A PROPOSED METHODOLOGY TO QUANTIFY ESG METRICS TO BETTER EXPLAIN THE IMPACT ON MARKET VALUE: A CASE STUDY OF GOLD MINING

by

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ABSTRACT

It is believed by some that environmental, social, and governance (ESG) has become a vital determinant of a mining company's market value, in addition to the traditional metrics of production, country risk, deposit characteristics, and corporate management. Institutional investment firms, like BlackRock, invest trillions of dollars annually through mutual funds and exchange-traded funds to promote sustainable development by analyzing a company's positive ESG metrics to support their investment decisions (BlackRock, 2018). Therefore, mining companies must maintain positive ESG performance to access critical institutional funding to continue operations or expand their investment portfolios.

Pursuing positive ESG initiatives, like reducing emissions or providing community support, comes at a cost to the firm. Mining companies must determine if the benefit of improved access to funding or any potential increase in market capitalization outweighs the cost of implementing ESG. This thesis aims to determine if six of the largest gold mining companies in the U.S. and Canada have received short- and long-term financial benefits from implementing ESG practices. The short-term impact is evaluated using an event study approach and finds the market has been unresponsive to positive or negative ESG performance information. Regression analysis determined that ESG ratings do not correlate to a firm's long-term financial performance.

ESG ratings are meant to assess the potential financial risks to investors from environmental, social, and internal governance practices that may impact a firm's reputation or financial profitability. Measuring ESG performance is a qualitative assessment of data gathered through interviews and questionnaires to the firm by an ESG rating analyst or through self-assessment and disclosures using prescribed guidelines. Third-party ESG scores may be subjective as each analyst may change the weight of ESG criteria, and the data used is not always verified or reliable (Lovas, 2021). Unfortunately,

the lack of consistency between ESG rating methodologies, metrics, data, and weightings causes confusion and often challenges and frustrates investors (Lovas, 2021). This thesis addresses the lack of universal ESG metrics for the mining industry by recommending new quantitative criteria for evaluating ESG initiatives from a technical perspective. For instance, measuring the environmental risk should consider a firm's efforts towards biodiversity offsets, energy efficiency, limiting land disturbances, and proper tailings management are all critical risks associated with mining.

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LIST OF ABBREVIATIONS

Acid Mine Drainage	AMD
Announcement Externally sourced from the firm	E
Announcement Internally sourced from the firm	I
Autocorrelation Function	ACF
Brazil, Russia, India, China, and South Africa	BRICS
British thermal units	Btu
Bureau of Land Management	BLM
Carbon Dioxide	CO_2
Clean Air Act of 1970/1977	CAA
Coefficient of Determination	R^2
Colorado School of Mines	CSM
Comprehensive ESG Score	C
Corporate Financial Performance	CFP
Corporate Social Responsibility	CSR
Cumulative Abnormal Return	CAR
Dow Jones Sustainability World Index	DJSI
Emissions Trading Systems	ETS
Environmental ESG Score	E
Environmental Impact Assessment	EIA
Environmental Performance	EP

Environmental Protection Agency . . . . . EPA

Environmental, Social, Governance . . . . . ESG

Exchange-Traded Funds . . . . . ETF

Global Industry Standard on Tailings Management . . . . . GISTM

Global Reporting Initiative . . . . . GRI

Good Corporate Governance Mechanism . . . . . CG

Governance ESG Score . . . . . G

Greenhouse Gas . . . . . GHG

Indonesia Stock Exchange . . . . . ISX

Initiative for Responsible Mining Assurance . . . . . IRMA

International Council on Mining and Metals . . . . . ICMM

International Organization for Standardization . . . . . ISO

London Bullion Market Association . . . . . LBMA

Massachusetts Institute of Technology . . . . . MIT

Mine Safety and Health Administration . . . . . MSHA

National Environment Protection Act of 1970 . . . . . NEPA

Negative Perception . . . . . N

New York Stock Exchange . . . . . NYSE

Organization for Economic Co-operation and Development . . . . . OECD

Positive Perception . . . . . P

Return on Assets . . . . . ROA

Return on Equity . . . . . ROE

Social ESG Score . . . . . S

Social License to Operate . . . . . SLO

Solvent Extraction Electro-Winning . . . . . SXEW

Sustainability Accounting Standards Board . . . . . SASB

Sustainable Development Goals . . . . . SDG

Tailing Storage Facilities . . . . . TSF

Toronto Stock Exchange . . . . . TSX

Total Reportable Incident Rate . . . . . TRIR

Toxics Release Inventory . . . . . TRI

Triple Bottom Line . . . . . TBL

U.S. Bureau of Labor and Statistics . . . . . BLS

U.S. Mine Safety and Health Administration . . . . . MSHA

U.S. Securities and Exchange Commission . . . . . SEC

United States Forest Service . . . . . USFS

United States of America . . . . . U.S.

Variance Inflation Factor . . . . . VIF

World Gold Council . . . . . WGC

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For my son, Lucas. The sky is the limit.

CHAPTER 1

PROBLEM OVERVIEW

Chapter one of this thesis will include the introduction, problem statement, research objectives, novelty of the research, and research limitations. The introduction provides a background of sustainable development goals relative to the mining industry. It also addresses the driving factor of environmental, social, and governance (ESG) behavior: societies demand sustainable products, and investors seek sustainable companies to support them financially. The problem statement further details the change in society's demand for sustainability and how mining companies are adapting to address societal concerns for global well-being. The problem is quantifying the impact of ESG initiatives undertaken by firms and evaluating if the firm benefits from ESG through increased access to funding or improved market value. This thesis aims to develop a quantitative methodology for effectively evaluating the economic impact of implementing sustainable initiatives by publicly traded gold mining companies. The research objectives section of this thesis details the hypothesis and economic measures considered. By reviewing the extent of previous research on the topic of ESG correlation to financial performance and identifying the gaps of analysis within the mining industry, the novelty of the research section addresses how this research differs from previous research. In particular, this thesis develops a new methodology for quantifying ESG instead of relying on an index's interpretation of a firm's ESG performance. This thesis utilizes a case study approach to evaluate six gold mining firms' ESG behavior instead of evaluating the entire mining industry or all industries within a given region. After identifying the unique qualities of this thesis, the research limitations are stated.

1.1 Introduction

Mining is a unique industry; finite minerals are extracted based on current market conditions, while prospecting and exploring focus on future use of various minerals. Since the first decade of the 21st century, there has been a debate about sustaining our finite natural resources, ensuring that future generations will have access to the resources they will require (Mudd, 2010). In 1987, the United Nations Bruntland Commission defined sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). As active mines deplete the known reserves of their deposits through normal operations, continuous exploration is required to replenish these resources and reserves. Resources are known mineral deposits that are either not economically or technically feasible to extract at a profit or are legally or socially restricted, prohibiting development. Resources include mineral targets undergoing feasibility studies or otherwise insufficiently defined to make a comprehensive economic assessment. In contrast, reserves are economically viable mineral deposits that are socially acceptable and legally compliant with well-defined characteristics regarding quantity and quality exploitable using conventional mining processes (Doughtery & Schissler, 2020). As commodity prices increase, mining firms either decrease the cutoff grade to mine a lower quality material, which may extend the mine life while limiting the short-term profitability. Conversely, a firm may pursue maximizing short-term profits by targeting higher-grade zones, resulting in a shorter mine life. In general, as prices increase, reserves should also increase as more material becomes economically viable. Today, commodity prices strongly influence the mining industry to high-grade deposits to remain profitable or to maximize present value, depending on the firms' strategy, and every year the average gold grade decreases as a result. Depleting high-grade reserves today requires further exploration to replace the volume of metals being extracted for future use.

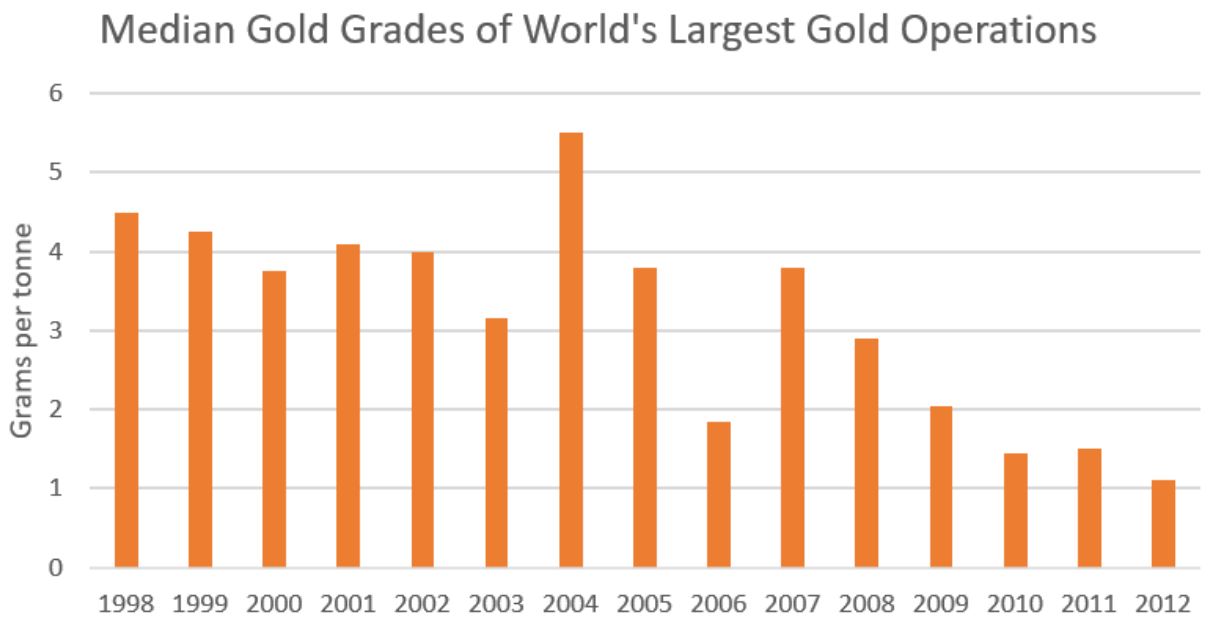

Figure 1.1 The Median Gold Grades of the World's Largest Gold Operations (Casey, 2013).

For many commodities, future resources may be of lower-quality and require more material volume to be mined and processed to make an equivalent, sustainable production volume. Regardless, exploration is a central element of the sustainability of mining and commodity markets.

Historically, mining companies were valued based on the quality and characteristics of deposits in their portfolio, business risk, corporate leadership, and commodity exposure. In recent years, however, society and investors have changed their focus from strict profitability to incorporating "softer" business strategy elements, such as environmental and social impact. In 2012, the United Nations developed seventeen Sustainable Development Goals (SDG) to address companies' impact on society, the environment, and the economy. The SDGs aim is "to promote prosperity while protecting the planet" (United Nations, 2022). The goals are believed to be "a call to action" to address poverty, inequalities, climate change, environmental degradation, peace, and justice. Many countries and companies utilize these goals to guide their decisions and seek a common set

of objectives. Sustainable Development Goals are similar to previous initiatives called corporate social responsibility (CSR), triple bottom line (TBL), and more recently, ESG. Regardless of the terminology used, environmental, social, and financial impacts have been and continue to be a growing focus for investors, consumers, and shareholders. Today, the these stakeholders may perceive that the value of mining companies is heavily dependent on their ability to address ESG concerns, even though quantifying environmental and social impacts may be esoteric or subjective (Lokuwaduge & Heenetigala, 2017).

With the inclusion of "softer" business objectives, mining companies have had to adapt to changing pressures for transparency by reporting their business strategies of environmental and social focuses. A modern firm must be economically viable, address social issues and comply with legal regulation, known as economic, social, and legal licenses. The profitability of the planned procedure and influence from the government or political policy determines the economic license. Abiding by all government regulations derives the legal license to operate. General acceptance and goodwill from the general public, special interest groups, communities, employees, and the media demonstrate a mine has a social license to operate. The firm must address all three licenses for mining activity to occur.

Figure 1.2 The Three Strand Model (adapted from Gehman et al., 2017).

In 2003, the International Finance Corporation (IFC) developed the Equator Principles, which was "intended to serve as a common baseline and risk management framework for financial institutions to identify, assess, and manage environmental and social risk when financing projects" (About the Equator Principles, 2021). The Equator Principles established minimum requirements for social and environmental management, stakeholder engagement, and transparent reporting that firms must abide by to finance large capital investment projects, including mine development. Even if firms established their own environmental and social risk management standards, the requirement to receive financing is a crucial driver for companies to incorporate, manage, and report social and ecological governance. The Equator Principles directly influence the economic license for a mining firm. If a firm violates the Equator Principles, the investment bank may immediately call the loan due, likely resulting in a firm's bankruptcy.

The London Bullion Market Association (LBMA), the world's largest precious metals trading platform, in association with the World Gold Council, has developed sustainable and responsible resourcing standards that its customers must abide by to trade their gold products. The LBMA requires complete transparency and reporting of the supply chain managed predominantly by the refiners supplying the doré to the market (Independent Precious Metals Authority, 2022). The refiners must also complete due diligence on their suppliers, including investigating workplace conditions, social engagement assessment, and environmental risks on a biannual basis. To ensure miners' products have access to internationally respected markets for sale, they must comply with established sustainability standards. Again, a firm's economic license may be adversely impacted by not abiding by sustainability standards, and the firm's ability to access a market and maximize commodity sales value could then be at risk.

Beyond the financial incentives for successfully maintaining environmental and social standards, miners must also maintain a "social license to operate" (SLO) which reflects the goodwill and acceptance of the local communities, stakeholders, employees, and the general public (Gehman et al., 2017). The social license to operate is influenced by the environmental impact of a firms' products and processes, customer power, customer interest, corporate brand visibility, and community pressure (Lynch-Wood & Williamson, 2007). Media coverage and company branding play a significant role in stakeholder acceptance of a project and can positively and negatively impact the timing and viability of an operation (Gehman et al., 2017). An economically and legally feasible mine may go undeveloped for decades or potentially never open without a social license to operate. The Pebble Mine in Alaska, for example, has been blocked from development for decades due to negative media coverage and the mining company has not satisfied the local tribal communities' concern that the mining activities will pollute the rivers and damage salmon fisheries. *The Washington Post* reported a story headline as "the EPA to protect Alaska's Bristol Bay by blocking major gold mine" before the release of a formal environmental

impact study (Grandoni, 2021). Even though Pebble Limited Partnership has spent millions in feasibility studies, environmental assessments, and community relations to acquire the legal and social licenses, the impact of negative publicity and failure to address environmental concerns has prevented the social acceptance and is a major factor keeping the Pebble Mine from being permitted. The delay in obtaining the SLO reduces a firm's profitability because of the time value of money, extensive holding costs, and lost opportunity costs.

The environmental and social impact of companies and their products are more widely known and made public primarily due to the advances in technology and the speed of information sharing which has occurred over the last decade (Silver, 2022). Society's awareness of a company's impact on the community and the environment influences their decisions to invest and financially support or block and protest. Since the public is more aware of a firm's activities, companies are becoming proactive in their management approach to mitigating risks related to sustainability above and beyond legal requirements.

In addition to obtaining a social licenses to operate, mining companies must obtain a legal license to operate from local, federal, and sometimes international regulators. In the 1970s, governments worldwide began to regulate the mining industry due to instances of several high-profile catastrophic mine failures. Largely in response to a major disaster at the Sunshine Silver Mine in Kellogg, Idaho, the United States (U.S.) promulgated the Federal Mine Safety and Health Act of 1977, which established a regulatory framework for enforcing occupational safety and health standards. This act has significantly reduced the number of fatalities in the industry (*United States Dept. of Labor*, 2021). Within the United States, local, state, and federal laws govern all aspects of the mining industry and were adopted to address perceived deficiencies in environmental, social, and safety regulatory oversight. The Federal Government regulates the mining industry through a patchwork of various regulatory agencies, including the Department of Labor – Mine Safety and Health Administration (MSHA), Environmental Protection Agency (EPA), United

States Forest Service (USFS), Bureau of Land Management (BLM), Office of Surface Mining (OSM), the Office of Natural Resource Revenue (ONRR), etc. (United Nations' Department of Economic and Social Affairs Commission, 2010). Individual states also play an important role in regulatory oversight and often manage federal statutes on behalf of the federal government. A mine operating in the United States must abide by all mandated laws and regulations to obtain a legal license to operate. These regulations protect workers, the environment, and the general public from harm. A conventional gold mining operation in the U.S. may require more than forty regulatory permits from these federal, state, and local agencies governing all facets of an operation (Beck, 2022).

Other advanced economies, like Canada, Australia, and some European countries have similar legal regulations for businesses impacting the environment and local communities that mirror those in the U.S. Canadian mines operate according to a set of general mining regulations and are also subject to regional laws and regulations associated with each province or territory (Government of Canada, 2022). Regardless of the level of government involvement, the underlying purpose is to safeguard core values related to protecting mine workers, the environment, and society from any harm that may arise from mining activities. To obtain the legal license to operate, a firm must prove its willingness and ability to abide by this established framework of laws, regulatory guidelines, and policies, as well as established best industry practices.

Underpinning each license required to develop and operate a mine, be it social, financial, or legal, the issues associated with environment and societal impacts are at the core for miners, investors, government officials, and the general public. Investors manage the demand for firms aligning with ESG goals by seeking opportunities to use their capital to help create a more sustainable future. In 2021, over USD 500 billion were invested in ESG-integrated funds (JP Morgan Chase & Co., 2022). According to Deloitte analysts, institutional investment managers with at least one ESG-aligned fund has grown nearly 300 percent since 2016 (Hamlin, 2022). JP Morgan asset managers claim these

ESG-integrated funds "help investors tackle climate change and enable the transition to a low carbon economy" (JP Morgan Chase & Co., 2022). The market is driving the change in focus from profits to impacts, consumer demand for responsibly sourced products, investors' requirements to meet consumer expectations, and regulation setting the minimum requirements to achieve a sustainable market.

However, reporting how mining companies are improving their impact on society and the environment is lagging behind consumer demand. Two types of companies have emerged to provide the market with information about ESG performance: standard setters and raters. Standard setters publish minimum requirements for companies to share their ESG information in a common format. Some standard setters also provide certification that a company has abided by their standards in reporting and may utilize a third-party audit to authenticate the reports. For gold, some of the standard setter companies include the following: International Organization for Standardization (ISO), Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), Responsible Jewelry Council (RJC), and the World Gold Council (WGC). The standards these companies advocate vary in topic from environmental management systems, supply chain integrity, and ESG related disclosures. It is up to a mining company to determine which of the standards they will use to publish their information to the public and which certifications are most meaningful. ESG Rating companies compile the information published by mining companies and evaluate each companies' performance based on a set of key criteria for each ESG pillar. Raters publish ESG ratings allowing investors to compare firms across industries. Each rating firm develops a unique methodology for measuring ESG risk considering the firm's industry and potential exposure to the key criteria. The top ESG rating companies are Moody's, Bloomberg, Sustainalytics, S&P Global, MSCI, and FTSE Russel's.

The standards setting companies have formed to fill the gap between consumer requests and the unknown activities of mineral resource companies. These standard setter issue

certifications to the miners for meeting a set benchmark. Among such companies is International Organization for Standardization (ISO), which has established the global guidelines for reporting a firm's environmental management systems through its ISO 14000 family of certifications. Although ISO does not issue the certification, its branding is understood globally that an ISO-certified firm reports and monitors ecological risks and is certified by an independent accredited third party (ISO Survey, 2022). ISO 14001 certification provides the market with an assurance that the company is environmentally conscious but does not quantify the firm's environmental impact or identify any improvements over time (D'Souza, 2004). The benefits of ISO certification are limited to a demonstration of environmental awareness and increased employee engagement to meet standards. Furthermore, ISO certification encourages better environmental performance from suppliers (*ISO 14001 Key Benefits*, 2015). There are more than 300,000 ISO 14001 certified companies around the globe (ISO Survey, 2022), but consumers are still not informed of the environmental impact of an individual firm simply because of the certification. Certification signals to the market that a firm meets the threshold of environmental impact disclosure but cannot differentiate between firms leading an industry in proactive environmental management and those meeting the bare minimum requirements.

Other firms have attempted to inform consumers and investors about mining activities and their social impact by establishing standards for companies to follow. For instance, the WGC created the Conflict-free Gold Standard to promote transparency of financial transactions. The standard provides a "mechanism by which gold producers can assess and provide assurance that their gold has been extracted in a manner that does not cause, support or benefit unlawful armed conflict or contribute to serious human rights abuses" (World Gold Council, 2012). The Conflict-free Gold Standard directly addresses the UN Sustainable Development Goal 16 – Peace, Justice, and Strong Institutions, by creating guidelines for financial transparency. Companies belonging to the WGC agree to

implement these standards and those who abide by the Conflict-free Gold Standard may publish their accreditation of producing responsibly sourced gold.

Other organizations, like Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), Corporate Sustainability Reporting, Responsible Jewelry Council, and International Council on Mining and Metals (ICMM) create standards for reporting social and environmental impacts to improve transparency for the end consumers. The standards these companies and organizations promote include compliance with human rights, water consumption and treatment disclosures, ecological assessments, or financial statement requirements. The standards result in increased transparency and improved communication between producers and consumers but only illustrate meeting a compliance threshold. Numerous standards and certification processes confuse the marketplace as each certification has a different priority and metrics for compliance. Without standardization of what sustainability means and how to measure target achievement, society and investors are unable to compare firms or determine the best investment options. Meeting a standard and obtaining certification is not the end goal but merely a display of threshold compliance and effort to achieve more sustainable production.

Credit and ESG rating firms depend on the ESG related and financial reports issued by companies to evaluate the company's investment credit risk. Investors need to understand how companies are exposed to specific ESG issues and how the company is managing these issues. Rating companies provide a tool for investors to compare companies within a specific industry, as well as across industry sectors. Investors may use these ratings to assist in decision making for investments or to help balance risk within a portfolio. If a company receives a poor rating, it may impact the company's stock value to be considered an "unsustainable asset" and excluded from an investor's portfolio. If multiple investors view the asset as unsustainable, it will likely cause an eventual negative impact to the stock price (*Why ESG ratings matter and how companies use them*, 2022). According to Mark Carney (2019), Governor Bank of England, "In the future, climate and ESG

considerations will likely be at the heart of mainstream investing" (p. 11). However, there exists a lack of consistency between raters' methodology; this causes ratings to vary, sometimes significantly, for a single firm. Differing methodologies and raters focus leads to confusion in the market as a single rating does not likely consider all the complexities for a firm or industry. Raters attempt to quantify the intangible and hard-to-measure, but the expectation remains that the rating be realistic even though it cannot be comprehensive.

To create value within sustainability, a firm must be at the frontier of implementation or demonstrate compliance with established policies or investment strategies to stand out against competitors as a superior option for investing. The problem is that the U.N. Sustainable Development Goals are vague and do not quantify measures for compliance. Without adequately defining an acceptable sustainability goal, companies cannot provide sufficient disclosure on execution.

1.2 Problem Statement

The economic principle of supply and demand theory suggests that in a stable market, supply and demand will adjust to reach an equilibrium price (CFI Education, 2015). For metal markets, the supply is relatively inelastic due to extensive time for exploration, low probability of success, delineation, engineering, acquiring financing, permitting, and pre-production periods. Therefore, metal prices are predominately driven by demand in the short-run. As discussed previously, society is demanding safe, environmentally conscious, and sustainable metal production to transition into a "greener" economy that is less dependent on fossil fuels with high carbon dioxide emissions. To meet consumer demands, producing operations are seeking to update their technologies, policies, and procedures to achieve a more sustainable mining practice.

At the forefront of environmental protection and action is the desire to reduce greenhouse gas (GHG) emissions in order to curb climate change. Seventy-six percent of the GHG emitted by humans are carbon dioxide (CO_2) emissions (Denchak, 2019). Governments have begun regulating CO_2 emissions using carbon taxes and various

emissions trading systems (ETS) with varying degrees of success in reducing the emissions level.

