Examining Environmental Performance: Cross-Country Analysis of Canada and the United States

By

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Abstract

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The purpose of this Masters' Research Paper is to compare Canada and the United States' (U.S.) contributions to pollution and carbon emissions. This paper considers the Environmental portion of the Environmental, Social and Governance metric (ESG) and, in particular, a review of seven industries that are known to cause pollution. The study uses ESG data from Refinitiv with a sample of 35,678 observations over the period of 2017 to 2021. The specific industries used are Financials, Energy, Transportation, Manufacturing, Construction, Fashion, and Technology. The findings show that overall, Canada has a higher Environmental Score, with a mean environmental score of 29.301 compared with a U.S. score of 19.36. When comparing specific industries, the financial industry results suggest that Canada exhibits a statistically significant advantage compared to the U.S. in terms of environmental score. For the energy, transportation, and construction industries, Canada has significantly higher scores then the U.S. However, no significant difference was found in the mean environmental scores for the manufacturing industry. Additionally, the mean environmental scores in the fashion and technology industries were both significantly higher in Canada compared to the U.S.

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1.1 | Proposal

Environmental stress and climate change concerns are dominating the news headlines around the globe, recently. Canada and US are facing environmental issues due to rising temperatures, drying soil, and major droughts. North America recently experienced a flash lettuce shortage that resulted in a drastic increase in its price. The rising temperatures are causing lettuce plants to be more susceptible to disease (Restaurants Canada, 2022). Flash droughts are one of many issues that arise from environmental hazards, such as rising temperatures. When focusing on Canada and the U.S., an important question is which industries are contributing the most to this environmental hazard?

Discovering the boundaries of the industries is paramount with respect to understanding where their due diligence ends when dealing with different methods of waste. Moreover, industries have developed pitfalls when it comes to creating ESG (Environmental, Social and Governance) strategies. Baringa, a consulting firm, commented on pitfalls such as *Misunderstanding the scope of ESG, focusing on point-scoring, failure to align ESG and core business strategies and trying to do everything at once***.** Many industries focus primarily on the 'Climate' part of Environment and fail to think more broadly about the overall impact they have on the environment, including areas such as biodiversity or water scarcity and pollution when dealing with the environment. Within industries, the focus is more on obtaining a high ESG score via third parties' evaluations, as opposed to deriving organic change for the better. Failing to align ESG and core business strategies may yield good results in the short term, but not necessarily in the long run. Lastly, trying to mend this all at once creates confusion for the industries overall.

This Masters' Research Paper (MRP) focuses on ESG data (specifically the Environmental factor) from Refinitiv, Bloomberg and uses the North American Industry Classification System (NAICS) to compare different industries between U.S. and Canada. The study looks at following industries: financials, energy, transportation, manufacturing, construction, fashion, and technology. These industries were chosen to represent industries that are ranging from one end of the spectrum to the other, in terms of their environmental impact (Howell, 2022).

Reputation is significant in the markets, as this is how the public is forming opinions about an industry. This paper is aiming to inform about the environmental impact within certain industries. Everyone needs to be aware of how some of the large or "well known" industries are impacting the environment with respect to biodiversity, carbon footprint, climate policies, natural resource conservation, waste by-products and greenhouse gas emissions (GHG). The use of Refinitiv, Bloomberg and the North American Industry Classification System (NAICS) will provide information and insight with respect to large, well-known industries and their environmental impact.

Chapter 1 | Introduction

1.2 | Purpose of Study

Canada and U.S. are very similar in terms of geography, however, when comparing their overall environmental score, there are differences. The purpose of this paper is to explore which country is creating more harm to the environment. Industries are bringing to light the importance of environmental process that can either aid or harm the environment. The commonly discussed Paris Agreement goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the

temperature increase to 1.5°C above pre-industrial levels" reported by [1]United Nations Climate Change.

To limit global warming to 1.5°C greenhouse gas emissions must peak before 2025 at the latest and decline 43% by 2030. Studying the environmental factors between Canada and the U.S. that impact the environment will aid readers to understand the significance of this factor, along with industries that are known to contribute to the environment, in either a positive or adverse way, and will provide insights into the environmental aspect of ESG. Glasgow Alliance for Net-Zero (GFANZ) is the world's largest combination of financial institutions committed to transitioning the global economy to net-zero greenhouse gas emissions launched in 2021. One facet of the GFANZ is attempting a timeline of 2030 for improved climate-finance framework. A key reason is that policymakers, industries, and consumers are more likely to place a higher value on health, climate, and biodiversity when there is a requirement to reach targets set within the current generation's lifetime. This approach avoids the tendency to pass the responsibility of positive change to future generations, as has been the pattern, according to the GFANZ Progress Report (2021). The ESG data comes from Refinitiv database and is used to compare and contrast the countries and industries chosen. Specifically, the Refinitiv data used is as follows: the Environmental Pillar Score, the Environmental Innovation Score, the Emissions Score, the Water Pollutant Emission to Revenue, the Renewable Energy Supply, and the Total CO_2 Equivalent Emissions to Revenue. Environmental Pillar Score is the score based on multiple variables summed together to derive the value, and the higher the value the better.

[1] See: https://unfccc.int/process-and-meetings/the-paris-agreement?gclid=Cj0KCQjwnrmlBhDHARIsADJ5b_nPDPTaVUcXb7LZdSyNj8fslF0IkBs7pS395BLufYGuIjpexhTdGzIaAs82EALw_wcB.

While researching the industries which contribute to environmental pollution the following seven were selected for analysis: Financial industry as they provide significant capital to industries that create environmental pollution; Energy as the nature of this business creates a lot of pollution to the environment according to Environmental Protection, Energy contributed 15.83 billion tons, Transportation contributing 8.43 billion tons, Manufacturing and Construction contributed 6.3 billion tons, Fashion contributed 2.1 billion tons and lastly, Technology contributed 1.02 billion tons of pollution into the environment.

The results show that Canada had an overall higher environmental score. Among the industries analyzed, financials, Canada had statistically higher results. Energy, construction and transportation had significantly higher environmental scores, and no significant difference for manufacturing.

