio and current ratio and liquidity ratios have high correlation values.

Table 1: Summary statistics

Variable	Min	Standard deviation	Median	Mean	Max
s	5.750	8.250	8.395	8.287	9.08
e	9.38	14.96	15.45	15.12	17.12
gp	−0.0600	0.1875	0.2400	0.2329	0.450
cr	0.890	1.790	2.500	2.814	6.690
lr	0.610	1.312	1.860	2.099	5.290
fl	0.1100	0.1600	0.2450	0.4487	10.21
fae	0.4800	0.6675	0.8250	0.8410	12.00
at	0.0700	0.5150	0.6300	0.6438	12.20
rota	−0.12000	0.04000	0.07500	0.07812	0.270
roe	−0.1900	0.0575	0.1000	0.0975	0.310
atr	0.690	3.317	4.015	4.302	9.180
eps	−0.0200	0.0375	0.2500	0.6817	7.600

Table 2: Variables, descriptions and measures

Variable	Description and measure
tip_{it}	Yearly total industrial processes emissions levels (log values)
CO_{2it}	Yearly total industry carbon dioxide levels (log values)
s_{it}	Logarithm of sales value for *i* firm, *t* year
e_{it}	Logarithm of earnings before interest and tax value for *i* firm, *t* year
gp_{it}	Gross profit margins for *i* firm, *t* year
cr_{it}	Current ratio for *i* firm, *t* year
lr_{it}	Liquidity ratio for *i* firm, *t* year
fl_{it}	Financial leverage for *i* firm, *t* year
fae_{it}	Fixed assets/equities ratio for *i* firm, *t* year
at_{it}	Asset turnover rate for *i* firm, *t* year
$rota_{it}$	Return on total assets for *i* firm, *t* year
roe_{it}	Return on equity for *i* firm, *t* year
atr_{it}	Account receivables turnover ratio for *i* firm, *t* year
eps_{it}	Earnings per share for *i* firm, *t* year

4.2. Empirical Model Specification

As we are interested in interdependence between environmental pollution and selected financial ratios, we developed the following two-equation system: Equation 1, represents yearly total industrial processes emissions levels (log values) as dependent variable. Independent variables are selected and calculated from financial ratio of cement firms.

$$tip_{it}=\theta_{it}+\alpha_1 s_{it}+\alpha_2 e_{it}+\alpha_3 gp_{it}+\alpha_4 cr_{it}+\alpha_5 lr_{it}+\alpha_6 fl_{it}+\alpha_7 fae_{it}+\alpha_8 at_{it}+\alpha_9 rota_{it}+\alpha_{10} roe_{it}+\alpha_{11} atr_{it}+\alpha_{12} eps_{it}+\mu_i+\varepsilon_{it} \quad (1)$$

In addition to first model, Equation 2 represents yearly total industry carbon dioxide levels (log values) as dependent value for environmental pollution. Independent variables are same as Equation 1.

$$CO_{2it}=\theta_{it}+\beta_1 s_{it}+\beta_2 e_{it}+\beta_3 gp_{it}+\beta_4 cr_{it}+\beta_5 lr_{it}+\beta_6 fl_{it}+\beta_7 fae_{it}+\beta_8 at_{it}+\beta_9 rota_{it}+\beta_{10} roe_{it}+\beta_{11} atr_{it}+\beta_{12} eps_{it}+\sigma_i+\psi_{it} \quad (2)$$

This research empirical analysis is based on the following general formula:

$$y_{it}=x_{it}\beta+\alpha_i+u_{it}, \quad i=1,2,\ldots,N,\ t=1,2,\ldots,T \quad (3)$$

Where $i = 1,\ldots N$ is the firm, t is the time period (yearend values), y is the dependent variable, x are independent variables and control variables. α_i, and β_i for second equation are the time constant factor. Tested models were estimated by using the standard panel data econometric techniques. H1 suggested that emissions levels are positively correlated with financial ratios. We expect $\alpha_1 > 0$ and $\alpha_2 < 0$ which are represents the emission levels are positive on sales but negative coefficient on earnings. And also we expect $\alpha_9 > 0$ and $\alpha_{10} < 0$ that indicate positive impact on ROA but negative impact on ROE ratio. For second equation we expect $\beta_1, \beta_9 > 0$ and $\beta_2, \beta_{10} < 0$.