The U.S. Federal Government has not regulated CO_2 or GHG emissions as the U.S. Supreme Court ruled in 2014 that GHGs cannot be treated as an air pollutants under the Clean Air Act of 1973. Therefore, without a new law passed by Congress, the Environmental Protective Agency (EPA) cannot require sources of GHG to obtain a permit but can require limitations of GHGs emissions based on the application of Best Available Control Technology (Leiter, 2014). Despite the lack of regulation in the U.S., companies have voluntarily begun to react to the public demand for reduced CO_2 emissions by joining the 2015 Paris Agreement, which aims to achieve net-zero emissions by 2050 (UNFCCC, 2022). Multiple mining companies have pledged their CO_2 reduction commitments and timelines for achieving their goals. Table 1.1 summarizes the mining companies, including some members of the International Community of Metals and Mining (ICMM) and their commitments to the Paris Agreement (GlobalData, 2021).

Table 1.1 Greenhouse gas emission and carbon neutrality targets for leading mining firms (GlobalData, 2021)

Mining Company	**GHG Emissions Target**	**Base Year**	**Neutrality Target**
BHP Group Ltd	30% reduction in operational emissions by 2030	2020	2050
Rio Tinto Limited	15% reduction in absolute emissions by 2030	2018	2050
Vale SA	33% reduction by 2030	2017	2050
Glencore PLC	40% reduction in total emissions by 2035	2019	2050
Anglo American	Reduce net GHG emissions by 30%	2016	before 2040
Newmont Mining Corp	Reduce GHG emissions intensity by 16.5% by the end of 2020	2013	NA
Barrick Gold Corp	At least 10% reduction by 2030	2018	NA
Freeport-McMoran Inc.	15% reduction by 2030	2018	NA
Newcrest Mining Limited	30% reduction by 2030	2018	NA
South32 Ltd	Stay below the company's FY15 Scope 1 carbon emissions	2015	2050
Teck Resources Limited	Reducing the carbon intensity by 33% by 2030	2010	2050

Green House Gas Emissions are broken into three categories, Scope 1, Scope 2, and Scope 3, based on the originating source of the emission. Scope 1 emissions occur from sources owned and controlled from a firm (WGC, 2018). For example, a miner has Scope 1 emissions from diesel operated equipment. Scope 2 emissions are considered indirect, such as electricity purchased by an organization. If a miner purchases electricity from a coal burning power plant, the emissions from the power plant would be considered Scope 2 emissions for the miner. Scope 3 emissions occur as a consequence of the activities of the organization, from sources not owned or controlled by it, such as transport of purchased materials or finished goods. For a gold miner, Scope 3 emissions are considered when doré

or concentrates are sold and transported to a refinery for further processing (WGC, 2018). In 2019, the WGC investigated the emissions of carbon dioxide throughout the entire supply chain of gold to estimate the annual emissions due to gold production and consumption. They reported that the gold industry, excluding artisanal and small-scale miners, emits approximately 30,000 tonnes of carbon dioxide equivalent CO_2e per tonne of gold produced in Scope 1 and 2 GHG emissions annually (WGC, 2019). After extrapolating to consider all sources of gold production and consumption (Scope 1, 2, and 3), the WGC estimates the annual emissions equate to around 126 million tonnes of CO_2e. Table 1.2 illustrates the findings of the WGC investigation of GHG emissions resulting from the global gold market.

Table 1.2 Annual global gold market GHG emissions

Category	**GHG Intensity**	**Listed Firms Gold Volume (t)**	**Listed Firms Total GHG Emissions (t CO2e)**	**Global Gold Volume (t)**	**Global Total GHG Emissions (t CO2e)**
	tonne of CO_2e per tonne of gold		*t CO_2e*		*t CO_2e*
Production (upstream)					
Scope 1	13,197	2,115	27,911,655	3,447	45,490,059
Scope 2	15,931	2,115	33,694,065	3,447	54,914,157
Scope 3	7,287	2,115	15,412,005	3,447	25,118,289
Refining/recycled gold	4	1,168	4,228		4,228
Consumption (downstream)					
Jewelry	370	2,237	827,690		827,690
Technology	0	200	168		168
Investment	4	1,252	4,532		4,532
Total	36,793		77,854,343		**126,359,123**

Source: Anthesis, S&P Global Market Intelligence, World Gold Council

The emissions intensities of gold production operations may vary considerably, depending on location, ore type and grade, and specific processes used. While each producer is different, the majority of GHG emissions result from purchased electricity (approximately 40-45 percent). Diesel/fuel combustion used in powering vehicles and machines or to generate electricity on-site accounts for approximately thirty to thirty-five percent of emissions. Upstream Scope 3 emissions related to the production and transportation of fossil fuels used by the gold industry causes an estimated twenty percent of the total GHG emissions (WGC, 2019). The WGC estimates a very small percentage (five percent or less) of emissions are due to direct GHG emissions from chemicals.

The transition for mining companies to reduce GHG emissions depends on their ability to utilize renewable energy sources and convert their mining fleet to electric powered (Leonida, 2020, Legge et al., 2021). The transition to renewable energy sources may require either changing power-purchase agreements or depending on capital availability, developing their own on-site renewable energy generation (WGC, 2019). Another significant focus for the mining industry is the electrification of mining vehicles. Companies like Caterpillar and Komatsu are reported to be working on battery-electric versions of their own mining vehicles (Gleeson, 2018). A prototype of a sixty-five-tonne payload battery-electric dump truck debuted in Switzerland in 2018 (Manthey, 2018). However, the ability to transition to a fully electric fleet of mining equipment is not expected to occur until the middle of the next decade. The shift to an electric haul fleet would increase the importance of clean energy production at the power plants, as over sixty percent of emissions may be due to electricity sourcing. Electrical supply and conversion from fossil fuel to renewable energy (Scope 2 Emissions for Equator Principles) are crucial for the mining industry to achieve a net-zero goal by 2050 (Equator Principles Association, 2020).

Even though decarbonization is a global concern and mining companies have committed to the process of reducing emissions, achieving this target will take time. Other immediate environmental and social concerns within the mining industry include water consumption

and purification, social transparency, irreconcilable and post-mining land usage, ongoing environmental commitments, and social equity. Mining and mineral extraction requires a significant amount of water to produce unrefined metals. According to the United States Geological Survey (USGS), the mining industry accounts for approximately one percent of total withdrawals from surface and underground aquifers in the U.S., of which over half is freshwater (Dieter et al., 2018). The use of surface and groundwater for mining may restrict the ability of the local community to properly irrigate crops or livestock and restrict residential usage, thus creating a significant social issue concerning water consumption. In addition to the public concern for consumption, the purification of water leaving the mine sites is also a crucial environmental and social concern. Land usage and encroachment on surrounding communities is another prevalent social issue for mining. The phrase "not in my backyard" (NIMBY) originated in the 1970s and became a platform against any industry or project that may affect the environment or communities (Ayma, 2018). Although government organizations like the European Union recognize the need for mineral production and promote safe mining regulations, the social stigma of adverse visual aesthetics from a project still exists and must be addressed by each mining firm. Investors and consumers want to know how companies manage and maintain social acceptance and social equity within the communities in which they operate (Eccles & Klimenko, 2020). By addressing these social and environmental topics, mining firms can differentiate themselves from their competitors by promoting their products as "sustainable."

Mining companies promote their products as "sustainable," "environmentally responsible," or utilize other marketing strategies to claim "green" production. To avoid the perception of "greenwashing," a mining company may publish environmental and social data in its annual reports or obtain third-party certification of its environmental conscience practices. Various non-mining-centric companies have developed guidelines for reporting sustainability efforts, including environmental and social impacts from production in an attempt to standardize reporting criteria across industries, allowing analysts to compare

companies. With standardized reporting, investment analysts can differentiate firms, products, and industries to assess risk. Unfortunately, without a single global standard, there is confusion within the marketplace due to data overload requiring each analyst to determine what information is critical for calculating risk. Producers are trying to improve transparency and publish information according to a standard; however, identifying leaders in sustainability and assessing environmental, social, governance (ESG) risk for investment is still challenging. Currently, there is no publicly disclosed price differentiation in the market for metal produced sustainably versus a less environmentally aware product. Therefore, one might assume the benefit of sustainable practices must be reflected in the company's stock price and ability to raise capital.

Today's leading investors, like BlackRock, are seeking to "invest in progress and recognize the companies solving the world's biggest challenges" (BlackRock Inc., 2022). Large brokerage firms support companies that actively pursue ESG in relation to public health, safety and security; electrification, green energy, pollution remediation and prevention; in addition to sustainable food, water, and waste (Rice & Prasad, 2022). In order for mining companies to compete for capital funding, they must address ESG concerns and publicly disclose their sustainability actions that deal with the most pressing global concerns. Disclosure of a firm's ESG activities increases its perceived corporate social responsibility, moral, and financial values by decreasing the cost of capital (Jang et al., 2020). This is particularly important for firms issuing bonds as ESG is a measure of risk.

In addition to miners' application to join an index ranking, they may also seek to differentiate themselves by obtaining certifications. The certification process typically involves an independent third-party audit of a company's compliance for specific standards. Most certifications establish a single benchmark for certification while others offer a tiered approach illustrating levels of compliance.

The Initiative for Responsible Mining Assurance (IRMA), for example, has four levels of compliance where level one is self-proclaimed alliance to the standard, and levels two

through four are audited with monitored emissions differentiating the levels. IRMA's certification addresses a company's business integrity, planning and managing for positive legacy, social responsibility, and environmental responsibility. Unfortunately, IRMA's certification process is not well known or utilized as only two mines have completed certification (one level three and one level four). Moreover, nine mines are classified as "ongoing audit" process as of January 2023. IRMA certifications are publicized on its website with full detailed reports; however, interest in the certification appears to be limited to African and South American companies (IRMA, 2022).

Of the certifications available within the gold industry, the most prevalent is the LBMA's Good Delivery Certification. This certification is most prevalent among refiners as it is a requirement for refiners to sell the refined gold on the LBMA Over-The-Counter (OTC) market, AURIUM. All gold that is traded on the AURIUM platform must be certified as good delivery that demonstrates the refiner has produced the gold in accordance with LBMA standards concerning the purity, quality, and physical appearance of the bars. As part of the good delivery standard, the refiner is responsible for verifying the source of gold purchased and complete a form, called "know your customer" due diligence, to confirm the metal is responsibly sourced. Although this certification is not for mining companies specifically, it does impact whether the gold mined can be traded on the LBMA AURIUM market or if it must go through less reputable means. The seventy-one LBMA Good Delivery Certified Gold Refineries produce approximately 5600 tons of gold annually, or seventy percent of the world's gold production (Hobson, 2020). When a miner is out of compliance with the LBMA Good Delivery Standard, the auditing refiner must provide written notification of the issues identified and share this document with the miner and LBMA Good Delivery Board for review. Depending on the issue, the miner is either given an opportunity to rectify the issue within a set timeframe or the refiner may terminate the purchasing agreement (Incident review process, 2023). If the purchasing contract is terminated, the miner must find an alternative refiner willing to purchase the

gold and will not have access to the AURIUM market.

Unfortunately, the certification programs and indices measuring sustainability are generic for all industries and lack the ability to quantify the unique impacts the extractive industries have on ESG. Quantifying the impact of water consumption, land usage, reclamation, air and water pollutants emissions, social wellbeing, and community support post-mining are a few of the unique challenges faced by mining companies associated with creating sustainable products. A problem for mining companies is determining the priority of ESG initiatives and analyzing if the costs outweigh the benefits. According to researchers, a sustainable firm has increased access to funding (Jang et al., 2020; Chodnicka-Jaworska, 2021) and a positive public perception which creates greater shareholder value (Chava, 2014; Franklin, 2008).

The problem for investors is identifying the companies to financially support, as the reporting standards are not tailored to the mining industry and do not require disclosure of information most pertinent to the impacts of the extractive industry. For instance, sustainability indices, such as the Dow Jones Sustainability World Index (DJSI-World), provide global rating systems focused on identifying leaders in each sector, but do not quantify ESG actions taken by firms. Participating firms must respond to DJSI questionnaires, substantiate responses with internal documentation, and be audited by a third party where relevant to verify accuracy of the data presented. DJSI calculates an ESG rating that demonstrates risk exposure and potential financial outcomes (Naqvi, 2020). However, the DJSI does not quantify the actual impact on the environment or communities. Michael Robinson et al. (2011) found empirical evidence for a positive and sustained increase in market value for firms joining the DJSI, but only a short temporary loss in value when the firms were removed from the indices. The lack of repercussions for removal from the indices make it an unreliable source for evaluating the impact that ESG reporting has on a firm's market value both in the short and long-term.

Unfortunately, previous research has not focused on the mining industry, specifically the gold industry. It has yet to be proven if ESG initiatives improve public perception and increase shareholder value for gold mining firms. If mining firms benefit financially from ESG by improving shareholder value, can the benefit be quantified in the short- or long-term market capitalization to influence investment decisions? If not, is there a better method to quantify the ESG performance of mining companies?

1.3 Research Objectives

The primary objective of this research is to develop a quantitative methodology to provide an effective means for evaluating the economic impact of implementing sustainable initiatives by publicly traded gold mining companies. This thesis hypothesizes a direct positive correlation between a firm's market value and its perceived commitment to sustainability relative to environmental management, social engagement, and internal governance assuming the asset base remains constant. Assessment of a firm's market value utilizes market capitalization, including value per share, number of shares of common stock outstanding, and volumes being traded on the days surrounding sustainability announcements. JP Morgan Chase & Co. (2022) claims that shareholders and the investment community currently demand more responsibility from mining firms to address climate change, to create a more balanced and inclusive workplace, and to publicly disclose stakeholder engagement. The demand for ESG-integrated funds is supported by over USD500 billion invested in 2021, including the fifty-five percent growth in assets, which is expected to continue to grow (JP Morgan Chase & Co., 2022). By identifying strategies developed by gold mining companies to satisfy these societal demands for sustainable mining practices, this research aims to empirically quantify the economic impact of these environmental and social strategies. Evaluating the market response to sustainability initiative announcements is the basis for comparison. The basis for comparisons made in this thesis is evaluating the market response to sustainability initiative announcements.

This dissertation is predicated on case studies that focus on assessments that correlate sustainability actions and their impact on market capitalization for six publicly traded gold mining companies: Newmont Corporation, Barrick Gold Corporation, Hecla Mining, Agnico Eagle Gold Mining, Kinross, and Yamana Gold. The outcome of this thesis will be the methodology of correlating specific sustainability initiatives to market capitalization with the data demonstrating the correlation.

First, this research will address whether ESG events immediately impact a firm's market capitalization. Second, this thesis will determine if ESG rating agencies appropriately measure ESG and evaluate the long-term market response to changes in ESG ratings. Finally, this work will address how ESG metrics can be improved to better explain the financial impact of ESG, specific to the gold mining industry, by proposing a new methodology to quantify ESG.

1.3.1 Firm Selection Criteria

The criteria for selecting gold mining companies included in this thesis were the following:

1. Must be a gold mining company publicly listed and traded on the New York Stock Exchange or Toronto Stock Exchange
2. Must be headquartered in the United States or Canada
3. Must be an operator, therefore, excluding royalty or streaming companies
4. Must have a market capitalization greater than three billion dollars
5. Must be founded prior to 2000

According to the Mining Feeds website, 145 publicly traded gold mining companies exist within the U.S. (11) and Canada (134) (Mining Feeds, 2023). Many investors prefer to invest in firms headquartered in their home country over a well-diversified international portfolio, a behavior referred to as "home bias" (Wallmeier & Iseli, 2022, p. 1). In light of investors' "home bias" behavior, this thesis focuses on publicly traded companies headquartered in the U.S. and Canada. Furthermore, mine operator companies can

influence ESG performance more than royalty or streaming firms. As such, the selected mining companies must be mine operators and not a producer, royalty, or streaming firms.

The last two criteria for selecting gold mining companies for this thesis require a market capitalization greater than three billion dollars and a mature company founded before 2000. Michael Borenstein (2022) assessed the difference in ESG ratings based on market capitalization and found that larger companies outperform smaller firms, likely due to the larger firms' focus and capacity for publishing sustainability reports, which play a significant role in the rating system. Previous research (Habib & Mourad, 2023; Shao, 2022) shows a strong positive correlation between ESG ratings and a firm's age. It is reasonable to assume that older mining companies should lead the industry in ESG performance. Therefore, this thesis requires the firm to be mature in the industry with over twenty years of experience.

Junior mining companies are often younger firms with smaller asset bases and experience more market volatility than mid-tier or large-scale miners. Consequently, junior miners attract short-term investors who seek a higher yield due to the increased risk from speculation on the quality of the assets (Constable, 2020). Because of the difference in the type of investor attracted to junior mining companies, this thesis assesses only mid-tier and large-scale miners. As a result of this selection criteria, the gold mining companies assessed in this work are Newmont Corporation, Barrick Gold Corporation, Kinross Gold Corporation, Hecla Mining Company, Agnico-Eagle Mines Limited, and Yamana Gold Incorporated. At the time of this study, these are the only companies that meet all five selection criteria.

1.4 Research Limitations

This research uses a case-study approach limited to investigating six medium- to large-scale gold mining firms in the U.S. and Canada. As such, findings may not apply to all firms within the gold industry or reflect the mining industry as a whole. The research is a historical review of ESG initiatives from 2014 to 2021 and does not indicate future

behaviors or projected market responses. The WGC issued the Conflict-Free Gold Standard in October 2012, providing gold producers a mechanism to assess and ensure that their gold has been extracted safely and lawfully (WGC, 2012). By 2014, the selected firms had sufficient time to implement and adopt the Conflict-Free Gold Standard, which operationalized the Organization for Economic Co-operation and Development (OECD) Due Diligence Guidance for Responsible Supply Chains for Minerals from Conflict-Affected and High-Risk Areas and incorporated the Responsible Gold Mining Principles. At the time, this standard was the first to ensure the monitoring and reporting of human rights and other ESG metrics throughout the gold supply chain and is used to reference the shift for mining companies to focus on sustainable development. This research will not use data prior to 2014 as 2013 is considered a transitional year of implementing the Conflict-Free Gold Standard, and previous years relied on different and inconsistent standards.

When establishing the short-term market value for a firm, this thesis only considers market capitalization. Investor perception is the primary driver of market capitalization but also depends on many variables, including financial performance, business risk, corporate management, an asset portfolio, production volumes, and operational characteristics. These factors are not included in the research and are considered constant for each firm over the relatively short time evaluated for each ESG announcement.

Various accounting metrics can measure the long-term market value of a firm. However, this thesis investigates return on assets, leverage, liquidity and credit rating as components of long-term market value. Capital structure is not considered in this research as an influence to the market value of a firm.

This thesis is limited to the analysis of public information and excludes any private information that may conflict with the data collected. This includes any private data collected from each firm that may alter the findings of this research. This thesis does not evaluate the different approaches gold mining firms use to communicate its ESG performance (websites, press releases, blogs, etc.) to determine which strategy provides the

largest financial impact.

Catastrophic ESG events, like failures of tailings storage facilities, that may have implications across the entire mining sector and are not limited to gold mining firms are not addressed or considered as part of this thesis. This research does not include the implementation of newly developed technologies, such as bioleaching or dry-stackings of tailings, as ESG initiatives investigated as part of this work.

1.5 Novelty of Research

In the past few decades, various researchers (Hamilton, 1995; Curran & Moran, 2007; Cheung, 2011; Ketola, 2022) have tried to address whether ESG increases a firm's market value. Researchers have investigated the valuation of sustainable projects based on regional (Capelle-Blancard & Petit, 2017; Ketola, 2022; Horvathova et al., 2012) or industry specifications (Xie et al., 2023; Surenjargal, 2022; Garcia et al., 2018). However, these conclusions are inconclusive as perceptions and expectations of the market vary by industry, location, and commodity. A general belief is that each industry has a measurable impact on the environment and society and that the market responds differently to ESG impacts based on a firm's or industry's past performance, market expectations for the future, and perceived criticality of the commodity.

This research addresses the ambiguity of results from past research by restricting the study group to six firms within the gold mining industry traded on the same stock exchange platform, the New York Stock Exchange (NYSE). By restricting the scope to firms within the gold industry, the thesis reduces the omitted variable bias that previous researchers have faced when incorporating multiple commodities and industries. By focusing on surface and underground hard rock gold miners, the research considers that each firm has access to similar technology, processing techniques, and a general supply chain structure that influence a mining company's ability to address ESG. The selected mining companies' global operations vary in location, influencing their approach and priorities for ESG initiatives. Although the NYSE does not require ESG reporting as a

listing rule, it does provide written guidance on ESG reporting, offer ESG-related training, and has a market is covered by a sustainability-related index (Sustainable Stock Exchanges Initiative, 2019). This research minimizes the potential for regional investor bias by assuming investors of the NYSE value sustainability in a similar manner.

Previous research (Robinson et al., 2011; Hawn et al., 2018) investigated market value changes based on joining, removal from, and continued ranking within sustainability indices, like the Dow Jones Sustainability World Index (DJSI). Robinson et al.'s (2011) results showed that shareholders respond more to negative ESG behaviors and have little-to-no response to positive ESG successes or continued strengths. Conversely, Hawn et al.'s (2018) found that the market moderately rewards firms for joining and continuing on the DJSI but experiences no penalty for removal. Studies using indices, such as the DJSI, rely on the valuation of sustainability metrics within the indices. These metrics are designed for all industries and do not specifically address or prioritize the crucial factors within the mining industry. Since sustainability indices collect undisclosed private data for ranking purposes and lack market response to changes in listings status, they cannot accurately reflect the market perception of a firm. This thesis differs from previous work, which relies on sustainability indices to measure market response by developing a database to measure ESG behavior specific for each firm. The work will investigate the relationship between each pillar of ESG to the firm's market value. By analyzing specific ESG behavior within a firm over time, this case-study style of research will be able to investigate the frequency of ESG topics publicized by each firm and how the market reacts to firm-specific ESG announcements.

Firms can report their ESG impact through press releases, independent third-party assessment reports, or annual publications such as sustainability reports or integrated financial statements. Additionally, under the Sarbanes-Oxley Act of 2002, the United States Federal Government (later adopted by the Canadian Government) mandates certain practices in financial record keeping and reporting for corporations that hold the corporate

leadership team criminally liable for the publication of fraudulent information (Sibold, 2009). Therefore, credible information collected from press releases, technical reports, and financial statements gathered from the U.S. Securities and Exchange Commission (sec.gov) or the Alberta Securities Commission (sedar.com), which complies with the Sarbanes-Oxley Act of 2002, are considered the most reliable sources of information. Thus, they are compiled for this thesis. Court-mandated investigation reports issued by third parties are also considered a credible source of information for this thesis. Credible public information influences market value, whereas private information, is not reflected in share price and, therefore, is not included in this research.

Finally, this thesis is unique from previous studies as it evaluates the ESG behavior of six firms within the gold mining industry of the U.S. and Canada instead of a broad study. This analysis of specific companies is helpful for firms to understand the influence of ESG initiatives on their market value and may be used to prioritize initiatives in the future.

1.6 Thesis Outline

Chapter one of this thesis will include the introduction, problem statement, research objectives, novelty of the research, and research limitations. The introduction provides a background of sustainable development goals relative to the mining industry. It also addresses the driving factor of ESG behavior: societies demand sustainable products, and investors seek sustainable companies to support them financially. The problem statement further details the change in society's demand for sustainability and how mining companies are adapting to address societal concerns for global well-being. The problem is quantifying the impact of ESG initiatives undertaken by firms and evaluating if the firm benefits from ESG through increased access to funding or improved market value. This thesis aims to develop a quantitative methodology for effectively evaluating the economic impact of implementing sustainable initiatives by publicly traded gold mining companies. The research objectives section of this thesis details the hypothesis and economic measures considered. By reviewing the extent of previous research on the topic of ESG correlation to

financial performance and identifying the gaps of analysis within the mining industry, the novelty of the research section addresses how this research differs from previous research. In particular, this thesis develops a new methodology for quantifying ESG instead of relying on an index's interpretation of a firm's ESG performance. This thesis utilizes a case study approach to evaluate six gold mining firms' ESG behavior instead of evaluating the entire mining industry or all industries within a given region. After identifying the unique qualities of this thesis, the research limitations are stated.