Chapter 1 | Introduction

1.3 | Organization of Paper

There are five sections in this paper. This current chapter is an introduction that describes the paper's purpose, background and the proposal. Chapter 2 provides a literature review; this chapter primarily observes ten different pieces of literature that contribute to the study of ESG, concentrating on the Environmental factor. Chapter 3 contains the data used in this research paper to complete t-tests, regressions, and summary statistics, using Stata. Chapter 4 will derive empirical results and Chapter 5 will draw a conclusion based of empirical results from Chapter 4.

Chapter 2 | Literature Review

This section of the paper explores the literature written on the environmental factor within ESG and its impact on firm growth, profitability, and board characteristics. When observing the permanent separation of economic growth and negative impact on the environment, attention should be paid to most economically developed countries due to their high rankings. High rankings are determined using Gross Domestic Product (GDP), economic, social, and financial performance, which correspond to much worse results in the case of environmental development (Ziolo et al., 2019). Environmental finance is an emerging and rapidly growing area and firms need to adjust to these environmental changes, which may yield many opportunities for wealth and growth (Linnenluecke et al., 2016). There are various historical examples of breakthroughs over the history of modern markets that have driven growth and wealth, such as, railways, electricity, automobiles, radio, microelectronics, and personal computers (Linnenluecke et al., 2016). To encourage clean technology the 2015 Paris Climate Agreement has given the green light to commercialize the firm's clean technology patents (Linnenluecke et al., 2016).

Firms operate within supply chains, and twenty years of research shows that there is a link between environmental supply chain practices and market-based, operational-based, and accounting-based practices of the firm, with firm performance being positive and significant (Golicic and Smith, 2013). Moreover, exploring environmental management and debt financing shows that they have a positive relationship with the capacity of a firm to earn revenue (Xu et al., 2020). Literature has revealed that financing via debt can mediate the effect of environmental management on financial sustainability (Xu et al., 2020).

Studies over a thirty-five year period confirm a positive correlation between environmental performance and financial performance (Albertini, 2013). Analysis of the studies over the thirty-five year period reveals the correlation is significantly influenced by environmental, financial performance measures, regional differences, and activity of the industry (Albertini, 2013).

Is 'Being Green' rewarded by the market? An empirical study was conducted with respect to decarbonization and stock returns, the study included data of 74,486 observations and 736 U.S. firms. The study employed portfolios constructed with carbon efficient-minus-inefficient firms (revenue-adjusted GHG emissions at the firm-level). This portfolio generated positive abnormal returns since 2010 with an investment strategy of longing carbon-efficient firms and shorting carbon-inefficient firms (In et al., 2017).

Lastly, board independence and board gender diversity show positive associations with carbon reduction initiatives (Haque, 2017). Younger CEOs are significantly more likely to lead firms with higher ESG scores, and institutional ownership is negatively related to firms' ESG scores. There is a central finding that U.S. firms that have directors exposed to the changes in regulations and reporting requirements experience an increase in ESG performance (using the MSCI KLD scores). Also, an important factor noted is that attributes of the firms' cost of capital are affected by their ESG performance, implying the stronger the performance the lower the cost of capital (Gillan et al., 2021). However, firms that are financially weaker are less likely to improve their environmental scores, suggesting that the costs of improving ESG scores could be a significant factor.

Chapter 3 | Methodology

3.1 | Introduction to Research Design

This section of the paper describes the data used in the study, which is derived from Morgan Stanley Capital International (MSCI) and Refinitiv. MSCI ESG ratings aim to measure a company's management of relevant ESG risks and opportunities. Refinitiv is a comprehensive data catalogue which offers broad data sets that aid in navigation of the rapidly changing financial markets, including ESG. First, what are the Environment Performance Indicators? The Environment Performance Indicators are: Renewable energy, environmental opportunities, management characteristics, environmental innovation, waste management, low carbon technologies, natural resources, toxic emissions, impact of products and services, biodiversity, operational waste, and water stress.

Environmental opportunities such as renewable energy and environmental opportunities capture factors that assess how companies are taking advantages of opportunities in the market for environmental technologies. Companies that proactively invest in product and services which address issues of resource conservation and climate change score higher. Management characteristics include effort to take advantage of opportunities as they arise, strategic targeting of a market for environmental tech or development of clean tech business segments. Waste Management is the measurement of environmental performance, and consists of toxic emissions and waste, packaging materials and waste, and electronic waste. Measuring low-carbon technologies and increased energy efficiency of facilities and products help in achieving a higher environmental score. Accurate and comprehensive measurements of natural resource usage, including factors such as water stress, biodiversity, raw material sourcing, and land use, are essential for understanding

and addressing environmental impacts. Along with positive indicators Refinitiv collects negative environmental indicators including toxic emissions and waste, energy and climate change, impact of products and services, biodiversity and land used, operational waste, supply chain management, water stress, and other concerns with respect to the environment.

The paper will be looking at the following industries (selected using 2-Digit NAICS scores): financials (52, 53, 54), energy (21, 22), transportation (48, 49), manufacturing (31, 32, 33), construction (23), fashion (44, 45), and technology (51). Table 3.1 below presents the industries being analysed for both Canada and the U.S.

Table 3.1 Industry Summary Statistics

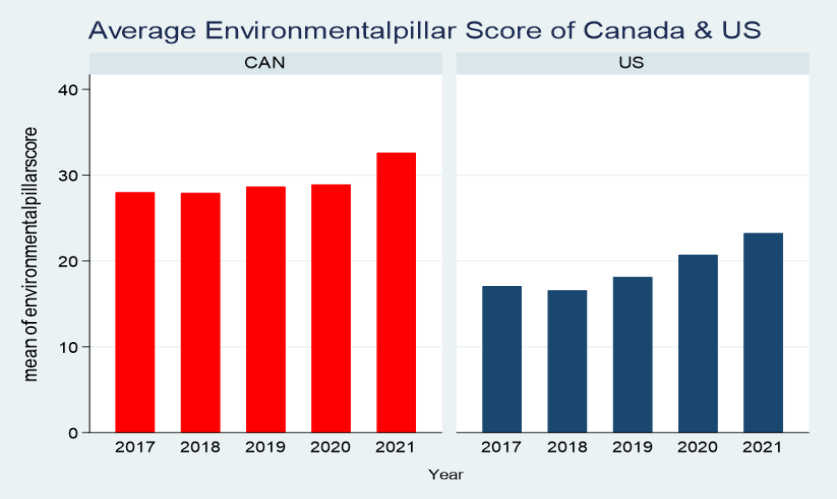
2-DIGIT NAICS	FREQ.	PERCENT	CUM.
21	1469	8.39	8.39
22	426	2.43	10.83
23	295	1.69	12.51
31	430	2.46	14.97
32	2549	14.56	29.53
33	2532	14.47	44.00
44	290	1.66	45.66
45	292	1.67	47.33
48	374	2.14	49.46
49	13	0.07	49.54
51	1530	8.74	58.28
52	5002	28.58	86.86
53	1892	10.81	97.67
54	408	2.33	100.00