5. RESULTS AND DISCUSSIONS

The results equations are analyzed according to pooled ordinary least squares (OLS) cross-section fixed effects and random effect model according to Housman test results. Panel regression test considers for two estimations that are pooled OLS, fixed effects and random effects. The results of Housman test showed that the random effects model were preferred to fixed effect model.

Table 3: Correlation matrix

	s	*e*	*gp*	*cr*	*lr*	*fl*	*fae*	*at*	*rota*	*roe*	*atr*	*eps*
s	1.00	0.97	0.23	−0.01	0.04	0.08	0.00	0.33	0.37	0.43	−0.07	0.07
e	0.97	1.00	0.36	0.03	0.08	0.08	−0.03	0.25	0.50	0.54	−0.15	0.08
gp	0.23	0.36	1.00	0.10	0.21	0.14	−0.08	0.10	0.77	0.81	−0.08	0.02
cr	−0.01	0.03	0.10	1.00	0.97	0.12	−0.79	0.05	0.16	0.03	−0.04	0.39
lr	0.04	0.08	0.21	0.97	1.00	0.13	−0.79	0.16	0.24	0.14	−0.06	0.46
fl	0.08	0.08	0.14	0.12	0.13	1.00	−0.01	−0.06	0.01	0.00	−0.08	−0.07
fae	0.00	−0.03	−0.08	−0.79	−0.79	−0.01	1.00	−0.38	−0.27	−0.15	0.25	−0.41
at	0.33	0.25	0.10	0.05	0.16	−0.06	−0.38	1.00	0.27	0.38	−0.09	0.01
rota	0.37	0.50	0.77	0.16	0.24	0.01	−0.27	0.27	1.00	0.95	−0.28	0.08
roe	0.43	0.54	0.81	0.03	0.14	0.00	−0.15	0.38	0.95	1.00	−0.16	0.07
atr	−0.07	−0.15	−0.08	−0.04	−0.06	−0.08	0.25	−0.09	−0.28	−0.16	1.00	0.06
eps	0.07	0.08	0.02	0.39	0.46	−0.07	−0.41	0.01	0.08	0.07	0.06	1.00

Estimation results of the Equation 1 and Equation 2 are presented in Tables 4 and 5. Table 4 shows the results for emissions levels as dependent variable and financial ratios as independent variables. Table 5 presents the results for carbon dioxide as dependent variable. In Table 4 for the emissions equation (tip_{it}) is significant predictors for financial ratios which are sales, earnings, gross profit margins, current ratio, liquidity ratio, financial leverage, ROE and account receivables turnover ratio on $Pr < 0.05$ significant value. The results supported H1 hypothesis. There is a positive relation on sales, profit margin, current ratio but negative coefficient estimation on EBIT, liquidity and financial leverage, ROE and account receivables. This implies higher emissions levels related on sales, profit margin and current ratio positively over time. At the same time interval, higher emissions levels decrease the EBIT and especially ROE which is one of the main indicators for financial performance.

Equation 1 pool data estimated R^2 results is 0.7702, and adjusted R^2 is 0.32092, F-statistic: 5.58615 on 12 and 20 df, P = 0.00038435.

Lagrange multiplier (LM) test (Honda) results are: Normal = −2.5147, P = 0.01191 which alternative hypothesis has significant effects. LM test for fixed effects versus OLS F-test for individual effect are F = 3.3906, df1 = 15, df2 = 20, P = 0.006002.