The second chapter of this thesis will address the methodology, data collection, and model verification. This research will use an event study to determine the short-term market reaction to ESG events and regression modeling techniques for long-term correlations to determine the correlation between ESG and financial performance. The methodology section will elaborate on the metrics used to determine correlation and discuss how the data is collected and authenticated. The model verification section will describe the techniques used to verify the model results and how conflicting data is addressed.

The third chapter of this research reviews existing literature on ESG's relationship to corporate financial performance (CFP) within the mining industry. This section provides a background of ESG metrics reviewed in the past and identifies the specific key indicators of ESG tracked in this research. The literature review will consider the results of correlation to CFP using indices reporting ESG ranking from previous researchers focused on the resource industries and will identify how this thesis differs in design. The literature review discusses the different modeling techniques, financial metrics, and regional results.

Chapter four of this thesis will discuss the results of the short-term event study. The analysis will include both positive and negative ESG events and the impact experienced by each firm. This chapter will discuss any difference in results based on firm size and other differentiable characteristics such as the timing of events.

The fifth chapter of this thesis will summarize the results of the long-term regression models evaluating the influence of each ESG pillar on financial performance using existing

ESG rating information from the Bloomberg ESG database and the new methodology for quantifying ESG. This chapter will discuss any improvements to the explanatory variables' significance in the correlation of a firm's financial performance and the new methodology presented. This section will also provide conclusions from comparing model results and discuss how the industry or financial sector may use the results to improve the measurement and prioritization of ESG initiatives.

Chapter six will describe the new methodology for quantifying ESG metrics and the process for assessing firms in this thesis. This chapter will briefly describe the difference between the new methodology to other existing ESG rating approaches and provide recommendations for improving ESG metrics specific to the mining industry. A technical discussion and implications of the research results will also be included in this chapter.

The conclusion will be in chapter seven of this thesis and will compare and contrast the research results relative to the thesis objectives. This chapter will also discuss this research's limitations, implications for the gold mining industry and investors, and recommendations for future research.

CHAPTER 2

RESEARCH METHODOLOGY

The second chapter of this thesis will address the methodology, data collection, and model verification. This research will use an event study to determine the short-term market reaction to ESG events and regression modeling techniques for long-term correlations to determine the correlation between ESG and financial performance. The methodology section will elaborate on the metrics used to determine correlation and discuss how the data is collected and authenticated. The model verification section will describe the techniques used to verify the model results and how conflicting data is addressed.

2.1 Event Study Analysis – Short-term Impact of ESG to Firm Market Value

This research will utilize an event study approach to investigate if ESG events influence a firm's short-term market capitalization. Event studies were first popularized in 1933 by James Dolley and have been widely used in the application of accounting and finance research (Miller, 2023). An event study focuses on the effect an event has on the price of a particular class of security or a firm's common equity. This technique allows researchers to analyze the financial impact of a specific event over a specified period – called an event window – based on the assumption of a rational market environment. Assessment of the event's impact requires the measurement of abnormal return versus a normal return. The normal return is defined as the expected return without conditioning on the event taking place. Furthermore, there are two types of modeling techniques commonly used to determine normal or expected returns: (1) the market model and (2) the constant mean return model. The constant mean return model assumes that the mean (average) return is constant through time. Conversely, the market model assumes a stable linear relation between the market return and the security or firm specific return (MacKinlay, 1997). For a market model, an estimation window needs to be defined using a period prior to the

event window. Generally, the event window itself is not included in the estimation period to prevent the event from influencing the normal performance model parameter estimates (MacKinlay, 1997). After calculating the abnormal returns, researchers designed the testing framework by developing a null hypothesis and determined the techniques for aggregating the individual firm abnormal returns. Ideally the empirical results will lead to insights relating to understanding the sources and causes of the effects (or lack of effects) of the event being studied.

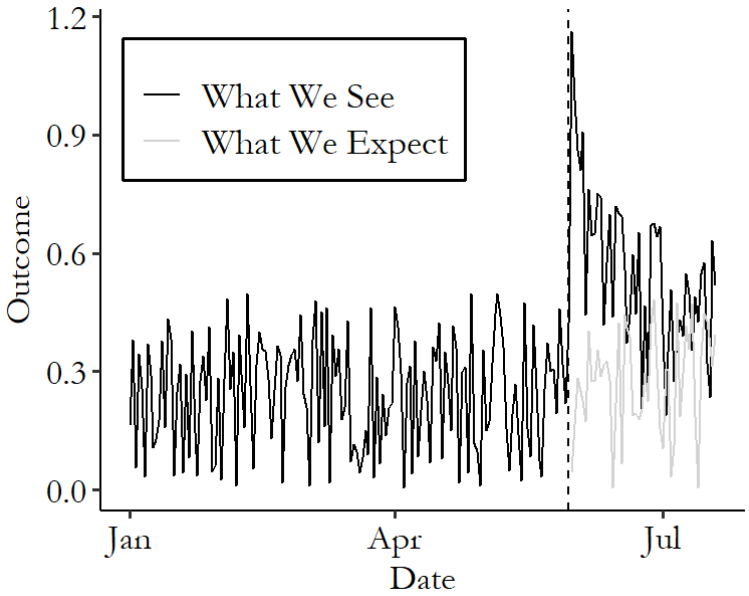

Figure 2.1 Example of Event Study - Expected and Actual Results (Huntington-Klein, 2023)

Figure 2.1 illustrates an ideal event study result in which the estimation model perfectly aligns with the pre-event window's actual results. Yet, divergence occurs after the event during the post-event window. The divergence shown in Figure 2.1 immediately following the event date (shown as the dotted vertical line) indicates to the researcher that the event caused an unexpected or abnormal return measured as the difference between "what we see" and "what we expect" (Huntington-Klein, 2023).

For this thesis, the selected events are the firm action and the announcement of planned action regarding the firm's ESG initiatives. An example of an ESG event is the hostile invasion of a mining operation by local communities demonstrating their opposition to the mining firm's activities, indicating a negative social interaction. A positive ESG event may be the announcement of planned actions to address decarbonization influencing the firm's environmental impact.

Announcement data for this study was gathered from StockWatch.com, a firm that tracks performance of company stocks, mutual funds, and indexes within the U.S. and Canada. Stock Watch also provides news articles, including internal announcements from each company and external news coverage that may impact share price. The headlines were categorized according to topics as impacting all pillars of ESG or comprehensive (C), environmental (E), social (S), or governance (G), as well as whether the event is an internal (I) or external (X) announcement creating a positive (P) or negative (N) image for the firm. Any announcement that relates to financial performance or an expansion of resources or reserves are excluded from the study as these announcements will directly influence a firms' stock price and make it impossible to determine if the change was due to financial or ESG performance. According to Morse (1981), financial announcements result in changes to trading volumes and stock prices for five days following an announcement and changes prior to the announcement indicates effects of anticipation or insider trading. To exclude any influence of financial performance announcements, only ESG announcements made outside a five-day window (before and after) a financial announcement were used in this study. For the six selected gold mining companies from 2014 to 2021, 2987 news articles were published, of which 170 (5.5 percent) related to ESG performance and were outside the window of influence of financial announcements. Of the selected announcements, thirty-eight (twenty-two percent) related to environmental, sixty-eight (forty percent) pertained to social factors, sixteen (nine percent) reflected changes to governance, and forty-eight (twenty-eight percent) contained comprehensive ESG information.

The event window is the time frame in which the event's impact is measured. The pre-event period is before the event occurs and illustrates the accuracy of the model in predicting abnormal returns. The event date is the date of the public release of information and the post-event window is a period of time following the event date evaluated to determine the impact of the announcement. This thesis investigates the impact of various event windows [t_1, t_2] for pre-and post-event including, five [-2, 2], seven [-3,3], and eleven-day [-5, 5].

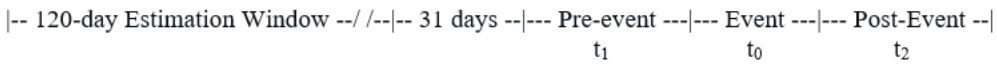

Figure 2.2 Estimation and Event Window Diagram

For this study, the market model was selected to derive the daily expected market return during the estimation period. The market model defines the expected return as a linear function relationship between market capitalization, typically measured as Tobin's Q or return on equity, to the return of the market index (Sayed & Eledum, 2021). The estimation period selected is [-151, -31] 120 trading days ending 31 days prior to the announcement to ensure that any information leakage or early disclosure does not influence the model results. According to market analysts, the average holding time for stocks in the U.S. is between ten months (Lu, 2021; Laidler, 2023) to five and half months as experienced during the COVID-19 pandemic (Chatterjee & Adinarayan, 2020). The purpose of an event study analysis is to determine if the announcement caused a change in the average investors perception of the company resulting in a change in the stock price. It is impossible to determine how long an average investor in a gold company will hold the stock as it depends on the investors appetite for risk, purpose, and expected outcome. For example, exchange-traded funds (ETFs) hold large volumes of the major gold mining producers' stocks, but balance the distribution between companies daily without necessarily being influenced by firm announcements.

The selected gold mining companies are all traded on the New York Stock Exchange (NYSE); for that reason, the NYSE index is used for the market model to estimate firm returns. Historical closing prices of the NYSE composite was gathered from Finance.Yahoo.com (ticker: NYA) from January 1, 2013 to December 31, 2021. In addition to modeling the expected return using the NYSE index value, this thesis modifies the market model to also include a linear relationship between firm stock price and gold price. Since the mining companies selected all produce gold as their primary commodity, there is an expected direct correlation between the gold price and company stock prices. Actual daily stock prices for each firm were gathered from Stockwatch.com and the percent change in closing stock price was calculated. This study utilizes percent change in price to simplify the process and, therefore, does not require prices to be in a set currency or adjusted for inflation over time. The same approach of converting from price to percent change in price is applied to the daily gold price and index closing values. The daily PM closing gold price was gathered from London Bullion Market Associate website (https://www.lbma.org.uk/prices-and-data/precious-metal-prices/). Since gold is traded on the London market, and holidays occur on different days than the U.S. market, any day that the U.S. market was open and London was not required an entry of zero percent change in gold price for that day.

Based on these assumptions of correlation between gold mining firm stock price with stock exchange index value and gold price, the stock price $R_{(f,t)}$ for gold mining firm f at time t is regressed against the two control variables as follows:

$$R_{(f,t)} = \alpha_f + \beta_f R_{(m,t)} + \delta_f A u_t + \varepsilon_{(f,t)} \tag{2.1}$$

where α_f, β_f, and δ_f are the regression equation parameters. The statistical error term, $\varepsilon_{f,t}$, is assumed to have a zero mean and constant variance.

Based on the parameter estimates of the market model of equation 2.1, one can measure and analyze the expected returns. The estimated return model is given as:

$$E(R_{(f,t)}) = \hat{\alpha}_f + \hat{\beta}_f R_{(m,t)} + \hat{\delta}_f \mathrm{Au}_t \tag{2.2}$$

where $\hat{\alpha}_f$, $\hat{\beta}_f$, and $\hat{\delta}_f$ are estimates of the true parameters obtained via an ordinary least squares regression.

Abnormal return (AR) is the difference between actual return $R_{(f,t)}$ and expected return ($\mathrm{E}(R_{(f,t)})$) in the absence of the event (Martinez, 2002). For this research, abnormal return $AR_{(f,t)}$ for firm f stock at time t is:

$$AR_{(f,t)} = R_{(f,t)} - E(R_{(f,t)}) \tag{2.3}$$

Where ($\mathrm{E}(R_{(f,t)})$) is the expected return if the event had not occurred.

Abnormal return for firm f stock at time t in equation 2.3 can be rewritten as:

$$AR_{(f,t)} = R_{(f,t)} - (\hat{\alpha}_f + \hat{\beta}_f R_{(m,t)} + \hat{\delta}_f \mathrm{Au}_t) \tag{2.4}$$

The concept of a cumulative abnormal return is necessary to accommodate the event window being analyzed. The sample cumulative abnormal return (CAR) within the event window (t_1, t_2), where $\mathrm{t}_1 < \mathrm{t}_0 < \mathrm{t}_2$ is the sum of the included abnormal returns,

$$CAR_{(f,(t_1,t_2))} = \sum_{t=t_1}^{t_2} AR_{(f,t)} \tag{2.5}$$

The average abnormal return for day t is computed as:

$$\overline{AR}_{(f,t)} = \frac{1}{n} \sum_{t=t_1}^{t_2} AR_{(f,t)} \tag{2.6}$$

where n is the event window length in trading days.

This thesis applies a parametric test of t-statistics to test the significance of abnormal returns. The distribution of any single abnormal return under the null hypothesis (H_0) is:

$$\mathrm{AR}_t \sim N(0, \sigma^2_{\varepsilon_t}) \tag{2.7}$$

Therefore, for an individual firm, whether abnormal return (AR) is different from zero can be tested by t-statistics as:

$$t_{\text{stat}} = \frac{\text{AR}_{(f,t)}}{\hat{\sigma}_{\varepsilon_t}} \tag{2.8}$$

where $\hat{\sigma}_{\varepsilon_t}$ is the estimation of the standard deviation of the abnormal returns in the estimation period. The distribution of the cumulative abnormal return under H_0 is:

$$\text{CAR}_{(f,(t_1,t_2))} \sim N(0, \sigma^2_{(f(t_1,t_2))}) \tag{2.9}$$

Therefore, the t-statistic can be written as

$$t_{\text{stat}} = \frac{\text{CAR}_{(f,t)}}{\sqrt{n} \times \hat{\sigma}_{\text{AR}_t}} \tag{2.10}$$

where $\sigma^2_{(f(t_1,t_2))} = n\sigma^2_{\text{AR}_t}$ and $\sigma^2_{\text{AR}_t}$ is the variance of the one-period mean abnormal return.

The results of the t-statistic test show if the ESG announcement event caused a statistically different change in firm stock price compared to the expected firm value. The null hypothesis is that the event causes no impact on firm stock behavior. A false null hypothesis suggests that the event had a significant impact on firm price resulting in an abnormal return. The cumulative abnormal return during the event window is the value of impact caused from the event. A positive cumulative abnormal return indicates that investors valued the event had reacted positively, which is reflected in the increase to stock price, while the opposite is true for a negative cumulative abnormal return.

The results will be analyzed for each firm to determine the cumulative benefit or loss the firm experienced from 2014 to 2021. This analysis allows one to discuss the influence ESG announcements have had on each individual firm and compare the results among firms. Cross comparing firms may lead to insights about the effectiveness of internal versus external publications or the number of publications provided by each firm. Finally, the results will be aggregated based on ESG category (E, S, G, or C announcement topic) to compare the impact by announcement topic. Analyzing the announcement topic will

provide insight into the priorities of the investors.

2.2 Linear Regression Modeling – ESG influence on Long-term Financial Performance

In addition to analyzing the short-term impact of ESG performance, this thesis also addresses the long-term impact of ESG on the firm's market value. Specifically, this study investigates the correlation between corporate financial performance and ESG Ratings as published by Bloomberg. Tobin's Q was selected as a measurement of corporate financial performance as it measures the firm's ability to expand its business and sustain its success in the long-term (Luo & Bhattacharaya, 2006). The long-term linear regression must be completed on an annual basis as the ratings and certain financial metrics are published annually. Similar to previous research efforts, this thesis will utilize Bloomberg's ESG ratings as a proxy to measure Corporate Social Responsibility (CSR) and analyze the impact of combined ESG ratings and individual pillar ratings. For example, Surendarjal (2019) investigated ESG ratings correlation to CSR for multiple industries for 2019. This thesis, however, restricts the scope to the gold mining sector and expands to cover multiple years, from 2014 to 2021 instead of a single year.

2.2.1 Hypothesis Development

The second main objective of this research is to understand the connection between corporate financial performance and ESG ratings within the gold mining industry from 2014 to 2021. The following hypotheses were formulated to address this objective.

H1: Higher Comprehensive ESG Score (C) results in greater firm financial performance, as measured by Tobin's Q for each gold mining company.

H2: Higher Environmental Score (E) results in greater firm financial performance, as measured by Tobin's Q for each gold mining company.

H3: Higher Governance Score (G) results in greater firm financial performance, as measured by Tobin's Q for each gold mining company.

2.2.2 Data Collection

Comprehensive ESG scores, governance scores, and environmental scores were downloaded from the Bloomberg Terminal for years 2015 to 2020. Information for individual firm Social Scores were not available through the Bloomberg Terminal and as such are excluded from this research. Bloomberg began publishing ESG Scores in December 2015; therefore, data collection was limited to 2015 and not prior. Scores for 2021 were also not available at the time of data collection for this study; thus, only scoring available up to December of 2020 was utilized. Not all firms were rated each year in each category; hence, only the information published was utilized in the regression analysis.

Financial data collected to calculate the financial metrics used in the regression modeling were sourced from each firm's annual financial statements (10-K) downloaded from Sec.gov. Information gathered included the number of outstanding common shares, net income, current assets, current liabilities, total liabilities, total assets, sales revenue, and long- and short-term debt. Each year was reviewed in depth to determine if unusual one-time events occurred that impacted the reported net income which would misrepresent the calculated return on assets for the given year. If the firm underwent a merger or acquisition and reported a loss or gain on sale, impairment, or adjustment to the fair value of assets, then the necessary adjustments were made to the net income. Stock prices for each firm as of December 31 for each year were collected from Yahoo Finance (finance.yahoo.com).

2.2.3 Data Collection Instrument

Bloomberg Intelligence collects data from each firm's annual reports, sustainability reports, corporate governance reports, and supplemental data, including the firm's website, to calculate comprehensive ESG scores ranging from 0.1 (lowest) to 100 (highest). Individual pillar scores for environmental and governance are calculated on a zero (lowest) to ten (highest) range. Based on the information collected, Bloomberg Intelligence

identifies and prioritizes the most material sustainability issues for the selected industry of interest. Table 2.1 provides a list of factors assessed by Bloomberg to determine ESG ratings for each pillar.

Table 2.1 List of factors that determine ESG Pillars for Bloomberg (Surendarjal, 2019)

Environmental (E)	**Social (S)**	**Governance (G)**
Air Quality	Community rights & relations	Remuneration
Climate exposure	Ethics & compliance	Independency
Ecological impact	Labor & employment practices	Audit
Energy management	Occupational health & safety management	Shareholder rights
Environmental supply chain management	Operational risk management	Diversity
GHG emissions management	Product quality management	Entrenchment
Sustainable product	Social supply chain management	Over boarding
Waste management		
Water management		

Source: Bloomberg Terminal, last accessed in September 2021

2.2.4 Variable Measurement

2.2.4.1 Dependent Variables: Corporate Financial Performance

Tobin's Q is used in this research as a determinant for the Corporate Financial Performance (CFP).

Tobin's Q measures the firm's ability to expand its business and sustain its success in the long-term (Luo & Bhattacharaya, 2006). It is calculated by dividing an asset's market value by its replacement value (Nasdaq, 2021). A calculated Tobin Q value greater than one indicates a good investment decision, while less than one warrants caution for investment.

In multiple studies, Tobin's Q has been used as the dependent variable (Surendarjal, 2019; Luo & Bhattacharya, 2006; Jo & Harjoto, 2011) for evaluating Corporate Financial

Performance (CFP) relative to CSR performance. Tobin's Q divides the asset market value by its replacement value (Nasdaq, 2021) to measure the firm's ability to expand its business and sustain long-term success (Luo & Bhattacharaya, 2006). Utilizing Tobin's Q for evaluating the sustainability of junior mining companies, for example, may be inappropriate as the market highly values speculation from exploration. The higher risk involved with an unknown deposit size and speculative asset value leads to the shareholder demand for a higher return. As the junior miner's operation enters the operational phase, the market speculation decreases, and the firm's stock price declines (Holmes, 2023). An increase in Tobin Q over time illustrates that investors' expectations for the firm's perceived value will rise with the improvement of CSR performance (So, 2021). However, Tobin's Q does not strictly measure CSR but also incorporates improvements for the firm regarding corporate reputation, advancing production, anticipation, or other influences from supporting industries. In an industry driven by speculation, such as investing in a junior mining company stock, Tobin's Q may capture the market's speculation on the expected growth of reserves before a mine begins operation instead of CSR performance. Large-scale mining companies are considered more stable, with fewer green field exploration projects driving investor growth speculation. As Tobin's Q cannot differentiate sources of speculation, this thesis cautiously assumes the speculation is due to CSR performance.

2.2.4.2 Independent Variables

Within this thesis, the independent variables are ESG ratings including the following: (1) Comprehensive ESG Score, (2) Environmental Score, and (3) Governance Disclosure Score collected from the Bloomberg Terminal database. Social pillar scores were not available through the Bloomberg Terminal Database at the time of data collection and as a result were omitted from this study.

2.2.4.3 Control Variables

Firm size, leverage ratio, return on assets, and liquidity ratio are the control variables to control features that might predict Tobin's Q (Surendarjal, 2019). Firm size is determined by taking the natural logarithm of sales revenue (Cho & Lee, 2020), which is an essential variable in CSR-CFP studies (Orlitzky et al., 2003). The larger the firm size, the higher is the potential for economies of scale (Wang & Qian, 2011). A higher leverage ratio indicates higher risk due to the high cost of capital, which can harm a firm's bottom line and is, hence, included as a control variable (Nirino et al., 2020).

Table 2.2 Variable Descriptions and Operations

Variable	**Variable Type**	**Measure**
Tobin's Q	Dependent	$\frac{\text{Total liabilities + (Number common shares outstanding x Stock price)}}{\text{Total Assets}}$
ESG Comprehensive Score	Independent	Bloomberg
Environmental Score	Independent	Bloomberg
Governance Score	Independent	Bloomberg
Return on Assets (ROA)	Control	$\frac{\text{Net Income}}{\text{Average Total Assets}}$
Firm Size	Control	ln(Sales Revenue)
Leverage	Control	$\frac{\text{Long-term debt + Short-term debt}}{\text{Total Assets}}$
Liquidity (Current Ratio)	Control	$\frac{\text{Current Assets}}{\text{Current Liabilities}}$

2.2.5 Regression Modeling

The following regression model is used to test the positive and significant correlation hypothesis of the comprehensive ESG score, E score, and G score with corporate financial performance, measured as Tobin's Q.

$$H1 : Q_{f,t+1} = \beta_0 + \beta_1 \times C_{f,t} + \beta_2 \times LE_{f,t} + \beta_3 \times Li_{f,t} + \beta_4 \times ROA_{f,t} + \varepsilon_{f,t+1} \qquad (2.11)$$

$$H2 : Q_{f,t+1} = \beta_0 + \beta_1 \times E_{f,t} + \beta_2 \times LE_{f,t} + \beta_3 \times Li_{f,t} + \beta_4 \times ROA_{f,t} + \varepsilon_{f,t+1} \qquad (2.12)$$

$$H3 : Q_{f,t+1} = \beta_0 + \beta_1 \times G_{f,t} + \beta_2 \times LE_{f,t} + \beta_3 \times Li_{f,t} + \beta_4 \times ROA_{f,t} + \varepsilon_{f,t+1} \quad (2.13)$$

where β_0 refers to the intercept constant; f refers to the firm; t refers to a year; Q refers to Tobin's Q; C, E, and G are the independent variables; LE refers to firm leverage; Li refers to firm liquidity; ROA refers to firm specific return on assets; and ϵ is the random error.

The results from this thesis's regression will establish a baseline of correlation between ESG and CFP when utilizing an independent ESG rating agency, Bloomberg. The results are hypothesized to be similar to Surendarjal's (2019) results for the precious metal mining sector which indicated a positive and significant relationship between ESG scores and firm financial performance. Surendarjal (2019) determined that ESG scores explained 2.1 percent of the firm's market performance measured by Tobin's Q.

2.3 New Methodology to Quantify ESG Metrics

Finally, this thesis will expand on previous studies (Heentigala et al., 2015; Caldeira & Pererira, 2022; Garefalakis & Dimitras, 2020) by evaluating the current procedures of ESG rating agencies and providing recommendations for improvements specifically for the mining industry. The current inherently qualitative approach ESG raters use allows the agent to assign weightings to the metrics according to their perception of the industry, firm, and potential risk, leading to biased, inconsistent ratings that cannot be externally replicated (Berg et al., 2022). Significant inherent risks within the mining industry are related to environmental and social impacts. This thesis identifies these mining-specific risks and provides quantifiable metrics for an ESG rating procedure.