Frequency represents the number of times the specific *2-Digit NAICS* code occurs in the dataset, the percent refers to the proportion of the dataset that the industry represents, and

cumulative is the cumulated frequencies in the dataset. As seen in the table above, financial industry (52,53,54) contributes a lot of data to this study due to the frequency and percentage of the data observed, followed by manufacturing (31,32,33), energy (21 and 22), technology (51), fashion (44 and 45), transportation (48 and 49) and construction (23). This summary table is provided to enhance readability and transparency of the data.

Looking at the overall environmental pillar score from Refinitiv for Canada and the U.S., the data shows that the average environmental pillar score is greater for Canada (29.301) than for the U.S. (19.396). Canada has a greater median - 29.301 than the U.S. - 5.027, a higher standard deviation (variation around the mean), and a negligible difference in the maximum. The environmental pillar score is the sum of resource used, emissions, and innovations. The table and bar graph below show a break down of the environmental pillar score by country. Of note, U.S. has a much larger economic stage paired with more exports and imports which also plays a role in this study.

Overall Environmental Pillar Score Canada and the U.S.						
Country	Mean	Median	Min	SD	Max	N
CAD	29.301	22.144	0	27.786	97	2,646
USD	19.396	5.027	0	25.786	98	16,342
Total	20.777	6.946	0	26.298	98	18,988



As seen in the graph above Canada has a larger overall environmental pillar score while the U.S. has a larger percentage change over the years. Over the time period of analysis, Canada increased by 6.4% (from 29 to 31) whereas U.S. increased by 24% (from 19 to 25).

Chapter 3 | Methodology

3.2 | Industries and Data Variables

Over the time period analyzed (2017-2021), most of the firms within each industry have increased their environmental score. However, Energy firms in Canada had a reduction in their environmental scores which resulted in a decrease of 7.8% (from 153 to 141). Similarly, the U.S. Transportation industry U.S. saw a reduction since 2019 which resulted in a decreased environmental score of 11.7%. Manufacturing experienced an overall environmental score increase in the data studied for both Canada and the U.S.

Construction firms increased their scores until the pandemic hit, which caused a decreased environmental score in U.S. firms U.S. This was a significant decrease as approximately 50% of firms experienced a decrease in their environmental score. However, U.S. firms in the construction industry have recovered. The Fashion industry has fluctuated quite a

bit with respect to environmental score in U.S., as observed in the Fashion data panel. Lastly, the Technology industry experienced increases in their environmental score for both the U.S. and Canada until 2021, where the environmental score had dropped for both countries respectively. The panel below includes the 2-Digit Code for industry specification, number of firms in Canada, number of firms in the U.S., and the combined number of firms. The panel will aid in viewing the industries explored in the paper and provide a clear idea of how they have changed over the years observed.

Table 3.2 Industries, Time Horizon, and Observations

Panel I - Financials				
Year	2-Digit Code	CAD	US	Total
2021	52,53,54	228	1367	1595
2020	52,53,54	220	1346	1566
2019	52,53,54	200	1268	1468
2018	52,53,54	185	1199	1384
2017	52,53,54	167	1122	1289

Panel II - Energy				
Year	2-Digit Code	CAD	US	Total
2021	21,22	141	299	440
2020	21,22	143	273	416
2019	21,22	151	216	367
2018	21,22	153	203	356
2017	21,22	129	187	316

Panel III - Transportation				
Year	2-Digit Code	CAD	US	Total
2021	48,49	20	68	88
2020	48,49	20	63	83
2019	48,49	20	77	97
2018	48,49	20	49	69
2017	48,49	20	46	66

Panel IV - Manufacturing				
Year	2-Digit Code	CAD	US	Total
2021	31,32,33	67	1159	1226
2020	31,32,33	81	1217	1298
2019	31,32,33	62	1048	1110
2018	31,32,33	58	939	997
2017	31,32,33	52	826	878

Panel V - Construction				
Year	2-Digit Code	CAD	US	Total
2021	23	12	50	62
2020	23	14	51	65
2019	23	12	23	35
2018	23	14	45	59
2017	23	12	38	50

Panel VI - Fashion				
Year	2-Digit Code	CAD	US	Total
2021	44,45	16	66	82
2020	44,45	28	121	149
2019	44,45	25	106	131
2018	44,45	25	88	113
2017	44,45	23	84	107

Panel VII - Technology				
Year	2-Digit Code	CAD	US	Total
2021	51	48	387	435
2020	51	56	468	524
2019	51	51	389	440
2018	51	49	325	374
2017	51	47	292	339

The variables employed in this paper that were extracted from the Refinitiv database are as follows: Environmental Pillar Score, Environmental Innovation Score, Emissions Score, Water Pollutant Emission to Revenue, Renewable Energy Supply and Total CO_2 Equivalent Emissions to Revenue. Environmental Pillar Score is part of a broader ESG assessment that evaluates the industries sustainability practices and its impact on the environment. The term "Environmental Pillar Score" refers to a metric or rating that assesses the environmental performance, while focusing on aspects of operations and practices. By providing an Environmental Pillar Score the aim is to provide stakeholders a quantitative assessment of the environmental performance.