Table 4: Equation 1 pooled data estimation OLS results

Variable	Estimate	Standard error	Pr(>|t|)	Significant
(Intercept)	4.78E+04	6.94E-12	<2.2e-16	***
s	2.70E-11	3.77E-12	0.005611	**
e	−6.58E-12	1.82E-12	0.036407	*
gp	6.28E-11	7.42E-12	0.003459	**
cr	1.57E-11	1.89E-12	0.003685	**
lr	−2.02E-11	2.30E-12	0.003099	**
fl	−2.47E-12	2.51E-13	0.002237	**
fae	−8.04E-12	2.87E-12	0.067793	t
at	−5.99E-12	2.50E-12	0.096468	t
rota	1.02E-10	3.87E-11	0.077004	t
roe	−1.17E-10	2.92E-11	0.027838	*
atr	−9.71E-13	2.07E-13	0.018395	*
eps	6.92E-13	2.46E-13	0.067199	t

Significant codes: 0 '***', 0.001 '**', 0.01 '*', 0.05 't', 0.1 'a ' 1. OLS: Ordinary least squares

Table 5: Second equation OLS estimation results

Variable	Estimate	Standard error	Pr(>|t|)	Significant
(Intercept)	0.3540772	0.1230294	0.009299	**
s	−0.0182766	0.0165629	0.282926	-
e	−0.0023551	0.1556707	0.988079	-
gp	−0.0228662	0.0198885	0.263824	-
cr	0.0198203	0.0215282	0.368197	-
lr	0.0040201	0.0040802	0.336260	-
fl	0.0042883	0.0832594	0.959434	-
fae	−0.1519801	0.0836123	0.084127	-
at	−0.4799220	0.3564899	0.193285	-
rota	0.5612073	0.3573964	0.132040	-
roe	−0.0020195	0.0038261	0.603425	-
atr	0.0133514	0.0173355	0.450197	-
eps	0.3540772	0.1230294	0.009299	-

Significant codes: 0 '***', 0.001 '**', 0.01 '*', 0.05 't', 0.1 'a', 1OLS: Ordinary least squares

Alternative hypothesis has significant effects. Hausman test (for random and fixed effect) results are: Chi-square = 23.632, df = 4, P = 9.467e-05 which indicate alternative hypothesis that is one model is inconsistent.

Second equation estimated R^2 results is 0.72133, and adjusted R^2 is 0.30055, F-statistic: 4.31406 on 12 and 20 df, P = 0.0019883.

LM test (Honda) results are indicate that the normal value is −2.568, P = 0.01023 and argued that the alternative hypothesis has significant effects. LM test results are F = 2.5963, df1 = 15, df2 = 20, and P = 0.02396 which indicate that the alternative hypothesis has significant effects. In order to test random and fixed effect Housman test results are Chi-square is 16.631, df = 4, P = 0.002279, and test results suggest the alternative hypothesis: One model is inconsistent. For second equation independent values probability results are higher than significant level which is $Pr < 0.05$. This shows that we cannot predict any relation on CO_2 with financial ratio rather on high R^2 results. These results also do not support H2 hypothesis.

6. CONCLUSIONS

The objective of this research is to investigate the impact of financial ratios on emissions level and carbon dioxide level. For this purpose, we have developed two equations to capture the relationship between emissions levels and financial structure. We found that there is a significant relation on total industrial process emission levels with financial structure. We also conclude that there is no significant relation on yearly total industry carbon dioxide level with selected financial structure over time. Sales, gross profit margin, current ratio haves positive impact on emissions levels. As emission levels increase these financial ratios also increase over time. On the other hand, as the emissions levels have negative coefficients on EBIT, liquidity ratio, financial leverage and ARTR. Rather the sales volume positively affected, earnings have negative impact on emission levels.

Before concluding, it is important to denote the limitations of the study. Our analysis is restricted with stock exchange listed firms on a given time period. Comparing different stock exchange listed cement firms over emerging markets on a long time period will cause general perspective on emissions levels with financial structure. Our estimates are conditioned on listed cement firms and country emissions data. Furthermore, we have focus on only selected financial ratio in this study. On the case of environmental impact and its effect on financial structure, it would be vital to replicate and similar researches to other industries.

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