2.4 Validation of Results

Information collected for this research relies on the credibility of publications based on the liability of corporate executives under the Sarbanes Oxley Act of 2002, which governs

the accuracy of reports and documents published by firms. The U.S. SEC Guide 7 and Canada's National Instrument 43-101 govern any disclosures concerning resource and reserve estimates holding mining firms and responsible parties liable for the information. However, there are no legal regulations pertaining to the liability of individuals or companies for information published in sustainability reports, as these reports are not considered to influence investment decisions. Other sources of information for this thesis may include press releases with direct statements from the selected firm and any published reports from court-mandated, third-party investigations. Data collected from other sources might conflict with government filings or corporate statements. In that case, the qualified statement from the corporation will be considered truthful, given the legal liability for corporate management. The priority of data collected is (1) financial statements, (2) sustainability reports, (3) court litigation records, and (4) press releases.

When analyzing firms' financial data, unique circumstances surrounding the dates of ESG announcements, such as announcements of acquisitions or significant changes to corporate structure or production expectations, may influence the legitimacy of the data. During the COVID-19 pandemic, the US stock market experienced the greatest volatility, particularly at the onset of the pandemic, compared to any other global pandemic in history (Baker et al., 2020; Kusumahadi & Permana, 2021). Consequently, announcements made during the onset of the COVID 19 Pandemic (March and April, 2020) are excluded from this study as the market volatility was not representative of normal market conditions. Outlier data associated with such announcements will be excluded from the model if the market value of the firm changes by more than one standard deviation from the normal daily variance on the trading day following the announcement.

Results of regression modeling are verified through the application of a t-test. The t-test is used for hypothesis testing in statistics and uses the t-statistic, the t-distribution values, and the degrees of freedom to determine statistical significance. The t-test value indicates whether the null hypothesis of correlation can be accepted (smaller value) or

rejected (larger value). To ensure that the results do not provide Type 1 errors, which occurs when the null hypothesis is falsely rejected (Kothari & Warner, 2007), due to correlation via an unobserved common factor (multicollinearity), this thesis will include complete correlation tables with dependent variables, interaction terms, and quadratic terms. This dissertation will detect and mitigate common-factor multicollinearity concerns by (a) providing full bivariate correlation tables and (b) provide separate specifications that include each collinear variable alone followed by a specification with both in accordance with recommendations from Arturs Kalnins (2018).

CHAPTER 3

LITERATURE REVIEW AND DISCUSSION

As corporate social responsibility (CSR) grew in popularity, researchers began to investigate the ability of CSR to create value for a firm. In 2009, Bonini et al. conducted a case study by interviewing 238 chief financial officers, investment professionals, and finance executives from various industries to understand the relationship between ESG and value creation. Researchers also surveyed 127 CSR professionals and self-proclaimed socially responsible institutional investors. The case study indicated that companies participating in ESG could create value by enhancing the reputation of companies, supporting growth, improving returns on capital, reducing risk, or improving management quality (Bonini et al., 2009).

Table 3.1 Value Creation of Environmental, Social, and Governance (Bonini et al., 2009)

Growth	**Risk Management**	**Management Quality**	**Returns on Capital**
New Markets	Regulatory Compliance	Leadership Development	Operational Efficiency
New Products	Public Support	Adaptability & Resiliency	Workforce Efficiency
New Customers	Sustainable Supply Chains	Long-term Strategic View	
Market Share			
Innovation			

Bonini et al.'s (2009) research indicated that investors and firms believe there are indirect, long-term reputation, and monetary benefits in pursuing ESG programs. However, a questionnaire or survey merely provides an opinion. Bonini et al.'s (2009) research does not mathematically quantify the correlation between firm value and ESG performance.

Throughout the literature, there has been an inability to identify the driving mechanism(s) for the relationship between ESG or CSR and a firm's financial performance.

Various studies have attempted to evaluate the correlation between firm value and inclusion on a sustainability index (Hawn et al., 2018; Cheung, 2011; Doh et al., 2010) or focused on entire markets within a specific region (Lackmann et al., 2012; Cheung & Roca, 2013; Clacher & Hagendorff, 2012, Ramchander et al., 2012). However, the results are controversial and inconclusive. Very few studies have focused explicitly on the extractive industry or a mineral commodity. This research aims to fill the gap in the existing literature to address the impact of ESG, specifically within the gold mining industry of North America. In three distinct sections, this research provides analysis for the following: (1) ESG announcements' short-term impact on firm stock price, (2) the long-term influence of ESG ratings on firm market value, and (3) the process ESG raters use to derive an ESG rating and how the process can be improved for the mining industry.

3.1 Short-term Financial Impact of ESG Using Event-Study Methodology

One expects that under normal market conditions, announcements by firms that are pertinent to an investor's portfolio management criteria would result in a short-term change in share price for the announcing firm. Researchers may use an event study to identify specific events that result in a change to share price. For example, Capelle-Blancard and Petit (2017), Krueger (2015), and Ketola (2022) have studied stock market reactions to ESG events using an event study approach and found that the market reacts adversely to negative ESG news. Nonetheless, the market is relatively unresponsive to positive ESG news. Other researchers (Cheung, 2011; Curran & Moran, 2007; Hamilton, 1995, Garcia-Castro et al., 2010) have used the event study approach to evaluate the impact of similar ESG related news across multiple industries to determine the impact to firms' financials. Conversely, this research adds to the discussion of market response to ESG events by investigating a time period post the great recession, from 2014 to 2021, and focusing on the gold mining industry based in the U.S. and Canada.

Moreover, Capelle-Blancard and Petit (2017) tested their hypothesis that ESG related news has significant effect on a firm's market value. The researchers collected over 33,000

ESG news events from Covalence EthicalQuote for 100 firms belonging to the Dow Jones Sector Titans Index dating from 2002 to 2010. Evaluating three- and ten-day event windows, Capelle-Blancard and Petit (2017) determined the firm share price decreases by 0.085 and 0.139 percent, respectively, at a one-percent confidence interval in response to negative ESG publications. The average impact to the firm was a loss of $0.25 per share for a three-day event window and a loss of $0.37 per share in a ten-day window. However, the market showed no statistically significant response to positive ESG news. The researchers further investigated the influence past disclosures has on the market reaction to negative ESG events and found that the more positive past media coverage, the lower the resulting loss. Similar to Capelle-Blancard and Petit (2017), this thesis analyzes positive and negative ESG events from news publications, press releases, or other sources to determine the difference in market reaction based on the context of the event. However, this thesis narrows the scope of the analysis to the gold mining sector using a more case study approach than a general market evaluation.

Krueger (2015) takes a different approach than Capelle-Blancard and Petit (2017) by evaluating ESG event data from KLD (now part of the MSCI rating firm) who categorizes the event and ranks it as positive or negative. KLD analyzes the event and provides a binary indicator to quantify the effect the firm has on their main stakeholders. The selected ESG events were then matched to daily stock prices, returns with the value-weighted market index (from the Center for Research in Security Prices), balance sheet, and income statement items. Krueger (2015) sampled 2,116 events concerning 745 firms from 2001 to 2007. He constructs the event study by estimating market model parameters using an estimation period of 250 trading days ending fifty days before the event date. He analyzed the statistical significance of the cumulative abnormal return (CAR) of the eleven-day [-5,5] and twenty-one-day [-10,10] event windows. Krueger (2015) found that shareholders respond negatively to adverse ESG events within the eleven-day and twenty-one-day event windows. Issues relating to negative community impacts

demonstrated a loss of 214 basis points, while adversarial environment issues generated a loss of 154 basis points on average within the eleven-day event window. Krueger (2015) noted that the only positive ESG events relating to environmental and community issues displayed significant results that were unfavorable reactions within the twenty-one-day event window. The researcher speculates that "shareholders perceive news about initiatives that increase community welfare as negative cash-flow shocks, which lead to a decline in stock prices in the short-run" (Krueger, 2015). The negative correlation between positive environmental initiatives and firm stock price suggests that shareholders do not reward investments for improving the firm's environmental footprint. Again, Krueger (2015) speculates that the short-term negative correlation is related to the substantial cash costs required for environmental improvement. Importantly, Kruger (2015) explains, "If the majority of shareholders are short-term oriented, such long-term oriented investments in environmental responsibility would not be sufficiently rewarded, and stock prices should decline on average" (p. 314). Krueger (2015) determined that shareholders respond negatively to negative ESG news, reducing the share price by approximately 111 basis points for the median twenty-one-day cumulative abnormal return. Krueger (2015) also determines that shareholders are relatively non-responsive to positive ESG news and even respond negatively to initiatives that draw down the cash position of a firm. This thesis varies from Krueger (2015) by using a shorter estimation period of 120 days when modeling the market response. Sensitivity analysis showed the most robust prediction of market return when using 120 days, and more extended estimation periods were less predictive as the gold market is highly volatile. Furthermore, this study expands upon Krueger's (2015) sensitivity analysis of various event windows by investigating shorter ones. Krueger (2015) considered a wider range of companies and industries, but because of the large sample size, he does not remove events that coincide with financial statement announcements. This work focuses specifically on events related to the gold mining industry which allows for a more granular analysis of the event topic and resulting impacts while being able to exclude

data that coincides with financial or reserves statements would skew the results.

In a more recent study published in 2022 by Noora Ketola, an event study approach was used to investigate the market reaction to ESG announcements from various news publications within the Nordic Region (Denmark, Norway, Iceland, Finland, and Sweden). Ketola (2022) explicitly considers 40 companies generating 16,765 events of ESG announcements from 2013 to 2020. The researcher reviewed ESG news announced by the media to determine if the news article is potentially positive or negative. The majority of the news is positive (87.28%). Ketola (2022) also segregates the data based on E, S, and G pillars; 45.14 percent of the news relates to governance, 37.15 percent relates to the environment, and only 17.72 percent relates to social. Ketola (2022) modifies the constant average return predictive model by using the total return index, which captures both the capital gains and the income generated from cash payments. The researchers' predictive return model uses an estimation window of 120 days [-130, -11] and a three-day and eleven-day event window for analysis. To reduce the effect of skewness in the return distribution, the researcher converts the daily returns to logarithmic returns. Ketola (2022) determines positive ESG news does not significantly impact firm value. However, negative ESG news typically results in a firm's market value decline by -0.227 percent in a three-day event window (Ketola, 2022). Negative ESG news related to social impacts was most significant at the five percent confidence level reducing firm market value by 0.518 percent on a cumulative average abnormal return in an eleven-day event window. Ketola (2022) found no significance in positive or negative governance announcements. Negative environmental-related announcements caused a market response of -0.342 percent in cumulative average abnormal returns in the three-day event window. Ketola's (2022) analysis supports the view that "investors appear to penalize firms more for their irresponsibility than to reward their positive behavior" (p. 43). This thesis continues to analyze ESG news influence on firms' short-term financial performance in recent years, but changes the scope of Ketola's study from a specific region to a specific industry.

Other studies have addressed a specific ESG topic, like carbon neutrality, which is universal to all industries, including mining. In 2023, Xinyi Xie, Jianan Lu, Mao Li, and Jiang Dai evaluated the market reaction to firm announcements related to carbon neutrality which relates to the environmental pillar of ESG. They found that firms experience a short-run decrease in stock returns that could be mitigated in the long run if managers enhance carbon disclosure. Xie et al.'s (2023) study investigated various lengths of event windows ranging from 6-day [-3, +3] to 26-day [-13, +13]. Xie et al. (2023) elected to use an estimation period of 125 trading days cover stock performance for half a year prior to the announcement of carbon neutrality. The researchers stopped the estimation window thirty-one days before the announcement [-155, -31] to ensure that any information leakage or early disclosure from outside the firm would not impact the study results. The dependent variable is the cumulative abnormal return around the event date calculated by the market model. Their study's empirical evidence from the event study implies that the carbon neutrality commitment harms market value, and cumulative average abnormal returns of the whole sample range from a loss of -2.09 to -1.21 percent (Xie et al., 2023). The market reaction varied by country (the United Kingdom or the United States) but also by expected goal dates, where firms targeting net zero sooner than 2050 experienced less of an impact though still negative and statistically significant. The firms targeting sooner carbon neutrality tend to have better environmental foundations, which decreases the initial mitigation costs. Xie et al. (2023) results of the significant adverse market reaction are consistent with the trade-off theory (Friedman, 1970) that engaging in environmental practices would increase costs to business operations, and improving environmental concerns conflicts with the organizational goal to maximize shareholder's profits, therefore triggering a loss in firms' market value (Aupperle et al., 1985; Gray & Shadbegian, 1995).

The researchers also investigated the influence of previous ESG performance on reducing the negative impact of cumulative abnormal returns following the carbon neutrality commitment. The regression model set the independent variables as ESG

combined score (sourced from Refinitiv), firm size, leverage, revenue, price-to-book ratio, total asset growth, and return on assets. Carbon disclosure was treated as a dummy variable, where no disclosure is zero and one otherwise. The dependent variable was the cumulative abnormal return in the six-day [-3, +3] and fourteen-day [-7, +7] event windows, as these windows were statistically significant in the event study. The regression modeling study found that a single-point increase in the firm's ESG combined score predicts a 0.1 percent increase in cumulative abnormal returns (Xie et al., 2023). Although historical ESG performance does not eliminate the negative impact of carbon neutrality commitments, improving market reaction does add value to the firm in the long term, even if indirectly. This thesis utilizes the same event study concept as Xie et al. (2023); however, instead of analyzing multiple firm reactions to the same announcement topic, this research considers multiple ESG-related events within a few selected gold mining firms.

This thesis intends to expand on the previous work by analyzing the short-term market reaction to ESG announcements using an event study methodology, specifically within the gold mining industry of the U.S. and Canada.

In summary, the previous researchers have focused on determining if ESG announcements generate a positive or negative market response by using an event study approach to evaluate market reactions in the short term. They have shown that the market punishes firms for adverse ESG-related events and either shows no response or weakly negative responses for positive ESG behaviors. This thesis also applies the event study methodology to address the market reaction to ESG announcements. Specifically, it focuses on gold mining companies in the U.S. and Canada, as this has yet to be previously studied. In addition to varying from other studies by narrowing the industry and regions assessed, this study evaluates the impact over multiple event windows to determine if market reaction varies over time.

Table 3.2 Previous Event-Study Assessments of ESG Relationship to CFP

Authors	**Time Period & Region Assessed**	**Conclusions**
Kruegger (2015)	U.S. KLD rated firms (2001-2007)	Kruegger investigates how the stock market reacts to positive and negative CSR events. He found that investors adversely respond to negative ESG events, and more so when the event is related to community and environmental issues. The researcher also found investors weakly negatively respond to positive events and speculates that shareholders perceive ESG initiatives as costly expenditures, which leads to a decline in stock prices in the short-run.
Capelle-Blancard & Petit (2017)	Dow Jones Sector Titans Index (2002-2010)	This study assessed the stock market's reaction to ESG news. Researchers found that firms facing negative ESG news on average lose 0.1% of their market value. However, the market showed no significant response to positive ESG news.
Ketola (2022)	Nordic Region (2013-2020)	This study examined the effect of ESG news published by the media on a company's value in the Nordic market. Ketola found an asymmetric response from shareholders to ESG related news. The research found that shareholders actively punish firms for irresponsible environmental and social behaviors, but do not reward responsible behaviors.
Xie et al. (2023)	USA and United Kingdom (2017-July 2021)	Investigated market reaction to firm's carbon neutrality commitments which relates to environmental performance. The researchers found that the carbon neutrality commitment harms market value, ranging in impact from a loss in returns between -2.09 and -1.21 percent. Overall, the results indicate that engaging in environmental practices increase costs to business operations, and improving environmental concerns conflicts with the organizational goal to maximize shareholder's profits, therefore triggering a loss in firms' market value.

3.2 Long-term Financial Correlation to ESG Performance

Analyzing the long-term impact of ESG performance requires a different approach than assessing the short-term market reactions to ESG announcements. Typically, regression models are used to determine the inter-dependency or the correlation of various variables on a specific value. The difficulty in determining the correlation of ESG performance to a firm's financial performance is selecting the optimal measurement of ESG performance. Environmental and social impacts are qualitative assessments and are difficult to measure consistently. One of the biggest challenges for researchers is selecting the appropriate key performance indicators to measure ESG performance in a meaningful way. Dow Jones Sustainability World Index (DJSI), KLD-Nasdaq Social Index, FTSE4Good Index, and Global Reporting Initiative (GRI) have proposed various indicators to measure ESG performance and reporting criteria. Although these companies may have an inherent bias in their analysis of firms as evaluated firms must pay for the service, many researchers have turned to these measures to determine if a correlation exists between ESG and firm value.

Hawn et al. (2018) modeled the market reaction to announcements of addition, deletion, or sustained performance on the DJSI using the regression modeling technique. The authors state that to use the DJSI, the announcements must originate from outside the firm, have a third-party audit of ESG performance, and the engagement must make the firm a leader within its industry. Hawn et al. (2018) found that firms are moderately rewarded through their profitability measures for continuing on the index but are not penalized for deletion from the index. The research also discovered a time-series trend indicating that the market is increasing attention to ESG activities. These researchers also conclude that there is evidence for geographic convergence. Some countries are rewarded less for participation in the indices as CSR becomes the "norm" and a general market expectation for that specific time and space (Hawn et al., 2018). Hawn et al.'s (2018) research does indicate that investors value positive ESG performance. However, since the DJSI completes annual evaluations of firms, other market considerations may have been

omitted from the study, such as production performance or general market conditions that also impacted firm value. Relying on an index as a measure of ESG performance forces the researcher to depend solely on the firm's evaluation by the indices, which introduces biases to the ranking of key performance measures based on the analyst's opinion and not necessarily industry-specific priorities.

Other studies (Liu et al., 2021; Aouadi & Marsat, 2016; Seraphine & Rokhim, 2021) have investigated the relationship between environmental performance and firm value, as opposed to the broader scope of ESG. Porter (1991) stipulates that "better environmental performance may be beneficial for firms since pollution is a sign of economic inefficiency" (Horvathova et al., 2012, p. 91). In 2012, Horvathova et al. (2012) used firm-level data from the Czech Republic to investigate the validity of Porter's (1991) claim, especially in the long-term. The study examined the inter-temporal effect of environmental performance (EP) on financial performance by measuring the level of air, water, land, and transfer of waste pollution as reported in the European Pollutant Release and Transfer Register data. The weight of the input (pollution) variables was assigned based on the hazard potential of pollutants which normalizes the emissions data. The financial metrics utilized in Horvathova's study include return on assets (ROA), return on equity (ROE), debt to sales, assets (to indicate the size of the firm), and profit in the current accounting period. Horvathova et al. (2012) concluded that "increased emissions deplete company profitability in the 2-year lag period but improve in the 1-year lag period" (p. 96). The researchers confirmed the Porter Hypothesis that a firm does receive financial benefit for decreased emissions in the long run and suggest that the negative impact on short-term profitability may be due to the cost of implementation to decrease emissions. Horvathova et al. (2012) intended to determine the cause-effect relationship between EP and financial performance for selected Czech firms over time. Like Horvathova et al.'s (2012) work, this thesis will utilize the same econometric modeling technique to determine the long-term influence of ESG on the firm's financial performance. However, it will also investigate the relationship

and influence of social impacts and the importance of governance for selected gold mining companies with global operations. Unlike Horvathova et al.'s (2012) research, which utilized publicized emissions levels to indicate a firm's environmental performance, this thesis will use ESG ratings to indicate ESG performance as the emissions reporting is not standardized or required for the North American-based companies selected for this research.

Surenjargal (2022) expanded on Horvathova et al.'s work by considering the impact of water management under a firm's environmental performance as it relates to a firm's market value. Since water management is critical topic for mining companies, then understanding if the market responds to a particular ESG scoring metric may influence the measurements used in this thesis. Surenjargal (2022) analyzed the influence of ESG on corporate financial performance for 269 publicly listed firms in the extractive industry whose ESG scores are available through Bloomberg for the year 2018. Surenjargal (2022) expanded on previous research by including the water score from Bloomberg as an additional measure for ESG performance. The researcher measured CFP through Tobin's Q and ROE compared to ESG and water score data by applying hierarchical multiple regression and partial correlation. Like this thesis, Surenjargal (2022) evaluated the three pillars of ESG separately to determine the individual level of influence. The previous study segregated the extractive industry into oil and gas, coal, base metals, precious metals, and marketing and refining sectors. Researchers quantified the water score by measuring the percentage of water recycled per total water used, freshwater usage, water policy, total water consumption, and water stress exposure (Surenjargal, 2022). Surenjargal's (2022) study supported the hypothesis that higher environmental, social, governance, and water scores indicate higher firm value as measured by Tobin's Q analysis when ESG data lags by one year. However, only a firm's environmental and water scores influence return on equity, not social or internal governance scores (Surenjargal, 2022). Surenjargal's (2022) research is fundamental to mining companies as they have a significant impact on water and the environment, and according to Surenjargal, they should experience higher market value for

improved performance over time. Nevertheless, this thesis exclusively considers gold mining companies in the U.S. and Canada as the investors in these countries have expressed concerns about environmental impact. If Surenjargal's (2022) conclusions are correct, the results of this thesis should further support the conclusion by demonstrating investors' value for environmental performance.

Few studies have investigated the relationship between ESG and firm value, specifically within the mining industry. Alexandre Garcia et al. (2018) and fellow researchers investigated the relationship between firm value, corporate sustainability, and ESG performance for 365 companies in Brazil, China, India, China, and South Africa (BRICS), which included a comparison of sensitive industries like mining. Researchers segregated the selected companies into sensitive industries (such as mining, oil, gas, chemicals, steelmaking, paper, and pulp) and non-sensitive (like finance, technology, and manufacturing). Researchers collected ESG performance data from Thompson Reuters Eikon and equally weighted it into seventy key performance indicators under eighteen categories within environmental, social, and internal governance pillars (Garcia et al., 2018). Garcia et al. (2018) included firm-specific financial data, specifically financial leverage, free cash flow, market capitalization, and return on assets. Garcia et al. (2018) utilized panel data (static and unbalanced) in a linear regression using pooled ordinary least-squared modeling techniques with random and fixed effects to determine the correlation between the selected financial metrics and ESG performance. The researchers concluded that the profitability of the firm's assets (ROA) is associated only with environmental performance, and the best ESG-performance companies tend to be less profitable. Unfortunately, of the companies included in Garcia et al.'s (2018) study, only nineteen percent were from the mining industry. A low percentage of extractive-based industry firms in the research likely skews the results for the mining industry, notably when including chemical plants and oil and gas companies. Like Garcia et al.'s (2018) study, this research will utilize market capitalization, free cash flow, and return on assets to measure a

firm's financial performance. However, this work will also include changes in the LBMA PM fixed spot gold price as a control variable adjusting for changes in the industry specifically and changes in the exchange value as a proxy for macroeconomic impacts on firm value.

The costs accrued by a firm for reducing pollution or engaging with communities do not necessarily benefit a firm's profitability, as these costs are not always associated with increased production. A recent study by Giovany Kurnia Widyawan (2021) investigated the costs and benefits of managing waste and preventing environmental pollution for mining companies in Indonesia. Kurnia Widyawan (2021) tested several hypotheses, including environmental costs having a positive effect on firm value, previous environmental disclosure having a positive effect on the firm's current value, and investigated if the independent commissioners and audit committees moderate the effects of environmental costs on firm value. The researcher gathered secondary data from financial, annual, and company sustainability reports from 2017 to 2020 for mining firms listed on the Indonesia Stock Exchange (ISX). The data included environmental costs, company environmental information, the proportion of independent commissioners, the number of audit committees, firm value, firm leverage, and firm size. Kurnia Widyawan (2021) utilizes a pooled least squared, fixed effect, and random effect regression model technique to test their hypotheses and concludes that a company's environmental costs can improve its economic and environmental performance. However, environmental information is insufficient to raise the company's worth (Kurnia Widyawan, 2021). Only thirteen out of fifty-four (twenty-four percent) registered publicly traded mining companies on the ISX publish sustainability reports, and these few sustainability reporting firms did not experience an increase in stock price. The mining industry in Indonesia is largely comprised of small-scale miners or junior mining companies with smaller capital budgets which leads to different motivations than the large-scale miners in the U.S. and Canada. Like the NYSE and TSX, the ISX does not require sustainability reports as a part of its disclosure requirements. However, over ninety percent of firms traded on the NYSE publish

a sustainability report indicating better disclosure and potentially higher pressure from investors in the U.S. and Canada on firms to participate in ESG than in Indonesia (Governance & Accountability Institute, 2021). Considering the higher percentage of firms in the U.S. and Canada publishing an annual sustainability report, it is likely that the market expects these publications (Hawn et al., 2018) and does not reward firms as seen in the Indonesian market.