Environmental Innovation score again is often part of a broader assessment within the framework of ESG, but specifically the E or Environment. It centers on how firms are embracing innovation in order to drive positive environmental outcomes and achieve sustainable goals. Some common examples of innovation include Research and Development, Patents or Intellectual Property which implies patents or intellectual property to aid in environmental technologies and solutions. Moreover, it includes product and process innovation, collaboration, and partnerships.

Collaboration and partnerships contribute a significant input in environmental innovation, as if collaboration is present with creation of partnerships, there can be an upward drive

in environmental innovation. Technology adoption can also aid in this variable as it measures the integration and innovation of environmental technologies or practices, which results in an increase of the environmental pillar score.

Environmental Innovation Score is a very important consideration when reviewing firms, industries, and countries. According to the U.S. Energy Information Administration, the industrial sector accounts for 36% of total U.S. end-use energy consumption, with manufacturing accounting for the largest share (Vass, 2023). Clean energy innovation remains short of what's required to address climate change. Further investment is needed to continue growing, and to edge the next wave of clean energy innovation (Economist, 2023). There is already an impressive set of technologies that can address decarbonisation, and existing technologies will take the generation 70 to 80% of the way to net zero. However, there's always a deficit in existing technologies that will require some standout innovation, not just extension technology (Economist, 2023). This variable has a lot of weight with respect to overall environmental impact.

Emissions Score refers to a rating that assesses greenhouse gas emission, and its overall environmental impact related to emissions. Moreover, this variable focuses specifically on evaluating the emissions management and performance within the context of the environment. Some of the factors that are measured within the emissions score are: the scope of emissions, intensity of the emissions, reduction targets, emissions reporting and transparency, and emission reduction incentives. By providing an emission score, there is an aim to provide stakeholders a quantitative assessment of emissions management and environmental impact.

Water Pollutant Emission to Revenue refers to a ratio or metric that assesses the amount of water pollutants emitted in relation to revenue. This variable is used to quantify the amount of water pollutants released and relate it to the overall revenue to obtain an understanding of environmental efficiency. Water Pollutant Emission to Revenue helps assess environmental impact by considering its revenue generating ability. A higher ratio indicates more water pollutants relative to revenue, whereas a lower number represents the opposite.

Renewable Energy Supply refers to the availability of energy resulting from renewable sources. Renewable energy is obtained from sources that are naturally replenished and have a minimal environmental impact compared to non-renewable sources such as fossil fuels. It is considered more sustainable and helps reduce greenhouse gas emissions. This variable is significant in creating a more sustainable energy system.

Total carbon dioxide (CO_2) Equivalent Emissions to Revenue refers to a ratio that quantifies total greenhouse gas emissions, expressed in terms of carbon dioxide (CO_2) equivalents, relative to revenue. It provides insights into carbon efficiency and environmental impact associated with business activities. Results from the panel below indicate that overall Canada has obtained higher scores in all variables except for Emission Scores and Total CO_2 Equivalent Emissions to Revenue. Canada not only had a higher mean compared with U.S., but also a higher median. Canada had a higher minimum and a significantly smaller number of observations within the data analyzed with (2017-2021). Canada is among the world's worst carbon emitters according to CBC news. Canada is responsible for 2.6 per cent of the world's total carbon emissions, Canada was ranked 10^{th} behind Brazil, Indonesia, Germany, India, the U.K., and Japan. What's notable is how

small Canada's population is compared to every other country in that top 10 (Woodside, 2021). However, when compared to U.S., Canada does not have the largest cumulative emissions, in fact, the U.S. does.

CBC News commented the average per-capita carbon emissions of people in each of those countries, a metric the authors called "average lifestyle carbon footprints." The study focused on key domains where tangible lifestyle changes could make a significant difference, including food, housing, and personal transportation (Bernstien, 2021). To summarize the variables studied in the panel below, Canada had better averages, median, and smaller maximum. The only sections that U.S. yielded better results were Emission Scores and Total CO_2 Equivalent Emissions.

Potential reasons why Canada had a lower environmental score than the U.S. for Emission Scores and Total CO_2 Equivalent Emissions may be due to Canadian oil fields emitting carbon dioxide. Canada relies heavily on the extraction and production of oil and natural gas, including from oil sands, which can result in higher CO_2 emissions. Canada has a smaller population compared to the U.S. but a larger land area. The energy demands and transportation requirements for a dispersed population across a vast country can contribute to higher emissions per capita.

The U.S. might have more advanced technologies and greater investments in clean energy and emission reduction, while Canada might be slower in adopting and implementing such innovations. Canada's colder climate might require higher energy consumption for heating, leading to increased emissions from residential and commercial buildings. Canada might have a higher rate of deforestation or land-use changes that release stored

carbon, contributing to higher CO_2 emissions. Lastly, Canada possesses significant natural resources which may involve energy-intensive extraction or processing methods.

Table 3.3 Refinitiv Variables Summary

Panel A - Environmental Pillar Score					
Country	Mean	P50	Min	Max	N
CAD	29.301	22.144	0.000	97.071	2646
US	19.396	5.027	0.000	97.980	16342
Total	20.777	6.946	0.000	97.980	18988
Panel B - Environmental Innovation Score					
Country	Mean	P50	Min	Max	N
CAD	20.633	0.000	0.000	97.143	2617
USD	12.797	0.000	0.000	99.367	16323
Total	13.879	0.000	0.000	99.367	18940
Panel C - Emissions Score					
Country	Mean	P50	Min	Max	N
CAD	32.935	24.057	0.000	99.894	2646
USD	21.462	4.688	0.000	99.821	16342
Total	23.06	7.143	0.000	99.894	18988
Panel D - Water Pollutant Emission to Revenue					
Country	Mean	P50	Min	Max	N
CAD	0.208	0.131	0.000	0.761	33
USD	1.213	0.076	0.000	17.848	115
Total	0.989	0.076	0.000	17.848	148
Panel E - Renewable Energy Supply					
Country	Mean	P50	Min	Max	N
CAD	0.447	0.343	0.042	1.000	71
USD	0.215	0.126	0.002	1.000	151
Total	0.289	0.210	0.002	1.000	222
Panel F - Total Co2 Equivalent Emissions to Revenue					
Country	Mean	P50	Min	Max	N
CAD	800.815	73.602	0.099	17111.440	1080
USD	384.086	42.227	0.000	51811.340	3915
Total	474.190	44.243	0.000	51811.340	4995