A critical difference between this thesis and previous research for the mining industry is the inclusion of credit rating as a measure of long-term market value impacted by a firm's ESG initiatives. Credit ratings measure a firm's financial obligations and the likelihood of default. Credit ratings can also influence CEOs as a monitoring function (Kung & Liu, 2007). The constant monitoring by rating agencies tends to influence management to act in the interests of shareholders to maximize goodwill and, therefore, can perform the function of corporate governance. Patrycja Chodnicka-Jaworska (2021) hypothesized that "higher ESG performance causes a higher level of credit rating, and companies can enjoy beneficial conditions in terms of the cost of debt" and investigated this hypothesis for European companies from 2010 to 2020 (p. 4). Chodnicka-Jaworska (2021) collected quarterly credit ratings from Fitch and Moody as the dependent variable compared to ESG measures. ESG measures included Refinitiv ESG scores based on self-reported information, environmental pillar score, social pillar score, corporate governance score, and ESG controversies score (Chodnicka-Jaworska, 2021). The ESG controversies score measures a company's exposure to environmental, social, and governance controversies and the adverse events reflected in global media.

Researchers also included financial factors such as profitability, earnings power, liquidity, leverage, and operating ratios. Chodnicka-Jaworska's (2021) study used panel event models, which is an extension of "difference-in-difference" designs that allows for estimating dynamic leads and lags to the event of interest while controlling for fixed factors, such as area and time (Clarke & Tapia-Schythe, 2022). The panel event study was

used to verify the researcher's hypothesis and confirms the significant impact of ESG factors on credit ratings, but they vary in magnitude between rating agencies. Fitch credit ratings are more sensitive to ESG measures than Moody's, and the most critical factor for both ratings is environmental (Chodnicka-Jaworska, 2021). Chodnicka-Jaworska (2021) determined that the energy, industrial, basic materials (including mining), and utility sectors are the most sensitive to ESG scores. The previous research also found that the valuation of company notes is sensitive to adverse events connected to ESG pillars. Chodnicka-Jaworska (2021) grouped mining with chemical companies, forestry, construction materials, and paper products which do not represent the same ESG responsibility or scrutiny as the mining industry. This thesis will expand on Chodnicka-Jaworska's (2021) studies by investigating the impact of ESG and credit ratings for the selected six gold mining companies on each firm's financial performance.

Table 3.3 Previous Studies of Long-term ESG correlation to CFP

Authors	**Time Period & Region Assessed**	**Conclusions**
Horvathova et al. (2012)	Czech Republic (2004-2008)	This study investigated the intertemporal relationship between a firm's environmental performance and financial performance. The researchers confirmed that a firm does receive financial benefit for decreased emissions in the long run and suggest that the negative impact on short-term profitability may be due to the cost of implementation to decrease emissions.
Hawn et al. (2018)	27 Countries (1999-2015)	Researchers evaluated market reactions to a firm announcing addition to, deletion from, or continued participation on the DJSI World. They found that firms are moderately rewarded through their profitability measures for continuing on the index but are not penalized for deletion from the index. Some countries are rewarded less for participation in the indices as CSR becomes the "norm" and a general market expectation for that specific time and space.

Table 3.3 Continued.

Authors	**Time Period & Region Assessed**	**Conclusions**
Garcia et al. (2018)	BRICS (2010-2012)	Researchers investigated the relationship between Thompson Reuters Eikon ESG ratings and firm size measured by market capitalization. The researchers concluded that the profitability of the firm's assets (ROA) is associated only with environmental performance, and the best ESG-performance companies tend to be less profitable.
Chodnicka-Jaworska (2021)	Europe (1990-2020)	Evaluated Refinitiv ESG scores influence on Fitch and Moody Credit ratings - determined that environmental ratings are the most important for sensitive industries (including mining) and the valuation of company financing notes are sensitive to adverse events connected to ESG pillars.
Kurnia Widyawan (2021)	Indonesia (2017-2020)	Environmental expenditures have a positive effect on firm value, but environmental disclosure has no effect on firm value specifically for Indonesian mining firms.
Surenjargal (2022)	Extractive Industry Firms listed on Bloomberg (2018)	Researcher investigated the influence of Bloomberg ESG Ratings and water score to a firm's financial performance. The study supported the hypothesis that higher ESG and water scores indicate higher firm value as measured by Tobin's Q analysis when ESG data lags by one year. However, only a firm's environmental and water scores influence return on equity, not social or internal governance scores.

Researchers typically use a regression modeling technique to evaluate the long-term relationship between a company's environmental or ESG and financial performances. Some researchers used ESG rating scores, inclusion on an index, or emissions data to measure environmental performance. Regardless of the metric used to measure ESG performance, the conclusions vary between researchers. Most found that firms with better environmental performance had lower financial performance than their competitors. Others found that the benefit of improved financial performance occurred when the environmental performance lagged by at least one year. Notably, the researchers investigated different

regions and periods, which may have contributed to the variations in results. Some regions previously investigated have significant influence from the government, such as Indonesia, the Czech Republic, and some of the BRICS countries, which restricts the market from acting as a free market like it would in the U.S. and Canada. When the government participates in the market by owning businesses and regulating environmental performance and disclosures, the market is less likely to demonstrate an accurate representation of the typical non-government investor.

This thesis uses Bloomberg ESG Ratings as the proxy to measure ESG performance to investigate the long-term relationship of ESG and financial performance within the free markets of the U.S. and Canada from 2015 to 2020 for the gold mining industry. This thesis contributes to the conversation by explicitly considering the reaction of a free market where the mining industry is well-regulated, and companies voluntarily disclose information relating to environmental performance for raters to evaluate.

3.3 ESG Rating Process and Improvement

In addition to addressing the impact of ESG on a firm's short- and long-term financial performance, this thesis also investigates the process for ESG ratings to determine opportunities for improvement, specifically for mining companies.

Heenetigala et al. (2015) from Victoria University investigated the publication and use of ESG measures by mining companies in Australia to determine if companies reported the same non-financial information allowing for a comparison of firms. Their research collected data from thirty mining companies' 2013 annual sustainability reports and compared information disclosure and how it was measured. The study by Heenetigala et al. (2015) showed that the industry needs uniform measures to report ESG indicators and the current structure encourages the inconsistent use of available indicators. Key Performance Indicators (KPIs) reported by firms in 2013 for environmental measures emphasized renewable energy, water usage, greenhouse gas (GHG) emissions, ozone-depleting substances, hazardous waste production, and biodiversity. This research will expand on

this list to include air emissions measured in kilo-tonnes of pollutants, waste generation, and land disturbance, pending the availability of information by the selected firms. Social KPIs addressed in 2013 included the number of employees, percent of females, percentage of employees hired from local communities, percent of indigenous peoples employed, employee turnover rate, community engagement, and health and safety metrics like fatalities, lost time injury rate, and hours of training provided for human rights. This thesis aims to highlight local community engagement by measuring the number of service hours, local project sponsorship, and the number of scholarships provided for evaluating social engagement.

Heenetigala et al. (2015) from Victoria University investigated the publication and use of ESG measures by mining companies in Australia to determine if companies reported the same non-financial information allowing for a comparison of firms. Their research collected data from thirty mining companies' 2013 annual sustainability reports and compared information disclosure and how it was measured. The study by Heenetigala et al. (2015) showed that the industry needs uniform measures to report ESG indicators, and the current structure encourages the inconsistent use of available indicators. Key Performance Indicators (KPIs) reported by firms in 2013 for environmental measures emphasized renewable energy, water usage, greenhouse gas (GHG) emissions, ozone-depleting substances, hazardous waste production, and biodiversity. This research recommends that ESG raters expand on Heenetigala et al. (2015) list of information disclosed by mining companies to request data on air emissions measured in kilo-tonnes of pollutants, waste generation, and land disturbance. Social KPIs addressed in 2013 included the number of employees, percent of females, percentage of employees hired from local communities, percent of indigenous peoples employed, employee turnover rate, community engagement, and health and safety metrics like fatalities, lost time injury rate, and hours of training provided for human rights. This thesis also suggests that raters consider the value of local community engagement by measuring the number of service hours, local project

sponsorship, and the number of scholarships provided for evaluating social engagement. Recommendations for quantifying social and environmental initiatives will reflect Heenetigala et al.'s (2015) research with the assertions previously mentioned.

Modeling internal governance to firm value is more challenging than environmental or social aspects, as direct measurement of a qualitative structure is only possible by using a function. Researchers define good corporate governance when a firm addresses the following critical principles through corporate social responsibility: transparency, accountability, responsibility, independence, fairness, and equality (Arslan & Alqatan, 2020; Karim, 2010; Stefani, 2015; Ulya & Prastiwi, 2014; Untoro & Zulaikha, 2013). In 2012, Wahidahwati developed a Good Corporate Governance Mechanism (CG), which assigned weights to the board of commissioners, management, audit committee, and investors as variables for CG. Using this corporate governance mechanism, Wahidahwati and Adrini (2021) quantified governance for application in the econometric modeling of corporate governance with firm value. The disclosure of CSR shows the performance of management in implementing good corporate governance, indicating its social responsibility, which investors positively respond to as reflected in an increase in market price (firm value). On this basis, Wahidahwati and Adrini (2021) hypothesized that internal mechanisms of good corporate governance positively affect CSR disclosure, and CSR disclosure promotes company value. Their study also hypothesized that environmental performance (EP) positively affects firm value, specifically within the manufacturing industry. The researchers utilized the indicator Global Reporting Initiative (GRI) to measure CSR by comparing the number of items disclosed by a company with the 91 disclosure items implied in GRI G4. Firm size, measured on a log natural of the book value of total assets, and leverage, measured as the debt-to-equity ratio, are additionally used with CSR and CG (as proposed by Wahidahwati, 2012) to model Tobin's Q as a representation of firm value. Multiple regression analysis indicated that CG, EP, and firm size significantly positively affect firm value. In contrast, path analysis indicated that EP

affects firm value through CSR, but CG does not impact firm value through CSR (Wahidahwati & Adrini, 2021). Wahidahwati and Adrini (2021) concluded that proper internal governance enhances the corporate image, increasing long-term firm value.

There currently exists a limited amount of research on improving measuring ESG performance. This thesis aims to fill the need for providing a new methodology for measuring ESG performance specifically for the mining industry.

Chapter 3 of this thesis has provided an overview of existing literature that evaluated ESG's relationship with CFP in the short- and long-term. Similar to previous studies, this thesis applies an event study approach to assess the short-term market reactions to ESG-related announcements. To fully capture the influence of ESG, this thesis includes an assessment of three-, five-, seven-, and eleven-day event windows. Previous works have evaluated a single event window length. However, this study considers the impact of four separate sizes allowing for assessing the duration of market reactions to announcements. In addition to reviewing existing short-term event studies, this chapter compared previous research that evaluated the long-term relationship between ESG and CFP using regression modeling. Various researchers have applied Tobin's Q (Surenjargal, 2022) or other financial metrics (Garcia et al., 2018; Horvathova et al., 2012) as a CFP proxy and have inconsistent conclusions. This research evaluated Tobin's Q as this metric reflects the firm's market value and investor perception more accurately than ROA or ROE. Instead of assessing a broad region or multiple industries, as previous studies have done, this thesis applies a case study approach. Chapter 3 explained the uniqueness of this thesis from previous works as it explicitly focused on six gold mining firms in the U.S. and Canada, as this sector and region have not been investigated. This chapter also provided examples from previous research on quantifying ESG metrics.

CHAPTER 4
EVENT STUDY RESULTS – SHORT-TERM IMPACT OF ESG TO FIRM MARKET VALUE

Chapter four of this thesis will discuss the results of the short-term event study. The analysis will include both positive and negative ESG events and the impact experienced by each firm. This chapter will discuss the differences in results based on firm size and other differentiable characteristics, such as the timing of events.

4.1 Event Data

The six mining companies selected for this research had a total of 2,987 announcements made from 2014 to 2021 collected from StockWatch.com. After excluding any announcements made on the day of or within five business days of financial statements or changes to resource and reserve estimations, there were 170 events for analysis. On average, each firm had thirty events selected for the study. The selected events were categorized by (1) context relating to E, S, G, or Comprehensive (C) which is a combination of E, S, and G factors or all together; (2) perception of context being positive or negative; and (3) whether the source was an announcement made by the firm (internal) or from other media sources (external). Table 4.1 presents the distribution of events based on context and perception. Table 4.2 shows the events based on the context and source of the announcement.

Table 4.1 Selected ESG Events by Context and Perception

	Positive Events		Negative Events		Total Events	
ESG Pillar	Number	Proportion	Number	Proportion	Number	Proportion
E	36	21%	2	1%	38	22%
S	52	31%	16	9%	68	40%
G	15	9%	1	1%	16	9%
C	48	28%	0	0%	48	28%
Total	151	89%	19	11%	170	100%

Table 4.2 Selected ESG Events by Context and Source

	Internal Events		External Events		Total Events	
ESG Pillar	Number	Proportion	Number	Proportion	Number	Proportion
E	28	16%	10	6%	38	22%
S	58	34%	10	6%	68	40%
G	15	9%	1	1%	16	9%
C	24	14%	24	14%	48	28%
Total	125	74%	45	26%	170	100%

The environmental announcements concerned the firms' climate strategy, biodiversity initiatives, water management, and reclamation awards. The two adverse environmental events were removing a mining company from a sustainable energy supply chain index and the final settlement payment against prior litigation concerning ecological damages. No catastrophic environmental events, such as tailings storage facility failures or significant life-threatening environmental releases, were assessed in this research.

Social license to operate is crucial for mining companies to continue operations and expand. The criticality of social licensing explains why the mining companies favor publicly announcing the benefits they provide to the local communities. The social benefits reflected in the announcements included providing medical services, scholarships, or career training, receiving safety awards, and investing in local communities. The adverse social events involved fatalities at a mine site, employee strikes, labor disputes, and lawsuits.

Within the governance pillar, the reputational damaging event, related to a class action lawsuit concerning the validity and adequacy of the price offered to shareholders during an acquisition, implies poor business ethics. The positive governance events included firms addressing gender equality, diversification of board members, or expanding local procurement as a signal of positive business ethics. Overall, only nine percent of the events investigated related strictly to firm governance. Most American and Canadian firms already have business ethics, diversity and inclusion, and anti-corruption policies, thereby limiting the number of announcements relating to these topics.

The comprehensive context evaluated in this research included announcements of ranking on the DJSI, publishing sustainability reports, or receiving awards for outstanding ESG performance. There were no negative comprehensive announcements assessed.

The mining companies assessed take an active role in communicating and publicizing their work related to ESG, as approximately seventy-five percent of the events considered came from internal sources. Most external publications were associated with the comprehensive category focused on ESG performance and awards presented to the mining companies.

4.2 Event Study Analysis - Market Model

The event study portion of this thesis assesses the impact of ESG announcements on the short-term market capitalization of a firm. This thesis hypothesizes a positive and statistically significant effect of ESG announcements on firm market capitalization. Specifically, this research utilizes the market model approach to estimate each gold mining company's stock value based on changes in the gold price and NYSE market index. The estimation window for this research is 120 days ending 30 days before the announcement date. This study applies the t-test described in Equation 2.10 to determine the statistical significance of the cumulative abnormal return during the event window for all 170 ESG events. The event windows [t_1, t_2] assessed are five, [-2, 2], seven [-3, 3], and eleven [-5, 5]. The event study results using the market model are displayed in Table 4.3 including the average CAR, average t-statistic (t-stat) result, and number of events for each event window.

Table 4.3 Event Study Results for Market Model - Cumulative Abnormal Returns

Window	**CAR Mean (%)**	**Average T-stat**	**Min (%)**	**Max (%)**	**N**
Panel A: All events					
$[-2, 2]$	-0.12	0.71	-21.74	29.88	170
$[-3, 3]$	0.16	0.81	-22.99	24.61	170
$[-5, 5]$	0.06	0.86	-32.09	26.30	170
Panel B: Environmental (E)					
$[-2, 2]$	-0.71	0.56	-10.14	7.37	38
$[-3, 3]$	-0.65	0.59	-14.47	9.76	38
$[-5, 5]$	-0.62	0.94	-16.45	18.60	38
Panel C: Social (S)					
$[-2, 2]$	0.80	0.84	-15.80	29.88	68
$[-3, 3]$	1.44	0.98	-17.29	24.61	68
$[-5, 5]$	0.92	0.90	-27.27	26.30	68
Panel D: Governance (G)					
$[-2, 2]$	-0.58	0.66	-10.73	8.89	16
$[-3, 3]$	-0.51	0.52	-13.23	11.71	16
$[-5, 5]$	-1.95	0.60	-32.09	11.31	16
Panel E: ESG Comprehensive (C)					
$[-2, 2]$	-0.91	0.65	-21.74	20.96	48
$[-3, 3]$	-0.98	0.81	-22.99	18.85	48
$[-5, 5]$	-0.15	0.82	-27.77	20.69	48

For statistically meaningful results at a ninety-five percent confidence interval, the t-stat must be less than 0.05. The results in Table 4.3 show that, on average, none of the events are statistically significant. The extreme variations between the minimum and maximum CARs further confirm the inconsistency of results from these events.

The market model used to estimate the expected stock return for each company had a low probability of accuracy. The coefficient of determination (or R^2) shows how well the model predicts the outcome of the dependent variable, in this case, a company's percent change in stock price. An R^2 value of one indicates that the model predicts 100 percent of the relationship. The average R^2 value for the 170 events evaluated in this thesis was 0.2, meaning that the market model could only predict the change in stock price with twenty percent accuracy. The twenty percent probability of accurately predicting the dependent variable skews the results, making the event study's results less reliable. The unreliable

results mean this thesis can only draw meaningful conclusions about how the market reacts to ESG announcements for gold mining companies after first adjusting the prediction model to improve the R^2 value.

Utilizing a more extensive dataset by expanding the regression from 120 days to all trading days from January 1, 2013, to December 31, 2021, which included 2259 data points, corrected the issue of an inaccurate prediction model. However, the market value of gold mining firms is complicated as many factors impact the firm's value, not all of which are measurable. Most mining firms tend to trend with their competitors as they are all affected by the same external factors. Figure 4.1 illustrates the stock price fluctuations of the six mining companies from 2014 to 2021. As shown from the logarithmic change in prices, Barrick and Newmont are highly correlated to each other. The similar correlations in price changes exist for Kinross, Agnico Eagle, and Hecla.

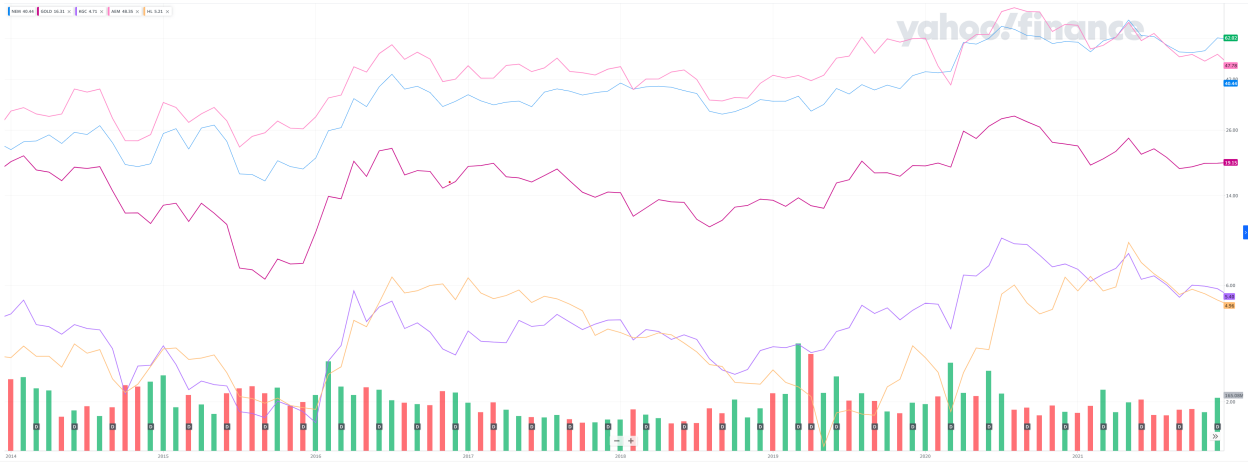

Figure 4.1 Newmont (NEM), Barrick (GOLD), Agnico Eagle (AEM), Kinross (KGC), and Hecla (HL) Logarithmic Price Comparison *Source: Yahoo.Finance.com*

Due to the high correlation between gold mining firms, it was determined to use a close competitor in addition to the gold price and market index for deriving the expected market return for each company. The coefficient of determination was greatly improved by including a competitor's change in the stock price as a control variable in Equation 2.1. Equation 4.1 details the adjustment to Equation 2.1 to have a competitor's difference in

stock price in the regression model.

$$R_{f,t} = \alpha_f + \beta_f R_{m,t} + \delta_f Au_t + \gamma_f C_t + \varepsilon_{f,t} \tag{4.1}$$

Each mining company used a single competitor from the six companies assessed in this thesis to determine the expected stock price return. 4.2 provides each gold mining firm's selected competitor, the resulting equation, and the adjusted R^2 value.

Table 4.4 Estimated Return Model using Competitor

Gold Miner	**Competitor**	**Estimated Returns Model**	**Adjusted R^2**
Newmont	Barrick (B)	$E(N,t) = 0 + 0.184 \times Au(t) + 0.337 \times R(t) + 0.749 \times B(t)$	0.650
Barrick	Newmont (N)	$E(B,t) = 0 + 0.370 \times Au(t) - 0.209 \times R(t) + 0.756 \times N(t)$	0.650
Hecla	Yamana (Y)	$E(H,t) = 0 + 0.367 \times Au(t) + 0.847 \times R(t) + 0.709 \times Y(t)$	0.501
Yamana	Kinross (K)	$E(Y,t) = 0 + 0.323 \times Au(t) + 0.0743 \times R(t) + 0.795 \times K(t)$	0.675
Agnico Eagle	Barrick (B)	$E(A,t) = 0 + 0.270 \times Au(t) + 0.00239 \times R(t) + 0.737 \times B(t)$	0.616
Kinross	Yamana (Y)	$E(K,t) = 0 + 0.275 \times Au(t) + 0.00537 \times R(t) + 0.766 \times Y(t)$	0.672

All models that use a competitor as a control variable have a coefficient of determination above 0.5, indicating at least fifty percent accuracy in predicting the gold mining company's price fluctuations. Adding competitors to the model significantly improved the model performance, allowing for event study to be conducted more reliably and meaningfully for each event.

4.3 Event Study Results by Company

Each of the gold mining companies had a different focus on ESG, creating a variety of approaches and communication strategies for publicizing their efforts. This section assesses the results of the ESG-related announcements or news publications concerning each of the six selected gold mining companies: Kinross, Newmont, Barrick, Yamana, Agnico Eagle, and Hecla. In addition to discussing the event study results by company, this section assesses the varying degree of success between the firms to determine if one firm experienced a more significant financial impact from ESG events.

4.3.1 Kinross Results

From 2014 to 2021, Kinross provided press releases or was mentioned externally in 340 publications. This thesis selected fifty-eight of these 340 publications as they were relevant to ESG topics and did not conflict with other financial or reserve update announcements. Most reports (thirty-one of fifty-eight) contained information concerning interactions with local communities, employees, or other social aspects of Kinross' ESG performance. There were fourteen comprehensive ESG performance announcements, ten environmental, and three related to governance. Table 4.5 contains Kinross' average cumulative abnormal return for the specified event window by ESG category.

Table 4.5 Kinross Event Study Results

Window	**Mean (%)**	**T-stat (Avg)**	**Min (%)**	**Max (%)**	**N**
Panel A: All events					
$[-1, 1]$	0.11	0.482	0.15	3.32	58
$[-2, 2]$	0.26	0.532	0.19	3.77	58
$[-3, 3]$	0.32	0.503	0.38	5.13	58
$[-5, 5]$	0.10	0.520	0.57	4.25	58
Panel B: Environmental (E)					
$[-1, 1]$	-0.63	0.432	-3.76	4.78	10
$[-2, 2]$	0.10	0.554	-5.45	7.40	10
$[-3, 3]$	0.15	0.610	-5.19	6.95	10
$[-5, 5]$	-0.22	0.513	-5.44	10.82	10
Panel C: Social (S)					
$[-1, 1]$	-0.04	0.511	-4.63	6.41	31
$[-2, 2]$	0.01	0.583	-7.38	5.69	31
$[-3, 3]$	0.53	0.564	-10.03	13.15	31
$[-5, 5]$	0.47	0.570	-12.68	11.72	31
Panel D: Governance (G)					
$[-1, 1]$	1.13	0.522	-0.81	2.55	3
$[-2, 2]$	3.88	0.392	-0.03	8.29	3
$[-3, 3]$	3.75	0.154	-2.87	10.70	3
$[-5, 5]$	3.32	0.185	-5.83	13.61	3
Panel E: ESG Comprehensive (C)					
$[-1, 1]$	1.28	0.447	-2.19	7.10	14
$[-2, 2]$	0.63	0.448	-3.43	9.64	14
$[-3, 3]$	0.24	0.418	-7.11	11.94	14
$[-5, 5]$	-0.35	0.484	-6.31	7.69	14

Of the fifty-eight ESG-related announcements, ten (less than twenty percent) displayed statistical significance at the three-, five-, seven-, or eleven-day event windows. On average, Kinross experienced a higher cumulative percent change in the stock price of 3.9 percent above the estimated difference in returns. Table 4.6 details the significant ESG events and cumulative abnormal returns for the respective event window.

Table 4.6 Kinross' Significant Events and Results

ESG Pillar	Date	Topic	Positive/ Negative	Internal/ External	Event Window	T-stat	CAR
C	6/8/2015	Named one of Canadas best 50 corporate citizens by Corporate Knights	P	E	5 days [-2,2]	0.0279	9.64%
	11/30/2015	Chirano ranked top miner in Ghana for environmental and corporate responsibility performance Paracatu Mine returned to full production.	P	E	3 days [-1,1]	0.0356	-1.77%
	6/10/2016	Kinross named one of Canadas top 2016 corporate citizens by Corporate Knights	P	E	3 days [-1,1]	0.0211	4.94%
	1/29/2020	Kinross corporate responsibility awards and recognitions for 2019	P	I	3 days [-1,1]	0.0356	4.53%
	8/24/2020	Kinross releases Sustainability Report	P	I	5 days [-2,2]	0.0347	-3.43%
E	9/19/2018	Bald Mountain wins Nevada mine reclamation award	P	E	3 days [-1,1]	0.0173	-1.99%
	5/24/2019	Kinross Chile attends climate change in mining dialogue	P	I	5 days [-2,2]	0.0427	7.40%
S	7/24/2015	Chirano funds project to bring electricity to neighboring village	P	I	3 days [-1,1]	0.0444	6.41%
	11/28/2016	Tasiast hosts second helping babies breathe workshop	P	I	3 days [-1,1]	0.0337	4.43%
G	6/2/2015	Kinross procurement reporting an example of best practices says Engineers Without Borders	P	I	7 days [-3,3]	0.0477	1.65%

The maximum cumulative abnormal return that caused an increase in stock price was 9.64 percent over a five-day event window when Corporate Knights named Kinross one of Canada's Best 50 Corporate Citizens. Figure 4.2 shows the estimated and actual percent

changes in Kinross stock price around the event date (t_0), including a broader period of ten days before and after the event.

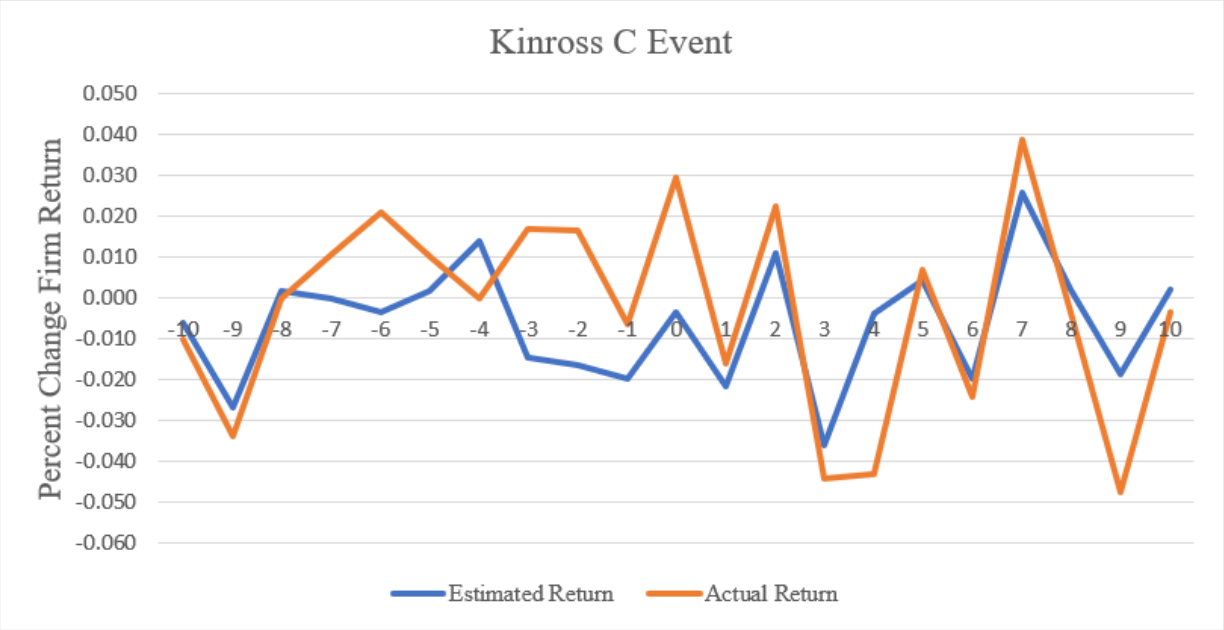

Figure 4.2 Kinross C Event - on June 8, 2015 (t_0) Top 50 Best Corporate Citizens in Canada

Conversely, Kinross experienced a negative 3.43 percent cumulative abnormal return in a five-day event window after releasing its Sustainability Report on August 24, 2020. Even though releasing information concerning the firm's sustainability practices is generally considered a recommended procedure, the market responded adversely. From two days prior until two days after the event, the actual returns for Kinross were below the estimated, making this a significant event for the five-day event window. The abnormal return was nearly zero within an eleven-day event window, meaning the market's reaction was short and not sustained longer than the week of trading, as shown in Figure 4.3.

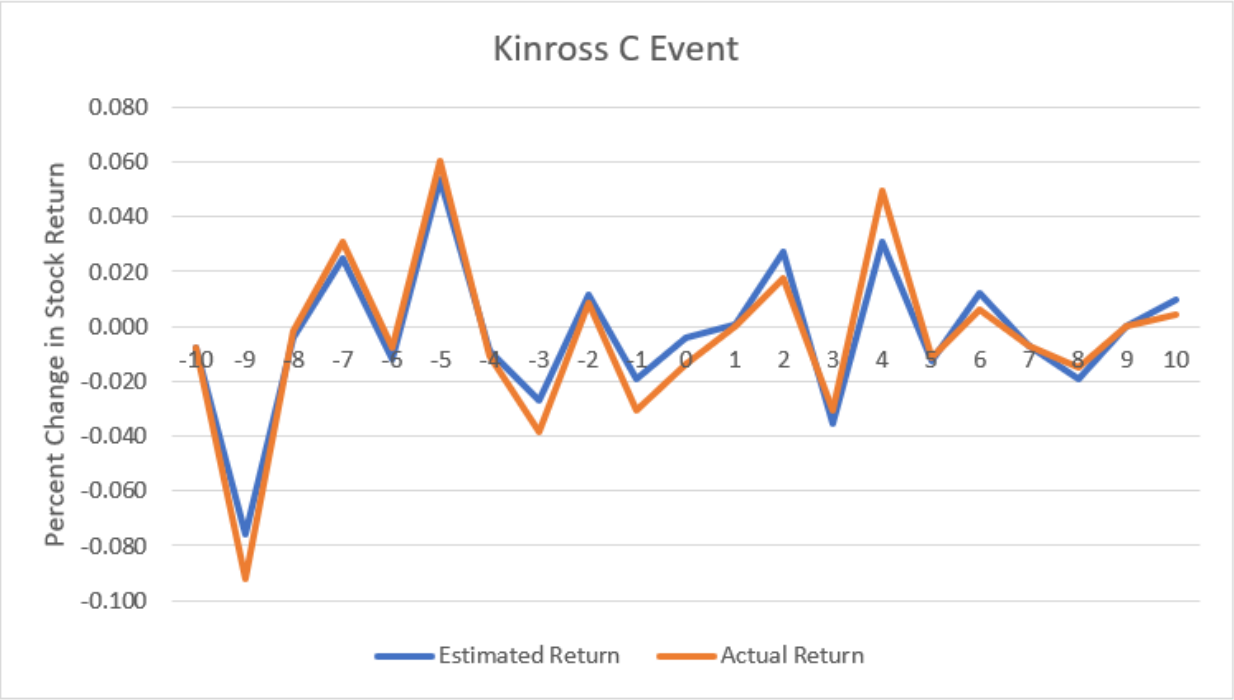

Figure 4.3 Kinross' C Event on August 24, 2020 (t_0) Sustainability Report Released

Half of Kinross's ten statistically significant events revolved around announcements relating to all ESG pillars (C). On average, the comprehensive events increased the firm stock price by 2.78 percent, considering various event windows. These announcements related to Kinross' release of sustainability or corporate responsibility reports and external recognition for its environmental and CSR performance. Twenty percent of the significant events related to social aspects of ESG and, on average, increased Kinross' stock price by 5.42 percent compared to its expected return. Environmental-focused announcements comprised twenty percent of the significant events and, on average, increased the firm's stock price by 2.71 percent. The one governance-related event increased Kinross' stock value by 2.55 percent on average.

Only seventeen percent of the ESG announcements made without the influence of financial disclosures contributed to a measurable variation in the expected change in stock price. Seven of the ten significant events positively impacted Kinross's market value, while

three triggered an adverse market reaction. Overall, there was not a consistently positive response to ESG announcements that increase Kinross's market value nor a predictable pattern to how the market responds.

4.3.2 Newmont Results

From 2014 to 2021, 445 announcements retrieved from StockWatch.com were related to Newmont specifically. Newmont released or was referenced in thirty-nine statements relating to ESG outside the five-day window of influence by financial or reserve growth disclosures. Seventeen related to comprehensive ESG topics, fourteen to social, five to environment, and three to governance. The cumulative abnormal return varied widely based on the topic and the evaluated event windows. Table 4.7 provides the cumulative abnormal returns of the thirty-nine events at the associated event windows.

Table 4.7 Newmont's Event Study Results

Window	**Mean (%)**	**T-stat (Avg)**	**Min (%)**	**Max (%)**	**N**
Panel A: All events					
$[-1, 1]$	0.34	0.607	0.23	4.71	39
$[-2, 2]$	0.19	0.566	0.17	3.65	39
$[-3, 3]$	0.57	0.529	0.68	3.60	39
$[-5, 5]$	1.52	0.611	0.68	4.49	39
Panel B: Environmental (E)					
$[-1, 1]$	0.10	0.606	-1.68	1.51	5
$[-2, 2]$	-0.10	0.833	-0.57	0.86	5
$[-3, 3]$	1.91	0.520	-1.19	3.92	5
$[-5, 5]$	-0.05	0.551	-2.92	3.18	5
Panel C: Social (S)					
$[-1, 1]$	0.11	0.531	-3.83	3.47	14
$[-2, 2]$	0.16	0.409	-3.75	3.22	14
$[-3, 3]$	-0.58	0.497	-4.69	5.83	14
$[-5, 5]$	0.98	0.678	-7.04	22.50	14
Panel D: Governance (G)					
$[-1, 1]$	-0.84	0.597	-2.93	0.72	3
$[-2, 2]$	0.10	0.594	-1.90	2.71	3
$[-3, 3]$	4.03	0.486	0.43	7.13	3
$[-5, 5]$	6.48	0.513	-0.40	12.67	3
Panel E: ESG Comprehensive (C)					
$[-1, 1]$	0.95	0.604	-1.72	4.85	17
$[-2, 2]$	0.42	0.507	-3.53	3.04	17
$[-3, 3]$	0.65	0.597	-5.64	5.51	17
$[-5, 5]$	1.77	0.561	-4.70	8.67	17

Newmont had one event that demonstrated a statistically significant influence on changing its share price in a five-day event window. Newmont announced reopening its Peñasquito mine after the Mexican government authorities lifted an illegal blockade. Newmont resumed supporting the twenty-five neighboring communities, enhancing potable water availability. The announcement improved the cumulative abnormal returns over the five-day event window by 1.74 percent above the expected return.

ESG Pillar	Date	Topic	Positive/ Negative	Internal/ External	Event Window	T-stat	CAR
S	10/9/2019	Illegal blockade lifted at Peñasquito and 25 neighboring communities' infrastructure projects resume	P	I	[-2,2] 5 days	0.010	1.744%

Table 4.8 Newmont's Significant Event and Result

Figure 4.4 displays the significant event for Newmont and associated estimated and actual percent changes to the stock price from ten days before and after the event. The announcement demonstrated positive social interactions with the surrounding communities, and it also signaled to the market that the firm's largest gold, zinc, lead, and silver-producing asset could resume production and sales, thus increasing cash flow and profitability. Although the announcement provided positive social interactions between Newmont and local communities, the interpretation of the announcement indicates future financial stability of Newmont, not strictly its ESG performance.

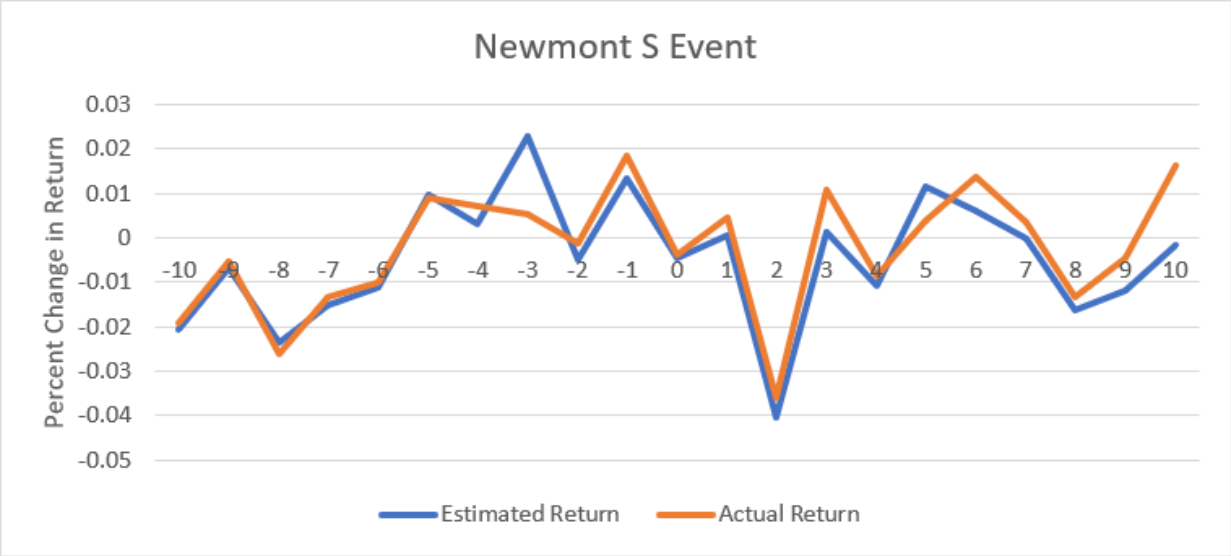

Figure 4.4 Newmont Social Event on October 9, 2019 (t_0) Removing illegal blockade

Newmont's one significant event accounted for approximately two percent of the ESG announcements evaluated in this thesis and less than 0.2 percent of all the announcements made in the seven years assessed. Although the market displayed a positive and significant reaction to the event, no pattern of positive responses existed nor enough events to definitively claim that ESG announcements influence the firm's stock price in the short term. The market generally remained neutral to statements concerning Newmont's ESG performance, as the stock price is not positively or negatively altered in the short term.

4.3.3 Barrick Results

Seven hundred thirty-nine announcements assessed in this thesis included references to or published by Barrick. Of the large volumes of reports, only forty related to ESG topics. Twenty-one of the forty ESG-focused statements were independent of financial and other announcements. Barrick prioritizes environmental aspects of ESG as over seventy percent of the events included reference to its environmental performance. None of the selected events specifically addressed social issues, and only two addressed governance policies. Four of the twenty-one events related to comprehensive ESG topics. Table 4.9 displays the average cumulative abnormal return for the assessed event windows and associated average t-statistic.

Table 4.9 Barrick Event Study Results

Window	**Mean (%)**	**T-stat (Avg)**	**Min (%)**	**Max (%)**	**N**
Panel A: All events					
$[-1, 1]$	-0.02	0.341	0.14	2.32	21
$[-2, 2]$	-1.09	0.154	0.56	3.49	21
$[-3, 3]$	-0.94	0.154	0.58	2.87	21
$[-5, 5]$	-1.50	0.217	0.71	2.75	21
Panel B: Environmental (E)					
$[-1, 1]$	0.05	0.326	-3.97	6.12	15
$[-2, 2]$	-1.31	0.390	-8.56	7.06	15
$[-3, 3]$	-1.04	0.418	-9.50	8.62	15
$[-5, 5]$	-1.51	0.602	-18.79	8.84	15
Panel C: Social (S)					
$[-1, 1]$	-	-	-	-	-
$[-2, 2]$	-	-	-	-	-
$[-3, 3]$	-	-	-	-	-
$[-5, 5]$	-	-	-	-	-
Panel D: Governance (G)					
$[-1, 1]$	-1.94	0.397	-2.65	-1.23	2
$[-2, 2]$	-0.94	0.714	-1.68	-0.20	2
$[-3, 3]$	-0.16	0.472	-2.47	2.15	2
$[-5, 5]$	-0.61	0.438	-6.44	5.21	2
Panel E: ESG Comprehensive (C)					
$[-1, 1]$	0.68	0.370	-2.60	4.77	4
$[-2, 2]$	-0.34	0.409	-4.14	3.74	4
$[-3, 3]$	-0.93	0.433	-4.97	3.73	4
$[-5, 5]$	-1.90	0.673	-13.51	6.82	4

The announcements, on average, did not significantly impact Barrick's stock price as the t-statistic is much higher than 0.05 on average. However, three events for Barrick demonstrated statistical significance, two related to environmental announcements, and one event was the internal announcement of changing emphasis on sustainability. On average, the market strongly negatively responded to these events resulting in a decrease in Barrick stock price by 2.5 percent within a three- or five-day event window. Table 4.10 details the specific events and the resulting impact on cumulative abnormal returns for the three statistically significant events.

Table 4.10 Barrick's Significant Events and Results

ESG Pillar	Date	Topic	Positive/ Negative	Internal/ External	Event Window	T-stat	CAR
E	11/23/2016	Nets Top Recognition for Renewable Energy Initiatives	P	E	[-1,1] 3 days	0.029	-1.44%
	4/4/2018	Keeping Bullfrog Above Water	P	I	[-1,1] 3 days	0.027	-2.01%
C	5/2/2017	Changing The Emphasis on Sustainability	P	I	[-2,2] 5 days	0.037	-4.14%

The most impactful event was Barrick's announcement of changing its sustainability emphasis and approach. One may have anticipated the statement made on May 2, 2017, of increasing focus on sustainability to increase a firm's share price. However, for Barrick, it caused a cumulative 4.14 percent decline in the share price compared to the anticipated stock return over the five-day event window. However, Barrick made a financial announcement on April 25, 2017, five days before the event, stating it did not achieve quarterly production targets. Even though the financial disclosure is outside of the evaluated event window, the negative perception of Barrick may have contributed to the magnitude of the response due to not meeting market expectations for the quarter. A longer overview of the event from ten days prior to and after the event date is illustrated in Figure 4.5, where the extreme decline in actual returns occurs the day after quarterly production results were released.

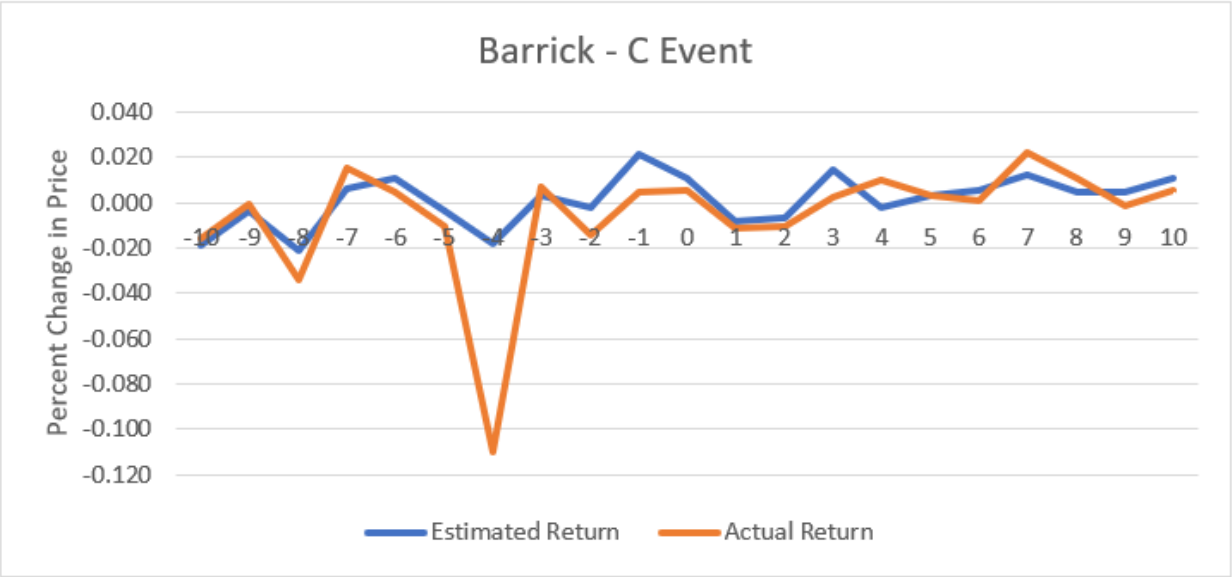

Figure 4.5 Barrick's C Event on May 2, 2017 (t_0) Increasing Focus on Sustainability

Compared to the market response experienced by Kinross, which was largely positive reactions, Barrick's announcements of ESG initiatives resulted in a decline in stock price. The difference in market response may be because Barrick announces fewer and less frequent ESG-related information to the market than its competitors. The market appears to be conditioned to expect financial announcements and may perceive the ESG initiatives as an additional cost restricting the profits that could be distributed to shareholders as dividends. Kruegger (2015) also found a weakly negative market response to ESG news and speculated that shareholders perceive ESG initiatives as costly expenditures, which leads to a short-run decline in stock prices.

4.3.4 Yamana Results

According to StockWatch.com, Yamana published or was referenced in 360 news articles. Of these 360 announcements, twelve related to ESG topics and did not coincide with or within five days of a financial publication. Nearly half (five) of the twelve announcements were related to social aspects of ESG, while four were comprehensive, two related to governance practices, and one was environmental impact focused. Table 4.11

provides the average cumulative abnormal returns based on the ESG category and associated event windows.