Chapter 3 | Methodology

3.3 | Statistical Tests and Regression

Statistics is a branch of mathematics and a field of study that involves collection, analysis, interpretation and organization of data. Statistics provides methods for summarizing, describing, and drawing conclusions from the data to understand relationships within a data set. This paper utilized the following: mean, median, standard deviation, correlation, t-tests and regressions. The mean is known as the average, it is calculated by summing all the values in the dataset and dividing by the total number of observations, the median is the middle value of the dataset, standard deviation is a measure of dispersion of the data around the mean and quantifies the amount of variation. Correlation measures the strength and direction of the linear relationship between two variables. The correlation coefficient ranges from -1 to 1, where -1 indicates a perfect negative correlation, 1 indicates a perfect positive correlation, and 0 indicates no correlation. T-tests are a type of inferential statistical test used to compare the means of two groups or samples. It determines whether the difference between the means is statistically significant or occurred by chance. Lastly, Regression analysis is a statistical technique used to model the relationship between one or more independent variables and a dependent variable. It helps to identify the strength and direction of the relationship and to make predictions.

Regressions provide a lot of information about the data in statistics, a very common regression is the Ordinary Least Squares (OLS), which is a used to estimate the parameters of a linear regression model. The linear regression model aims to find the best straight line that describes the dependent and independent variables. OLS is commonly used because of its efficiency and interpretability. However, using log transformations is a very common way to handle situations where a non-linear relationship exists between independent and

dependent variables (Benoit, 2011). The OLS regression that has been used for this study is seen below:

$$Environmental\ \ Score = \beta_1(Canada) + \beta_2(Cash) + \beta_3(Total\ Assets) + \beta_4(Market\ Capitalization) + \beta_5(EBIT) + \beta_6(Auditor\ Tenure) + \beta_7(2018) + \beta_8(2019) + \beta_9(2020) + \beta_{10}(2021) + e \qquad (I)$$

This regression equation will be repeated for each of the industry restricted samples.

Cash is obtained from the firms balance sheet, Total Assets represent the summation of all assets (short-term or long-term), Market Capitalization represents the total value of all outstanding shares of the company, calculated by multiplying the current market price of each company's outstanding shares by the total number of shares outstanding, EBIT (Earnings before Interest and Taxes), is know as operating income or operating profit, and auditor tenure represents the number of years the company's auditor has been in service. All the above variables are obtained from Compustat. Log transformations are often used for skewed data, such as monetary data and often has the effect of spreading out clumps of data and bringing together spread-out data (Ford, 2018). This paper has created log transformations for Cash, Market Capitalization and Total Assets.

The general approach to this study involves the following components: data collection and preparation, calculating the descriptive statistics, univariate tests, multivariate tests, and interpretation. Data was collected from MSCI and Refinitiv, then filtered to reflect 2017-2021 and specified industries, after the data was prepared the descriptive statistics were

created which included mean, median, standard deviation. From there compute the univariate tests, multivariate tests to draw an interpretation.

The data is being used to derive overall environmental score for Canada compared to U.S., and within each country's selected industries. This study chose 5 years (2017-2021) for the time horizon, and selected the data based on 2-Digit NAICS scores. After the data had been filtered it was run in a univariate test (t-test) to see if Canada's and U.S's means were significantly different. After those results were recorded, the test was repeated for the specific industries, to produce a result to see which country had a better environmental score.

After that test is completed, a multivariate test (regression) was performed, using the entire data with an indicator for Canada, where this variable represents whether the observation is from Canada (1) or the U.S. (0). It is a binary variable that allows us to investigate any differences in the environmental pillar scores. Other firm specific control variables used are Cash, Total Assets, Market Capitalization, Earnings Before Interest and Taxes (EBIT), and Year. A positive coefficient for Total Assets and Market Capitalization would indicate that larger industries, as measured by their total assets, or Market Capitalization respectively, tend to have higher environmental scores. A positive coefficient for EBIT would suggest that companies with higher EBIT tend to have higher environmental scores. Auditor Tenure represents the number of years the company's auditor has been in service. A positive coefficient for this variable would indicate that companies with longer auditor tenure may have higher environmental scores. Lastly the regression includes the control variable Year, which accounts for time specific trends.

Chapter 4 | Results

4.1 | Summary Statistics

To gain an initial understanding of the characteristics of the variables, this section provides a detailed description of the mean, median, minimum, standard deviation, maximum values of the two countries, and the sample size.

Table 4.1 Summary Statistics for Each Country

Overall Environmental Pillar Score Canada and the U.S.						
Country	Mean	Median	Min	SD	Max	N
CAD	29.301	22.144	0	27.786	97	2,646
USD	19.396	5.027	0	25.786	98	16,342
Total	20.777	6.946	0	26.298	98	18,988

The summary statistics results show the values for the environmental pillar score with respect to both Canada and U.S. From Table 4.1, the mean value of both Canada (29.301) and U.S. (19.396) are both above the respective median value of 22.144 and 5.027. When the mean is greater than the median, it suggests that the distribution has a positive or right-skewed shape, where a few higher values contribute to an overall higher mean. The minimum value for both countries was zero, the maximum value for Canada was 97.071, while the maximum for U.S. was 97.980, which is a negligible difference. Both standard deviation values suggest a significant amount of variability in the scores within the dataset. This indicates that the environmental pillar scores exhibit a wide range of values around the mean. Canada has a larger standard deviation (27.786) compared to U.S. (25.786). However, the size of the sample affects the reliability and representativeness of the standard deviation. A smaller sample size may result in higher variability and less precise estimates of the population standard deviation.

This table captured the number of observations in which Canada equated to approximately 16% of U.S. observations. U.S. is much larger as referenced throughout the paper. However, another reason could potentially be due to exports and imports. In 2021, Canada exported $355 Billion to U.S. while U.S. exported $259 Billion. This is implying that U.S. is obtaining more resources (crude oil), goods and services which aid in growing the economy. Looking from a top-down approach that means growing economy, growing industries, and growing companies.