Table 4.11 Yamana Event Study Results

Window	**Mean (%)**	**T-stat (Avg)**	**Min (%)**	**Max (%)**	**N**
Panel A: All events					
$[-1, 1]$	0.47	0.601	0.73	2.33	12
$[-2, 2]$	0.19	0.623	0.77	2.51	12
$[-3, 3]$	0.52	0.609	0.86	2.64	12
$[-5, 5]$	0.53	0.602	0.84	2.50	12
Panel B: Environmental (E)					
$[-1, 1]$	1.48	0.611	1.48	1.48	1
$[-2, 2]$	0.25	0.930	0.25	0.25	1
$[-3, 3]$	4.54	0.540	4.54	4.54	1
$[-5, 5]$	6.94	0.343	6.94	6.94	1
Panel C: Social (S)					
$[-1, 1]$	2.19	0.653	0.07	5.76	5
$[-2, 2]$	2.48	0.388	-1.99	7.73	5
$[-3, 3]$	3.33	0.579	0.26	7.82	5
$[-5, 5]$	3.57	0.573	-1.59	11.87	5
Panel D: Governance (G)					
$[-1, 1]$	-1.83	0.435	-2.91	-0.75	2
$[-2, 2]$	-1.61	0.613	-3.28	0.06	2
$[-3, 3]$	-2.50	0.417	-2.90	-2.10	2
$[-5, 5]$	-5.36	0.246	-8.12	-2.61	2
Panel E: ESG Composite (C)					
$[-1, 1]$	0.58	0.680	-1.57	3.93	4
$[-2, 2]$	-0.27	0.633	-3.23	1.32	4
$[-3, 3]$	0.15	0.739	-1.58	2.20	4
$[-5, 5]$	0.56	0.731	-1.98	2.82	4

Three percent of the announcements published regarding Yamana included reference to ESG topics, and none materially impacted its stock price. Over the seven years assessed, Yamana's stock price, on average, changed daily by 0.004 percent, which was the least variability to daily stock prices of any of the six companies evaluated in this thesis. The lower variability may indicate that investors trade Yamana stock less frequently, making it relatively stable compared to the other gold mining firms. Yamana was purchased in 2022 by Agnico Eagle Mining, which signals that in the time frame evaluated in this study,

Yamana may not be actively expanding, potentially discouraging investment.

Yamana had the least number of announcements relating to ESG of the six companies evaluated, and the market was indifferent to these announcements as the stock price remained consistent with the predictive model.

4.3.5 Agnico Eagle Results

From 2014 to 2021, Agnico Eagle published or was referenced in 720 publications available through StockWatch.com or on its website. Twenty-three (or three percent) of the publications evaluated in this thesis related to ESG performance and were not influenced by other announcements. Nine events were comprehensive. Six focused on social aspects of ESG, five on environmental performance, and three considered the governance of Agnico Eagle. Table 4.12 details the average cumulative abnormal return for Agnico Eagle's twenty-three events.

Table 4.12 Agnico Eagle Event Study Results

Window	**Mean (%)**	**T-stat (Avg)**	**Min (%)**	**Max (%)**	**N**
Panel A: All Events					
$[-1, 1]$	0.72	0.540	0.21	4.71	23
$[-2, 2]$	1.05	0.495	0.34	4.19	23
$[-3, 3]$	0.36	0.500	0.45	5.24	23
$[-5, 5]$	0.71	0.487	0.60	4.90	23
Panel B: Environmental (E)					
$[-1, 1]$	-0.83	0.572	-2.25	0.86	5
$[-2, 2]$	-0.38	0.450	-2.05	1.93	5
$[-3, 3]$	-1.24	0.574	-5.97	2.11	5
$[-5, 5]$	-2.45	0.590	-7.22	0.96	5
Panel C: Social (S)					
$[-1, 1]$	0.27	0.559	-1.03	3.18	6
$[-2, 2]$	0.51	0.598	-1.50	2.39	6
$[-3, 3]$	-0.29	0.663	-2.18	1.58	6
$[-5, 5]$	0.65	0.508	-2.14	4.92	6
Panel D: Governance (G)					
$[-1, 1]$	1.44	0.633	0.11	3.80	3
$[-2, 2]$	1.02	0.450	-0.94	2.73	3
$[-3, 3]$	1.10	0.590	-0.91	4.13	3
$[-5, 5]$	1.87	0.483	-1.32	5.77	3
Panel E: ESG Composite (C)					
$[-1, 1]$	0.97	0.506	-1.32	3.02	9
$[-2, 2]$	1.23	0.518	-2.33	5.59	9
$[-3, 3]$	1.63	0.363	-3.45	7.41	9
$[-5, 5]$	2.73	0.393	-3.36	9.41	9

On average, the ESG events evaluated did not impact Agnico Eagle's stock price. However, a single event had a statistically significant impact on Agnico's market value over a three-day event window. On June 9, 2016, Agnico Eagle published a story on its website detailing its partnership with Quebec's Ministry of Forest to protect wildlife and grow the woodland caribou herd. The positive story of environmental protection and sustaining the natural wildlife in Canada resulted in a decrease of Agnico Eagle's cumulative abnormal return of 1.87 percent in the three-day event window shown in Table 4.13.

Table 4.13 Agnico Eagle's Significant Event and Result

ESG Pillar	Date	Topic	Positive/ Negative	Internal/ External	Event Window	T-stat	CAR
E	6/9/2016	Partnerships to protect the environment	P	I	3 days [-1,1]	0.0372	-1.87%

The negative impact of the announcement to protect the environment accounted for a slight difference in actual percent change in stock price compared to the estimated value. Agnico Eagle's actual stock price aligned with the estimate outside the five-day window around the event date. Figure 4.6 illustrates how closely Agnico Eagle's actual return follows the estimated return over a twenty-one-day time window.

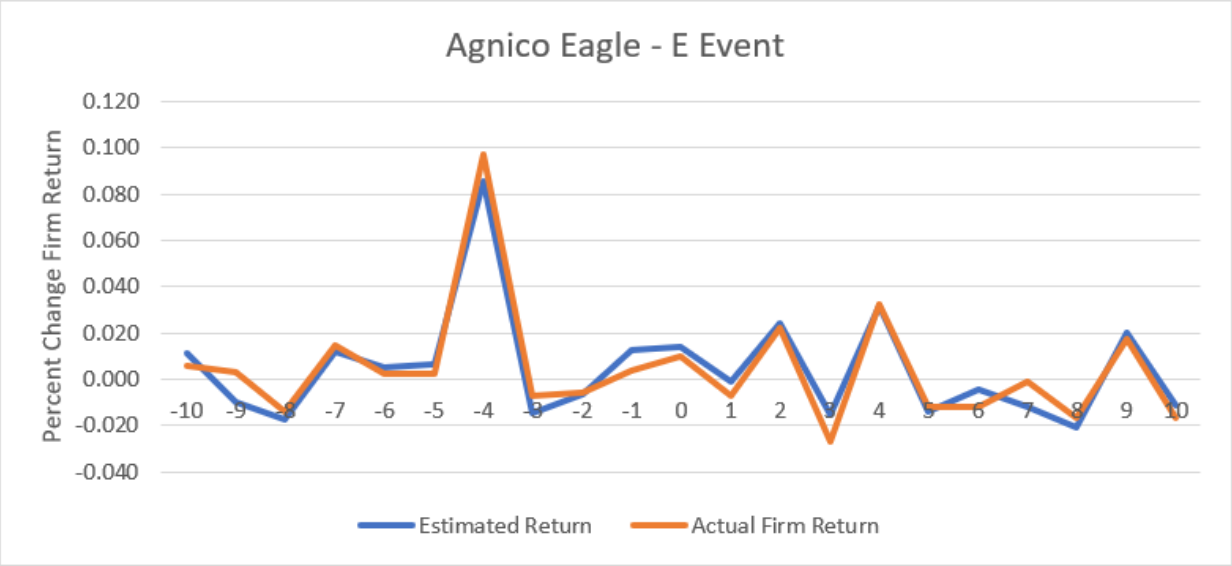

Figure 4.6 Agnico Eagle's E Event on June 9, 2016 (t_0) Partnership to Protect the Environment

Like Newmont and Yamana, the ESG event studies for Agnico Eagle indicated that the market does not respond to the release of ESG information. The single event that demonstrated measurable impact for Agnico Eagle revealed a negative perception as the marketplace punished the firm for contributing funds to protecting the environment.

However, a single event in seven years does not provide sufficient evidence that the market consistently punishes Agnico Eagle for ESG performance. Furthermore, there is insufficient evidence from Agnico Eagle's events to support the positive correlation between ESG announcements and the firm's short-term market value.

4.3.6 Hecla Results

Over the seven years assessed in this thesis, 380 internal and external news articles mentioned Hecla Mining, twenty-six of which related to ESG performance. This thesis selected seventeen ESG performance publications that were not influenced by other Hecla announcements. None of the news articles used in this research referred to comprehensive ESG topics. Seventy percent (12 events) related to Hecla's social performance, including news articles concerning labor strikes, agreements with the First Nations, or safety awards. Two events related to environmental behavior, including reclamation awards and final settlement payment for previous grievance lawsuits in Idaho. The last three announcements assessed for this thesis concerned Hecla's governance, including appointments of new executive management and litigation for improper pricing during an acquisition. Table 4.14 summarizes the average cumulative abnormal return for the seventeen ESG-focused events involving Hecla Mining.

Table 4.14 Hecla Event Study Results

Window	**Mean (%)**	**T-stat (Avg)**	**Min (%)**	**Max (%)**	**N**
Panel A: All Events					
$[-1, 1]$	0.20	0.523	0.55	5.61	17
$[-2, 2]$	1.44	0.534	1.09	5.96	17
$[-3, 3]$	1.69	0.493	1.02	5.84	17
$[-5, 5]$	3.65	0.625	1.22	6.49	17
Panel B: Environmental (E)					
$[-1, 1]$	1.65	0.572	1.65	1.65	2
$[-2, 2]$	2.26	0.407	2.26	2.26	2
$[-3, 3]$	6.47	0.125	6.47	6.47	2
$[-5, 5]$	5.01	0.446	5.01	5.01	2
Panel C: Social (S)					
$[-1, 1]$	2.41	0.564	-2.91	13.21	12
$[-2, 2]$	3.55	0.628	-2.99	11.66	12
$[-3, 3]$	1.95	0.512	-7.58	18.50	12
$[-5, 5]$	5.06	0.651	-2.65	17.16	12
Panel D: Governance (G)					
$[-1, 1]$	-6.12	0.555	-11.98	-0.26	3
$[-2, 2]$	-8.54	0.460	-16.38	-0.71	3
$[-3, 3]$	-6.11	0.451	-14.64	2.42	3
$[-5, 5]$	2.95	0.559	-2.59	8.50	3
Panel E: ESG Composite (C)					
$[-1, 1]$	-	-	-	-	0
$[-2, 2]$	-	-	-	-	0
$[-3, 3]$	-	-	-	-	0
$[-5, 5]$	-	-	-	-	0

One of the seventeen events provided statistically significant results that the abnormal percent change in Hecla's stock return materially differed from zero at a ninety-five percent confidence interval. The event related to Hecla's announcement of appointing a new director on March 1, 2021. The market did not well receive the information as the stock price declined by more than sixteen percent within five days surrounding the event detailed in Table 4.15.

Table 4.15 Hecla's Significant Event and Result

ESG Pillar	Date	Topic	Positive/ Negative	Internal/ External	Event Window	T-stat	CAR
G	3/1/2021	Hecla Appoints New Director	P	I	5 days [-2,2]	0.035	-16.38%

Before the announcement of new management on March 1, Hecla released its full-year financial statements for 2020 on February 18, 2021. The market exceeded the positive expected increase in stock price following the financial statements. From the date the financial results were released until the beginning of the five-day event window for the new management event, the cumulative abnormal return was a 17.4 percent gain. After the announcement of new management, the market demonstrated a significant negative response. Consequently, this may be a corrective action to adjust from the overly positive response from the annual financial results. Figure 4.7 illustrates the interaction of these two events.

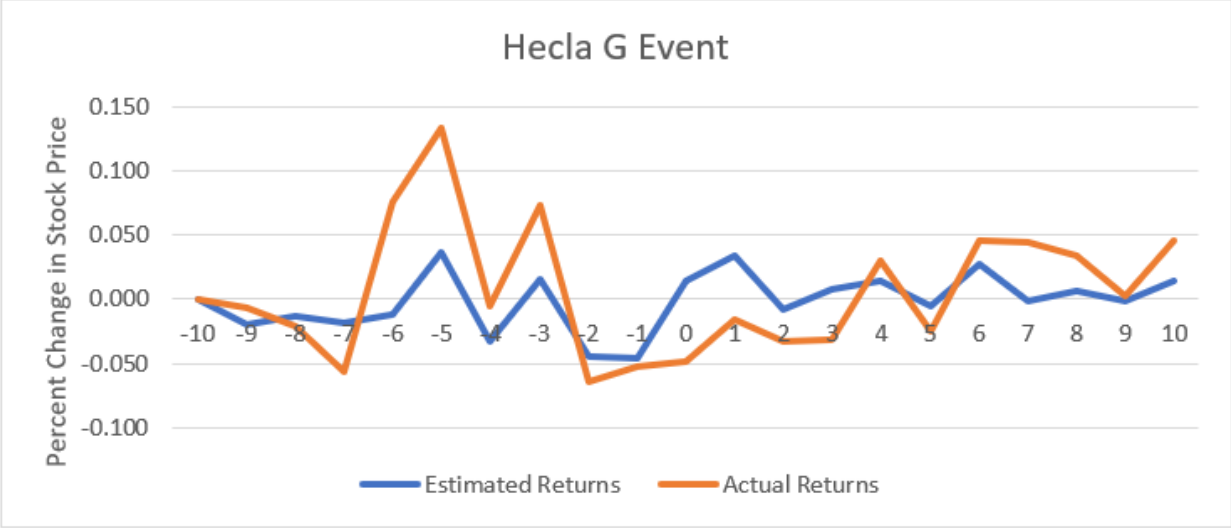

Figure 4.7 Hecla's G Event announcing new director on March 1, 2021 (t_0), Financial Statements Released (t_8)

Overall, the market did not respond to Hecla's ESG announcements. The proximity of the only significant event for Hecla to its annual financial statement made it impossible to differentiate the response results from either event. Although the prediction model had the weakest coefficient of determination of any companies investigated in this thesis, it was verified as accurate as financial and reserve statements showed statistical significance using the same estimation model. The market did not respond to Kinross' ESG information regardless of source or perception.

4.4 Short-Term Event Study Results and Discussion

Between the six gold mining companies assessed in this thesis, 2,975 publications referenced these firms. One hundred seventy of the 2,975 publications were related to ESG information and evaluated for their impact on the firms' short-term market value. Of the 170 ESG-focused announcements, only sixteen showed statistical significance through the event study methodology, meaning only nine percent of the announcements produced a noticeable impact on a firm's stock return. In addition to the low success rate of ESG news impacting a firm's market value, the results varied widely from extremely negative and well below the expected return by sixteen percent to outperforming expectations by nearly ten percent. The average difference in stock return for the sixteen significant events was an outperformance of expected returns by 0.5 percent compared to the average daily change in stock price of 0.025 percent for all six companies. Table 4.3.1 summarizes the CAR results and conclusions for each firm.

Table 4.16 ESG Event Study Results for Gold Miners

Gold Miner	**Number of Announcements (2014-2021)**	**ESG Announcements Assessed**	**Number of Significant Announcements**	**Average CAR for Significant Events**	**Conclusion**
Kinross	340	58	10	+3.9%	The market inconsistently responds to positive ESG events regardless of the source, but on average provides a benefit to stock price.
Newmont	445	39	1*	+1.7%	Market is relatively unresponsive to ESG events.
Barrick	730	21	3	-2.5%	Market weakly and negatively responds to ESG news.
Yamana	360	12	0	N/A	Market is unresponsive to ESG events.
Agnico Eagle	720	23	1	-1.9%	Market weakly and negatively responds to ESG news.
Hecla	380	17	1*	-16.4%	Market is relatively unresponsive to ESG events.
Total	**2975**	**170**	**16**	**+0.49%**	**Market is generally unresponsive to ESG information**

**Note: Removed from final analysis due to influence from financial statements.*

Less than ten percent of standalone ESG announcements involving the top gold mining companies in the US and Canada impacted the firms' market value. The resulting changes to a firm's stock price were inconsistent regarding magnitude and direction across firms

and topics. Responses ranged from extremely adverse, decreasing share price by sixteen percent, to overly optimistic, increasing stock value by nearly ten percent. None of the statistically significant statements were a result of negative ESG performance.

Even though most announcements involved actions relating to the social pillar of ESG, only three were statistically significant. The three impactful events created a benefit on average of a 4.5 percent increase in share price for the firm involved. Approximately four percent of social announcements positively and significantly impacted a firm's market value in the short term.

Announcements relating to a firm's comprehensive ESG behavior were the second most frequent announcement topic assessed in this thesis. Six significant statements were made for the C category, meaning the success rate of these announcements to impact the firm's market value was one out of eight. The market responded positively on average, and the share price increased by 1.6 percent. Fifty percent of the responses were negative. Although the market responded more frequently to C events, the results were inconsistent.

Environmental performance is considered a crucial pillar of ESG for the extractive industry as it has a higher risk than other industries. The gold mining companies in the US and Canada evaluated in this thesis make a considerable effort to protect the environment, support biodiversity, and promote the health of the ecosystems surrounding their operations. Kinross and Barrick particularly focus on communicating their environmental efforts. However, this thesis indicated that the market weakly responds to these announcements and, on average, provides a benefit to the firm of 0.02 percent. Thirteen percent of the environmental statements triggered a measurable market response, and eighty percent of the significant announcements triggered an adverse reaction from the market. The market most frequently punishes a firm for environmental reports by approximately two percent, except for the one event where the market provided a benefit of over seven percent. Like Kruegger (2015) and Xie et al. (2023), this thesis finds that the market punishes firms for environmental improvements as the expenditure conflicts with

the organizational goal of maximizing shareholder profits consistent with the trade-off theory (Friedman, 1970).

Governance topics were the least frequently presented to the market by the firms or external news publications. Excluding Hecla's governance event, which was likely influenced by financial disclosures, only one other G event was statistically significant. The positive recognition of proper governance practices caused an increase in the share price of 1.65 percent above expectation. However, this single event demonstrated a success rate of one out of fourteen for G to statistically impact a firm's market value. This thesis did not have sufficient evidence to support the hypothesis that proper governance increases a firm's share price in the short-term following such an announcement.

Each of the six companies had a unique approach to communicating its ESG performance. Agnico Eagle utilized the blog page on its website to share its significant initiatives for improving its ESG performance. Agnico's stories were important for conveying its priorities and successful initiatives. However, investors must search for the blog page, which likely saturates the market less than external news publications. Conversely, Newmont received the most external recognition for its ESG performance through awards and achieving the top rank for various sustainability indices. Regardless of the source of the announcement, Newmont and Agnico Eagle each only had one significant event. Newmont, Agnico Eagle, and Yamana demonstrated that the market does not reward their positive ESG publications, similar to the findings of Ketola (2022).

Hecla had the fewest events but the most negative news coverage concerning labor strikes and the final settlement from a previous lawsuit for environmental damages. Nevertheless, none of the events showed statistical significance without the influence of financial statements. Capelle-Blancard and Petit (2017), Kruegger (2015), and Ketola (2022) all found that the market punishes firms for negative ESG news, particularly relating to the environment. Contrary to these studies, this thesis found that Hecla's negative ESG news did not receive the same punishment from the market as previous

research. Unfortunately, this thesis did not include the date of the initial litigation claim against Hecla, as this type of event is more likely to trigger a significant market response than the final payment.

Barrick aggressively advertised its ESG initiatives from 2016 to 2018, but after 2018 it only had two announcements without the influence of financial results. The positive significant events between 2016 and 2018 for Barrick all resulted in an adverse market reaction. Kruegger (2015) evaluated US firms and found that the market reacts adversely to positive ESG initiatives, speculating that the shareholders perceived the costs associated with ESG as unnecessary. The results for Barrick coincide with Kruegger's (2015) conclusions up until 2018, when Barrick changed its advertising of ESG. Before 2018, Barrick published an average of seven press releases showcasing its environmental solutions. After 2018, Barrick no longer published press releases focused on environmental elements but restricted the news publications to reflect only external recognitions, like ranking on the DJSI. This thesis cannot confirm whether the adverse market reaction to ESG investment has continued beyond 2018, particularly for Barrick.

Unlike Barrick, Kinross remained consistent in aggressively broadcasting its ESG initiatives throughout the period assessed in this thesis. Kinross had the most press releases of the six gold mining companies and consequently had the greatest number of significant events. Seventeen percent of the ESG announcements made a measurable impact on Kinross' short-term stock price. However, not all publications increased in stock price; thirty percent of the announcements showed adverse market reactions. When the market supported the announcement, Kinross experienced an average increase in its stock price of 5.5 percent higher than expected. The three adverse reactions caused an average decline in the stock price of 2.4 percent. Kinross generally benefited from the numerous ESG announcements, even if a few events had an adverse market reaction. Xie et al. (2023) speculated that a firm that frequently and consistently publishes ESG information experiences less negative impact than its competitors when publishing new ESG data.

Kinross is one of the few firms that has benefited from ESG disclosures. Kinross' consistency in publishing information and lasting priority for ESG is likely recognized in the investment community so that it has not punished Kinross for the additional costs associated with ESG initiatives.

This thesis hypothesized a direct positive correlation between a firm's market value and its perceived commitment to sustainability relative to ESG performance. By applying an event study approach, this thesis found that the market has not reacted to negative ESG publications specifically for the six gold mining firms assessed. Furthermore, this research found inconsistent market responses to positive ESG initiatives. Four of the six gold mining firms did not experience any market reaction, while one experienced an adverse response from the market. Kinross was the only firm to experience multiple positive and significant market responses to its ESG announcements. It provided the most information outside of the influence of financial and reserve data. The market inconsistently responded to Kinross' ESG announcements but was beneficial overall. This thesis concludes that the market inconsistently responds to ESG information but generally is unresponsive. The exception is if the firm has an extensive history of publishing ESG disclosures making it less of a market shock.

CHAPTER 5
ESG INFLUENCE ON LONG-TERM FINANCIAL PERFORMANCE RESULTS AND DISCUSSION

The fifth chapter of this thesis summarizes and discusses the results of the long-term regression models evaluating the influence of each ESG pillar on financial performance using existing ESG rating information from the Bloomberg ESG database. This thesis hypothesized that each pillar of ESG, which is individually rated by Bloomberg (environmental, governance, and comprehensive), would provide a positive significant contribution to a firm's long-term financial performance. This section provides conclusions from the long-term regression model results. It suggests how the mining industry or financial investors could use the results to improve the measurement and prioritization of ESG initiatives.

5.1 Descriptive Statistics

Variance Inflation Factor (VIF) checks data for multicollinearity between independent variables. A VIF value less than five indicates no multicollinearity issue for the data (Akinwande et al., 2015). The VIF value for ESG comprehensive rating in the initial assessment of all variables was over ten, indicating a severe correlation between predictor variables in the model. Testing of the VIF value of the independent variables showed that the comprehensive ESG score had a high risk of multicollinearity with a VIF score greater than ten which could cause unreliable coefficient estimates and p-values in the regression. The size variable indicates a moderate correlation between the other variables selected in the model at a VIF value of 5.208. The comprehensive ESG score likely has an extreme VIF when assessed with E and G since the E and G scores are weighted to derive the C score. Individually evaluating each ESG score eliminates the issue of multicollinearity and correlation between the three ESG measurements. Due to the high correlation between

firm size and the remaining financial metrics, removing firm size as an independent variable improves the regression results. The remaining variables have a VIF value of less than five, indicating that the multicollinearity of independent and control variables is acceptable. Figure 5.1 illustrates the VIF values for each independent and control variable.