Summary Statistics provide an analysis of the environmental variables for Canada and the U.S. Research was conducted to capture well known industries that created a lot of pollutants and emissions measured in tons. Table 3.4 shows test results comparing industries between Canada and the U.S., measuring the environmental pillar score provided by Refinitiv. It is to be noted that Canada had a larger mean in Financial industry regarding environmental pillar score for this industry with a value of 32.479, while U.S. mean was 15.554. The associated t-value is 19.674, and the significance level (p-value) is 0.000, indicating a highly statistically significant difference in the mean environmental pillar scores between the two countries within the Financial industry. The Energy industry results indicate that the mean environmental pillar score in U.S. is significantly different from that in Canada.

Transportation is not significantly different between Canada (33.203) and U.S. (29.126). Moreover, the t-value of 1.270 corresponds to a p-value of 0.205, which exceeds the significant level of 0.10, which implies there is not sufficient evidence to comment on significance with respect to this industry. Manufacturing mean environmental pillar score in Canada (29.116) is significantly higher than the mean in U.S. (20.870). The t-value of

5.417 corresponds to a p-value of 0.000, indicating a statistically significant difference between the two countries. Construction within the two countries does not show a significant difference. Also, with a p-value of 0.979 exceeding the significance levels of 0.01, 0.05, and 0.10 there is sufficient evidence to conclude a statistically significant difference in the mean environmental pillar scores between Canada and U.S. within the Construction industry.

The Fashion industry mean environmental pillar score in Canada (26.832) is significantly higher than the mean in the United Sates (21.259). The t-value of 2.0501 corresponds to a p-value of 0.0408, suggesting statistically different between the two countries. Canada demonstrates a statistically significant advantage over U.S. in terms of the mean environmental pillar scores within the Fashion industry. Lastly, Technology mean environmental pillar score in Canada (30.1359) is significantly higher than the mean in the United Sates (13.5011). The t-value of 7.972 corresponds to a p-value of 0.000, suggesting statistically different between the two countries. Canada demonstrates a statistically significant advantage over U.S. in terms of the mean environmental pillar scores within the Technology industry.

Chapter 4 | Results

4.2 | General Statistics

This paper provides an analysis of the environmental impact delivered by Canada and U.S within the time horizon 2017-2021. It is using industries ranging from Financial and the Technology industry to Manufacturing and Transportation industry. environmental impact that has been delivered by Canada and U.S.

Stata programming was used to run regressions between Canada and U.S., for the chosen industries.

Table 4.2 General Statistics

	year	t-statistic	p-value
Canada and U.S.	2021	7.6350	0.0000
	2020	6.9335	0.0000
	2019	8.8359	0.0000
	2018	9.4651	0.0000
	2017	8.5256	0.0000

As observed in the above table, both Canada and U.S. for each year observed in this paper have statistical significance with respect to the environmental pillar score. However, as discussed in Table 3.4, there was significance for Canada in all industries except energy, transportation, and construction. Energy displayed a higher mean for U.S. with respect to the environmental pillar score. Although Canada had a greater mean for transportation and construction, the p-value was above 0.01, 0.05 and 0.10 which exceeds the typical significance levels. Therefore, there is not sufficient evidence to conclude a statistically significant difference in the mean environmental pillar scores between Canada and U.S. The same can be said for the construction industry.

Chapter 4 | Results

4.3 | Correlation Analysis

Table 4.3 Results of correlation analysis between variables

	Canada	U.S.	MC	E.P.S
Canada	-	-0.758	-0.035	0.117
U.S.	-0.758	-	-0.011	-0.130
MC	-0.035	-0.011	-	0.266
E.P.S	0.117	-0.130	0.266	-

The variables are described as follows: MC – Market Capitalization and E.P.S – Environmental Pillar Score. The correlation analysis of all variables in Table 4.2 indicates that the correlation coefficient between Canada and the Environmental Pillar Score is 0.117 which implies a positive direction for Canada and the Environmental Pillar Score, whereas U.S. correlation is -0.130 which implies a negative correlation. However, these correlation coefficients are close to zero, suggesting a very weak relationship between the variables. There is a moderate positive correlation between the Environmental Pillar Score and Market Capitalization (0.266), which implies as Market Capitalization increases so does the Environmental Pillar Score. The correlation between Canada and U.S. is -0.758 which implies opposite relationships. The magnitude of -0.758 suggests a strong negative correlation. This magnitude could be derived from economic competition, or resource allocation.

It is uncommon for a correlation to be +1 or -1 as this is perfect correlation. Perfect correlation if +1 indicates a perfect positive correlation meaning as one variable increases, the other variable increases proportionally. On the other hand, a correlation coefficient of -1 represents a perfect negative correlation, meaning that as one variable increases, the other variable decreases proportionally.

Chapter 4 | Results

4.4 | Statistical Test Results

In the t-test below, the objective is to compare the mean environmental pillar scores between Canada and U.S. across different industries. The table displays the mean values, t-values, significance levels for each industry and number of observations. Based on the t-test results comparing the mean environmental pillar scores between Canada and U.S. in the Financials industry, the findings suggest that Canada exhibits a statistically significant

advantage. The mean environmental pillar score in Canada (32.479) significantly surpasses that of U.S. (15.554) with a t-value of 19.674 ($p < 0.001$). The results imply that, within the financial industry, Canada demonstrates a notably higher environmental pillar score.

The Energy industry results indicate that the mean environmental pillar score in U.S. is significantly higher than the Canadian one, while Transportation industry's score is not significantly different between Canada (33.203) and U.S. (29.126) The Construction industry exhibits similar results to the Energy sector.

Manufacturing mean environmental pillar score in Canada (29.116) is significantly higher than the mean in U.S. (20.870)., with a t-value of 5.417 (p-value of 0.000), indicating a statistically significant difference between the two countries.

Fashion results showcased the mean environmental pillar score in Canada (26.832) was significantly higher than the mean in U.S. (21.259). The t-value of 2.0501 corresponds to a p-value of 0.0408, indicating a statistically significant difference between the two countries. Lastly, Technology had similar results as Fashion, the mean environmental pillar score in Canada is significantly higher than the mean in U.S.. Therefore, overall, it-can be concluded that Canada demonstrates a statistically significant advantage over U.S. in terms of the mean environmental pillar scores within the Technology industry.

Of course, when reviewing the number of observations, it is clear that U.S. is much larger, as is their economic environment. The U.S. has a more developed system of equity finance, including angel investors willing to finance startups and a very active venture capital market that helps finance the growth of those firms (Harvard Business Review,

2017). Also, U.S. universities produce much of the basic research that drives high-tech entrepreneurship. Faculty members and doctoral graduates often spend time with nearby startups, and the culture of both the universities and the businesses encourage this overlap (Harvard Business Review, 2017).

Table 4.4 Test Results for Canada and U.S

	Canada & United States							
	Canadian Mean				US Mean			
	2017-2021							
Variables	No. Obs.	Mean	[t-value]	Significance Level	No. Obs.	Mean	[t-value]	Significance Level
Industires								
Financials	1,000	32.479	19.674 [0.000]	***	6302	15.554	19.674 [0.000]	***
Energy	717	29.016	-5.061 [0.000]	***	1178	35.301	-5.061 [0.000]	***
Transportation	100	33.203	1.270 [0.205]	*	287	29.126	1.270 [0.205]	*
Manufacturing	322	29.116	5.417 [0.000]	***	5188	20.870	5.417 [0.000]	***
Construction	64	19.314	-0.026 [0.979]	*	231	19.382	-0.026 [0.979]	*
Fashion	117	26.832	2.0501 [0.0408]	***	465	21.259	2.0501 [0.0408]	***
Technology	134	30.1359	7.972 [0.000]	***	1396	13.5011	7.972 [0.000]	***
No. Obs.	**2,454**				**15047**			

*, **, and *** denote the statistical significance of the coefficients at the 10%, 5%, and 1% levels, respectively.

Chapter 4 | Results

4.5 | Ordinary Least Squares Regression Results

Please refer to the table below throughout the Ordinary Least Squares (OLS) Regressions discussion of this paper to understand how the independent variables were derived, along with observations, R-squared, F-statistic and Root Mean Square Error. Auditor Tenure was observed due to the relevance of this variable with respect to the environmental pillar score. Findings from previous literature observe that longer auditor tenure enhance environmental performance (Paolone et al., 2022). Auditor tenure allows for familiarity and knowledge of the firm, trust and influence, continuous improvements, and long-term perspective. Observing the coefficients to represent the estimated relationship between environmental pillar score and the variable, respectively.

Table 4.5 Regression Variables

Variable	Description
Cash	Natural Log of cash from Balance Sheet
Total Assets	Natural Log of Total Assets from Balance Sheet
Market Cap	Natural Log of Market Capitalization from shares outstanding * price per share
EBIT	Earnings Before Interest and Tax from Income Statement
Auditor Tenure	Length of time an auditing firm has been engaged to provide auditing to a specific industry
Constant	Refers to the constant term or intercept in the regression equation.
No. Obs	Total count of individual data points
R-squared	Measure that indicates the proportion of the variance in the dependent variable
F-Statistic	Used to test the overall significance of a regression model
RMSE	Measure of the average magnitude of the residuals or prediction errors in a regression model.

Table 4.6 Ordinary Least Squares Regression

Environmental Pillar Score & Multiple Variables
Canada & US
Ordinary Least Squares (OLS) Regression

Variable	Coefficient	t	P>|t|	Significance
Canada	8.332	16.610	0.000	***
Cash	0.436	3.490	0.000	***
Total Assets	2.696	18.640	0.000	***
Market Cap	4.588	29.080	0.000	***
EBIT	0.004	7.900	0.000	***
Auditor Tenure	0.476	19.970	0.000	***
2018	1.361	2.420	0.015	***
2019	2.586	4.710	0.000	***
2020	4.534	8.490	0.000	***
2021	6.539	12.160	0.000	***
Constant	-45.484	-52.560	0.000	***
Observations	15,324			
R-squared	0.393			
F-Statistic	992.36			
RMSE	20.343			

*, **, and *** denote the statistical significance of the coefficients at the 10%, 5%, and 1% levels, respectively.

The regressions referenced in this paper are constructed using Ordinary Least Squares (OLS), and log transformations. The following variables have been log transformed: Cash, Total Assets, and Market Capitalization. Log transformations are often used for skewed data, such as monetary data and often has the effect of spreading out clumps of data and bringing together spread-out data (Ford, 2018). Moreover, log transformations are a very common way to handle situations where a non-linear relationship exists between independent and dependent variables (Benoit, 2011).

Environmental Pillar Score is the dependent variable in this regression. Independent variables used are Total Assets, Market Capitalization, earnings before interest and taxes (EBIT) and Gross Profit or Loss.

All the variables included in this regression are statistically significant, most of the variable's p-value are less than 1%, and the one that is over 1% is still less than 5%. Generally, larger absolute t-values indicate greater statistical significance. As observed from the regression results, Canada had a statistically significant Environmental Score relative to the U.S. Total Assets, Market Capitalization, Auditor Tenure, and the year 2021 all produce relatively high magnitudes, and all positive. These high magnitudes suggest that the corresponding coefficients are likely statistically significant, moreover, providing evidence of a meaningful relationship with the environmental pillar score. Economic impact implied by the regression results show that a 10 percent increase in each independent variable: Cash increases the environmental score by 0.042, Total Assets increases the environmental score by 0.257, market capitalization increases the environmental score by 0.437, and auditor tenure increases the environmental score by 0.045. Lastly, the regression coefficients are all positive indicating a positive relationship between the dependent variable (environmental pillar score) and the independent variables listed.

Next, this paper regressed the specific industries. For the financial industry the results indicate that the coefficient for Canada is statistically significant. However, cash is not significant, neither are the total assets, the coefficient cash is negative implying more cash reduces environmental pillar score. Market capitalization is highly statistically significant as is EBIT and auditor tenure. Reasons for these variables being statistically significant in

the financial industry could be due to the nature of that industry where the significant variables are relevant in the finance.

Within the Energy industry, Canada is not statistically significant, which was confirmed by the univariate tests, and cash is significant along with total assets. Also, market capitalization is highly significant along with EBIT, but auditor tenure is not statistically significant. However, the years used in the regression estimate that 2019, 2020, and 2021 are statistically significant. This could be due to the pandemic (COVID-19) which may have reduced energy consumption, ultimately increasing the environmental pillar score. Within Transportation industry for Canada is not statistically different than the U.S. However, cash, total assets, market capitalization, EBIT, and auditor tenure are positively statistically significant. Although market capitalization is statistically significant, the coefficient value is negative which implies the market capitalization has a negative effect on the environmental pillar score.

The Manufacturing industry in the time period observed that Canada is not statistically significant neither are the years for the purpose of this paper. However, cash, total assets, market capitalization, EBIT and auditor tenure are statistically significant. The construction industry observed the same significance results within the variables as the manufacturing industry. However, one notable difference is that although EBIT is statistically significant, the coefficient implies EBIT has a negative effect on the environmental pillar score. In the Fashion industry Canada wis not statistically different than the U.S., where as cash, total assets, EBIT, and auditor tenure were statistically significant. Market capitalization was not used for this industry as the regression was stronger (greater R-squared) without market capitalization.

Lastly, technology industry was observed with respect to the environmental pillar score. For Canada, total assets, market capitalization, EBIT and auditor tenure were statistically significant. However, cash was not statistically significant. This could be due to the nature of the technology industry. Most "Tech" companies are plowing cash into their research and development, resulting in cash not being used for improving their environmental pillar score.

Overall, the regressions performed in this paper, analyzed the relationship between the various independent variables mentioned, and the environmental pillar score. The results indicated that the total assets and EBIT consistently showed statistically significant positive association with the environmental pillar score across multiple industries. A longer auditor tenure also had a statistically significant positive relationship with the environmental pillar score. However, Canada as an independent variable yielded mixed results, with some regressions showing a statistically significant difference and others indicating no significant effect. The findings imply that the size of assets, financial performance (EBIT), auditor tenure, may play important roles in shaping the environmental performance of the industries. Furthermore, Canada seems to be significantly different in their scores overall, as well as for financial, transportation, manufacturing, fashion, and technology industries. Lastly, the results show that the size of assets, financial performance (EBIT), auditor tenure, and the presence of Canada may play important roles in shaping the environmental performance of the industries.

Chapter 5 | Conclusion

This paper explored Canada and U.S., comparing environmental impact between countries, and within industries, that are known to be polluters. Overall Canada is doing better when it comes to the overall environmental score, using the data and time period analysed in this paper. Univariate tests results show that for the financial industry, Canada exhibits a statistically significant advantage compared to the U.S. in terms of environmental pillar score. For the energy, transportation, and construction industries, they were not statistically significant in the mean environmental pillar scores between Canada and the U.S. On the other hand, no significant difference was found in the mean environmental pillar scores for the manufacturing industry. Additionally, the mean environmental pillar scores in the fashion and technology industries were both significantly higher in Canada compared to the U.S., indicating a notable difference between the two countries in these sectors.

Large investment management companies are beginning to realize potential risk or vulnerability within the ESG as investors pulled money from companies ETF, an example was the assets of the iShares ESG Aware MSCI USA ETF have dropped from $25 billion to $13.8 billion (Quinson, 2023). Sudden $4 billion outflow from BlackRock shows how concentration risk is making a bad situation worse for sustainable investment in U.S. (Quinson, 2023). However, from a political standpoint, Canada plans to meet its emissions reduction targets, grow the economy and build resilience to climate change. In December 2020, Canada took further action with A Plan for a Healthy Environment and Healthy Economy, announcing 64 new measures and CDN $15 billion in investments to make good on the outlined commitments (DiSanto, 2022). President Biden also committed to accelerating bilateral ambition towards combating climate change. These examples show

that both countries are working towards accelerating the transition to zero-emission vehicles, cross-boarder clean energy and infrastructure which is the production and use of clean electricity, and environmental restoration and conservation efforts (DiSanto, 2022). This paper contributes to an expanding literature that investigates the Environmental pillar within ESG, between the two neighbouring countries. Moreover, it compares environmentally harsher industries in order to explore results and areas of weakness that could be improved. Environmental impact has been well known before the 21st century, but was not focused on (Meldrum, 2022). Environmental issues are at the forefront of most news sources in Canada, as June 30th, 2023, there had been fires in Nova Scotia, Quebec, Alberta, and British Columbia (Czachor, 2023). Could the effects of climate change cause more industries to tighten up their pollution, based on what has been happening in North America? Or will they still look for the cheapest solution?

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Appendix A: Environmental Indicators

Positive Environmental PerformanceIndicators	Data Set Column Headers	Negative Environmental Performance Indicators	Data Set Column Headers
Environmental Opportunitites - Clean Tech	ENV-str-A	Regulatory Compliance	ENV-con-B
Waste Management - Toxic Emissions and Waste	ENV-str-B	Toxic Emissions and Waste	ENV-con-D
Waste Management - Packaging Materials & Waste	ENV-str-C	Energy & Climate Change	ENV-con-F
Climate Change - Carbon Emissions	ENV-str-D	Impact of Product and Services	ENV-con-G
Environmental Management Systems	ENV-str-G	Biodiversity & Land	ENV-con-H
Natural Resource Use - Water Stress	ENV-str-H	Operational Waste	ENV-con-I
Natural Resource Use - Biodiversity & Land Use	ENV-str-I	Supply Chain Management	ENV-con-J
Natural Resource Use - Raw Material Sourcing	ENV-str-J	Water Stress	ENV-con-K
Natural Resource Use - Financing Environmental Impact	ENV-str-K	Environment - Other Concerns	ENV-con-X
Environmental Opportunities - Green Buildings	ENV-str-L		
Environmental Opportunities in Renewable Energy	ENV-str-M		
Waste Management - Electronic Waste	ENV-str-N		
Climate Change - Energy Efficiency	ENV-str-O		
Climate Change - Product Carbon Footprint	ENV-str-P		
Climate Change - Insuring Climate Change Risk	ENV-str-Q		
Environment other strengths	ENV-str-X		