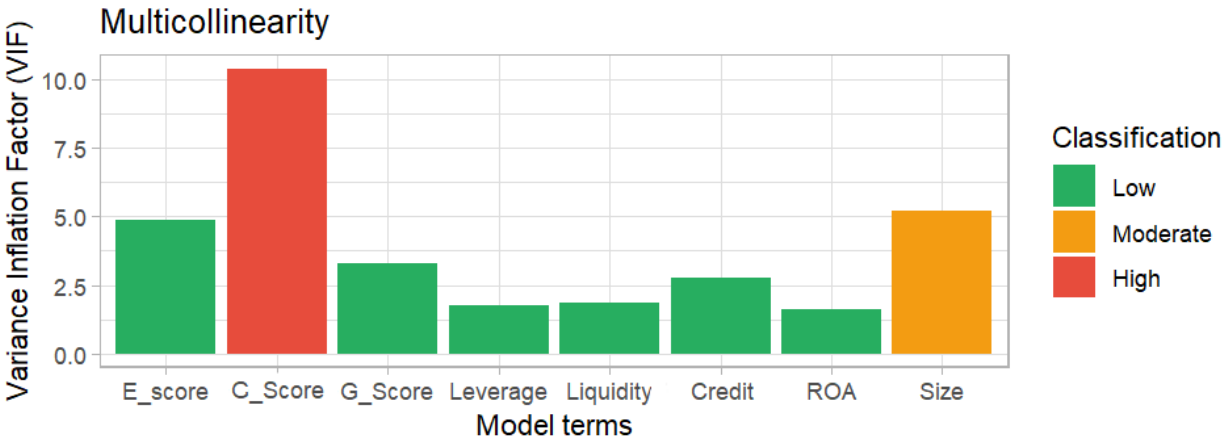

Figure 5.1 Multicollinearity of Model Variables

Separating each ESG score for analysis significantly improved the multicollinearity, as all variables had a value of less than two. The low VIF results indicate that the regression variables are independent and more reliable. Figure 5.2, Figure 5.3, and Figure 5.4 illustrate the VIF values for the separate regression models.

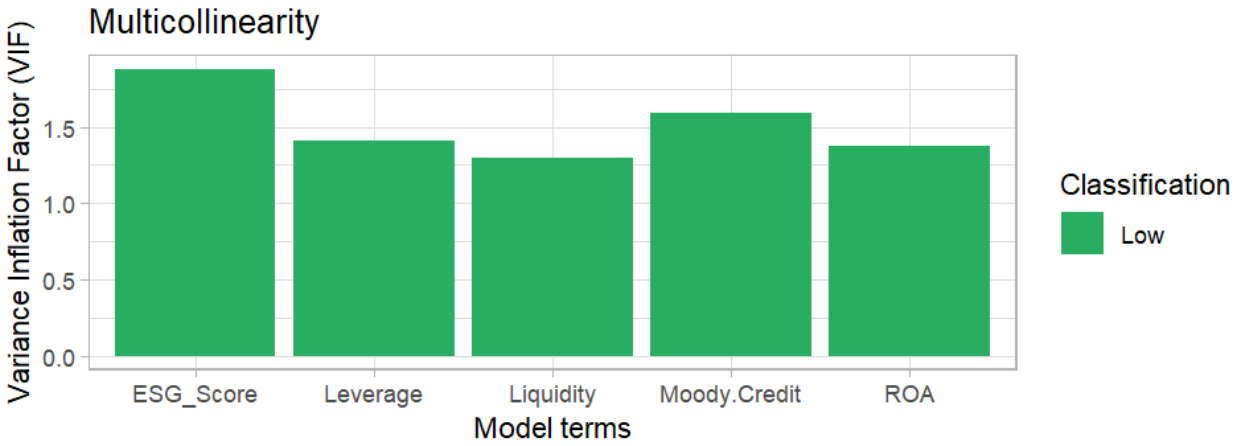

Figure 5.2 VIF Values using Comprehensive as only ESG Metric

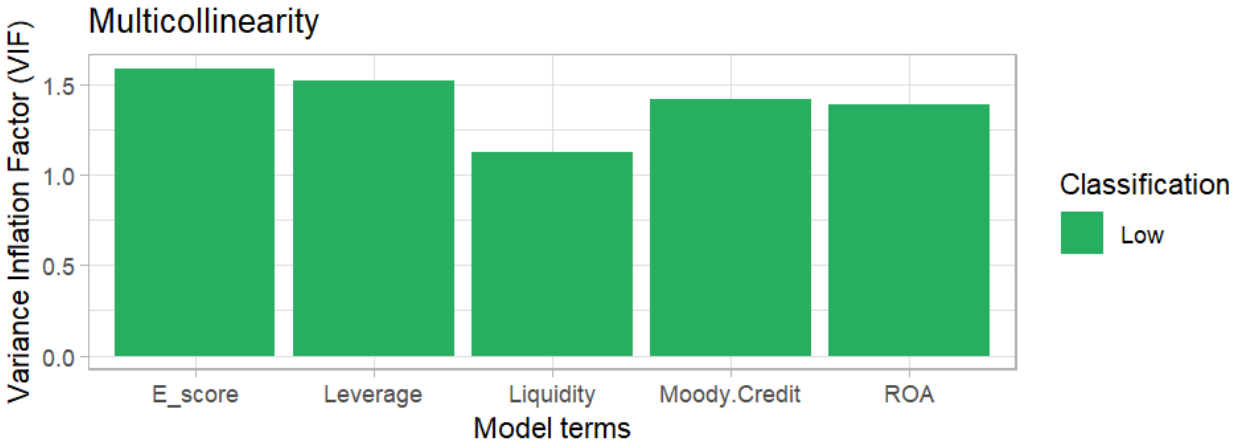

Figure 5.3 VIF Values using Environmental score as only ESG metric

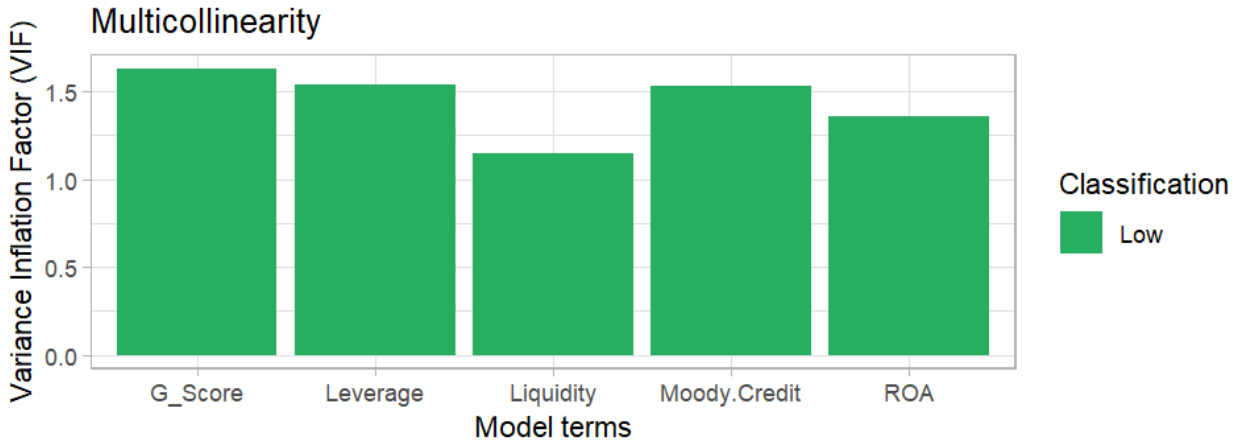

Figure 5.4 VIF Values using Governance score as only ESG Metric

Since the data is a time series (measuring the same variables in a sequence over time), autocorrelation may cause an issue with the reliability of the regression results. Autocorrelation measures the relationship between a variable's current and past values (Mallick, 2020). This thesis applied the autocorrelation function (ACF) test to determine if autocorrelation was present in the residuals from the regression analysis. Values equal to one indicate a perfect correlation between current and lagged values. One expects the current value to have a perfect correlation with zero lag as it is the same value. The test results provided ACF values between 0.35 and -0.35 for all three regression models

suggesting no autocorrelation effect in the residuals. Figure 5.5, Figure 5.6, and Figure 5.7 illustrate the ACF values for each regression model.

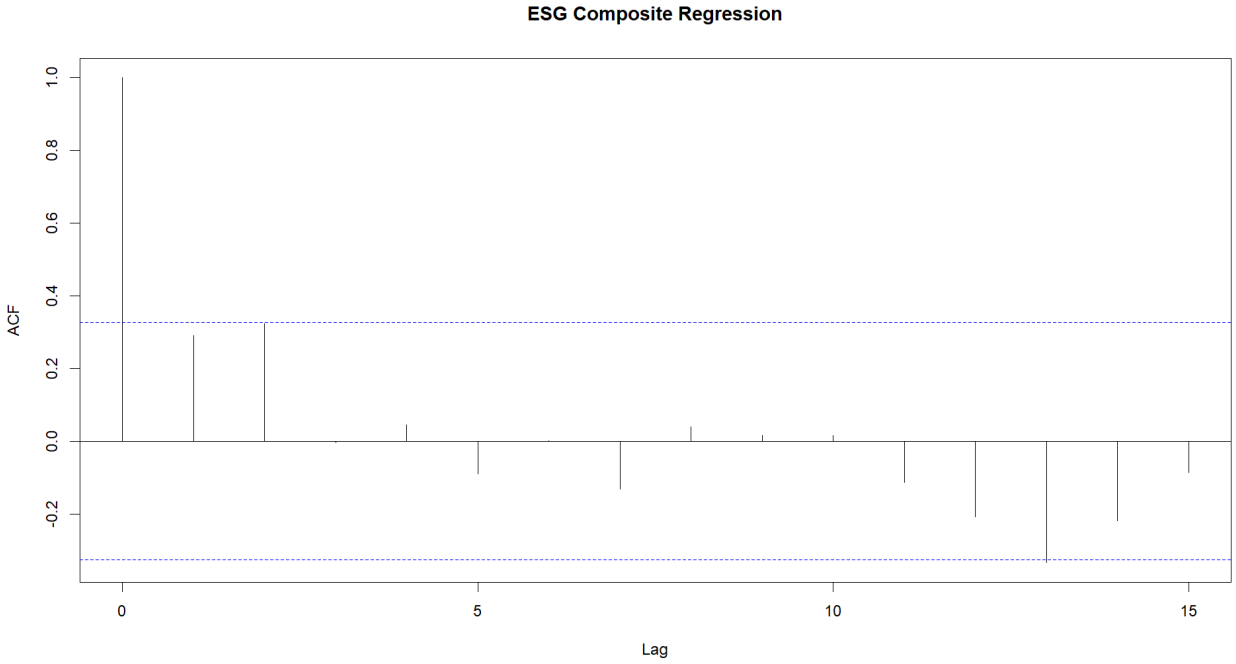

Figure 5.5 Autocorrelation Plot - C Score

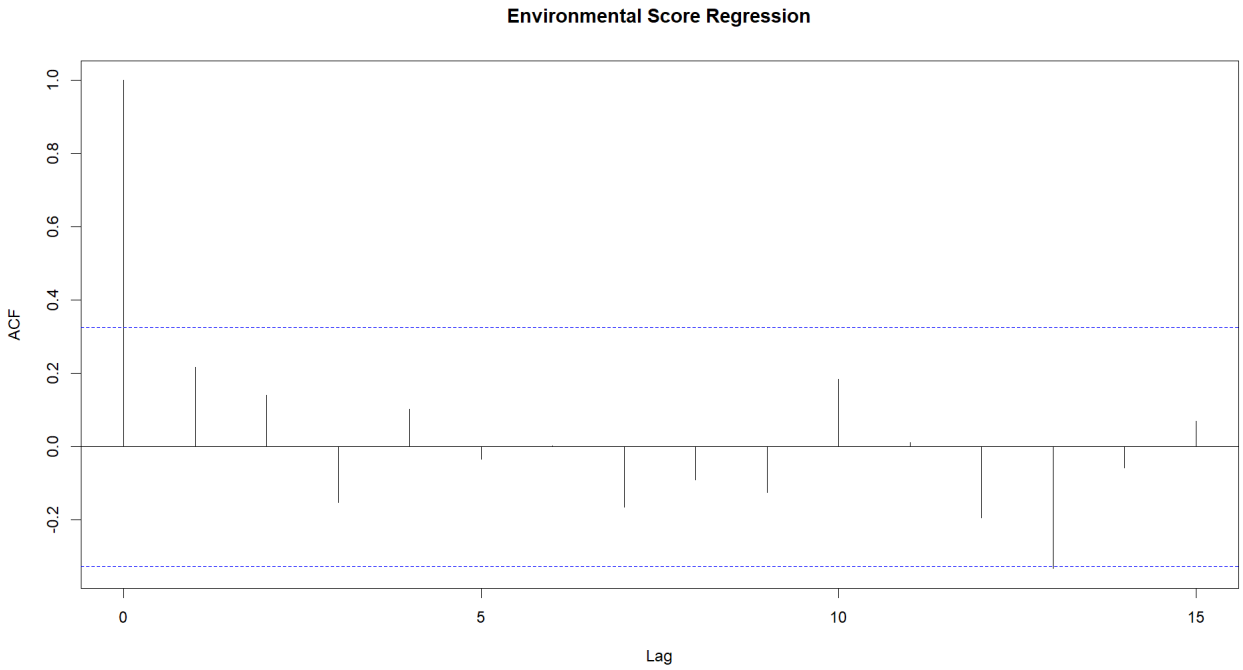

Figure 5.6 Autocorrelation Plot - E Score

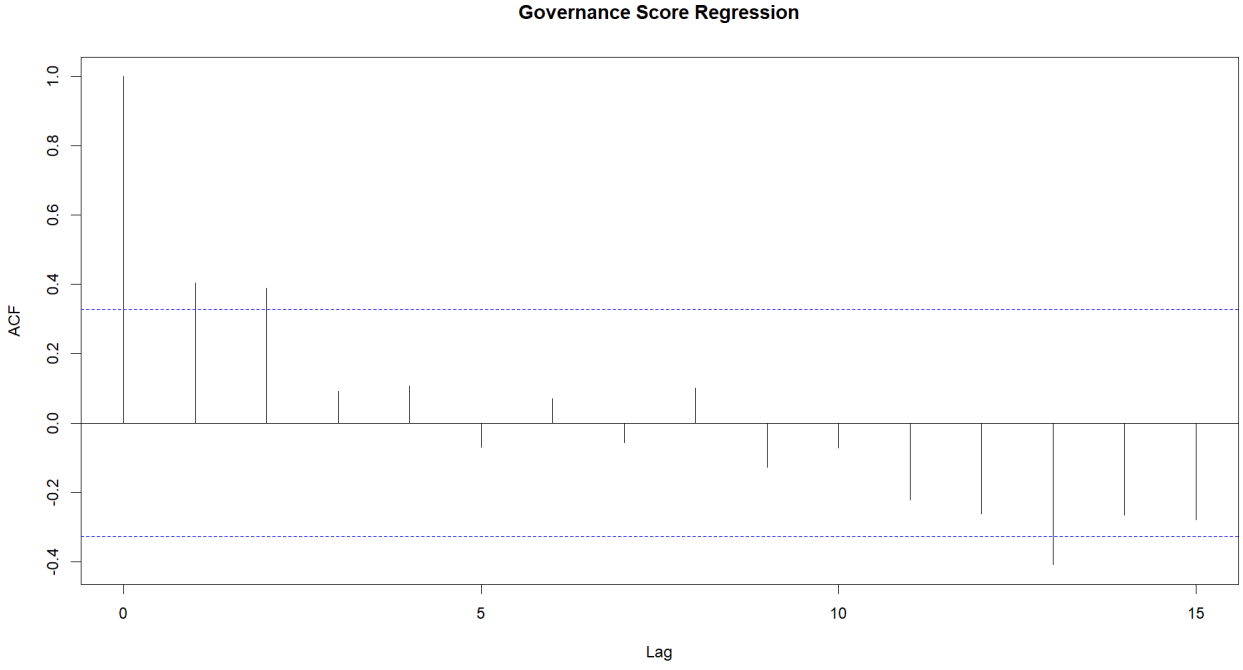

Figure 5.7 Autocorrelation Plot - G Score

Finally, to ensure normal data distribution, this thesis tested normality assumptions and evaluated the probability plot of the standardized residual. In the normality test, the data points are plotted against a theoretical normal distribution so that the points form an approximate straight line (Chambers et al., 1983). Figure 5.8, Figure 5.9, and Figure 5.10 illustrates each model's Normal Distribution Plots of the Residuals.

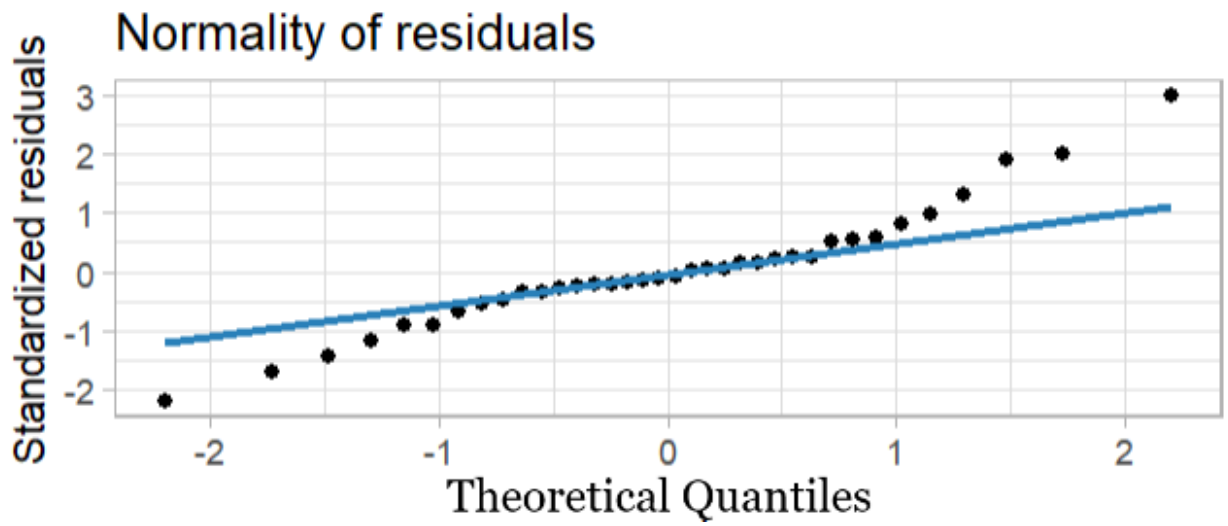

Figure 5.8 Normality of Residuals Plot for Comprehensive Score to Tobin's Q

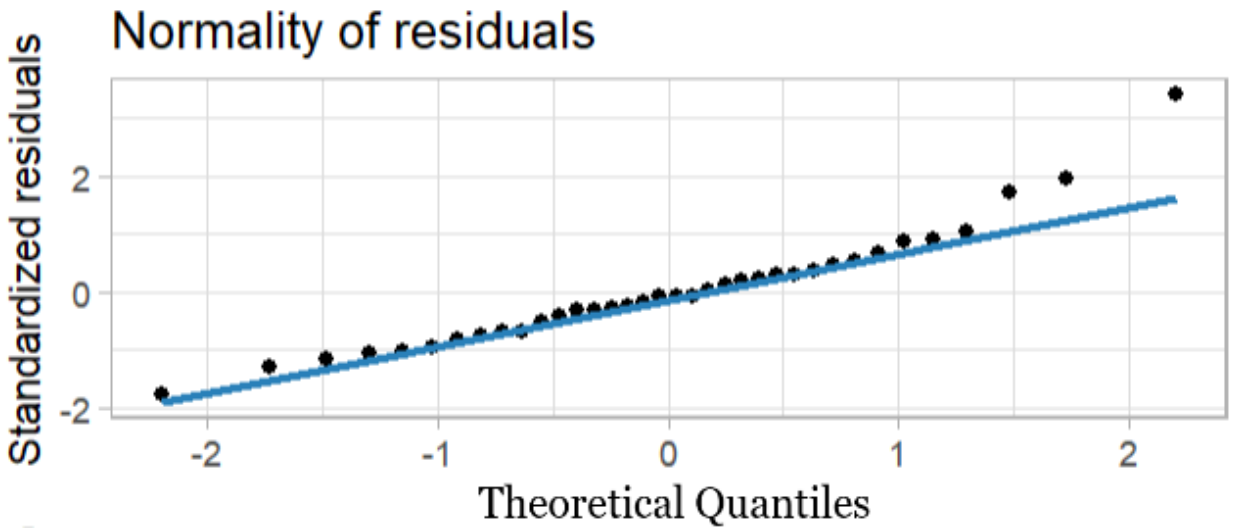

Figure 5.9 Normality of Residuals Plot for Environmental Score to Tobin's Q

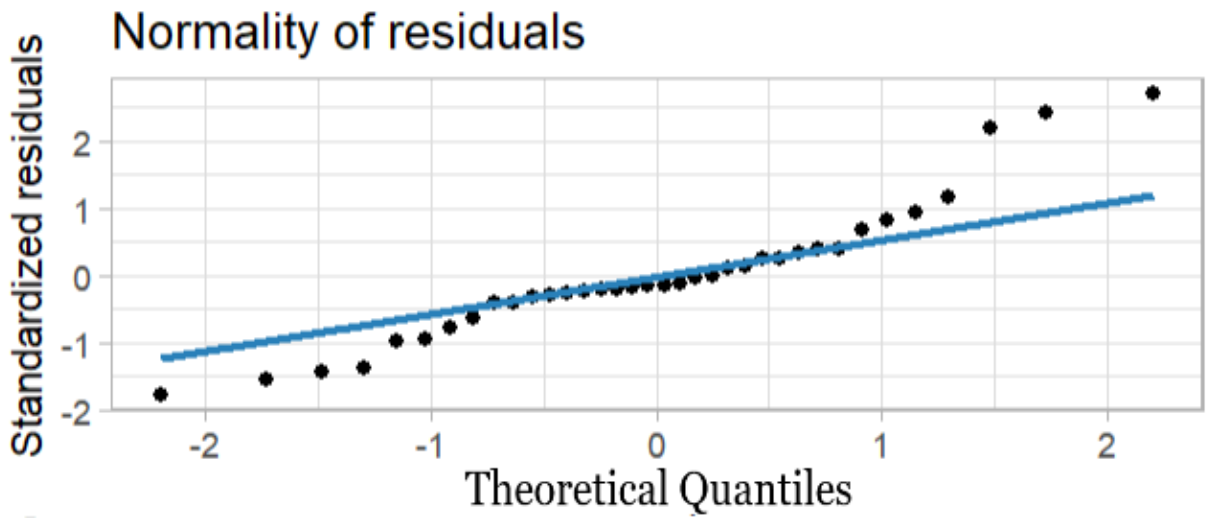

Figure 5.10 Normality of Residuals Plot for Governance Score to Tobin's Q

In addition to checking for multicollinearity, the normal distribution of the data, and autocorrelation, the data must be assessed for heteroscedasticity, which occurs when data has unequal variability across the predictor variables (Glen, 2018). In a regression analysis, heteroscedastic data can result in biased coefficients. Ideally, the data is homoscedastic, meaning the variance of the errors is constant. This thesis applied Park's test, which examines the data for a systematic relationship between the squared residuals and the independent variables in the regression model (Wiedermann et al., 2017). None of the independent variables demonstrated heteroscedasticity from Park's test, increasing the reliability of the results.

Unfortunately, Moody's Credit scores were constant over time for most companies, except for Barrick. Agnico Eagle and Hecla had no credit ratings during the time assessed. These companies did not issue bonds and used a different capital structure, likely using shareholder equity and cash to fund expenses, while the other companies relied on loans or bonds. The lack of variability in the credit ratings over time (shown in Figure 5.11) and missing data for some companies raise concerns about the ability of changes in credit ratings to explain variations in the CFP. This violates the assumptions that the variation

in the independent variable changes due to the dependent variable. For these reasons, the regression analysis of this thesis cannot use Moody Credit ratings.

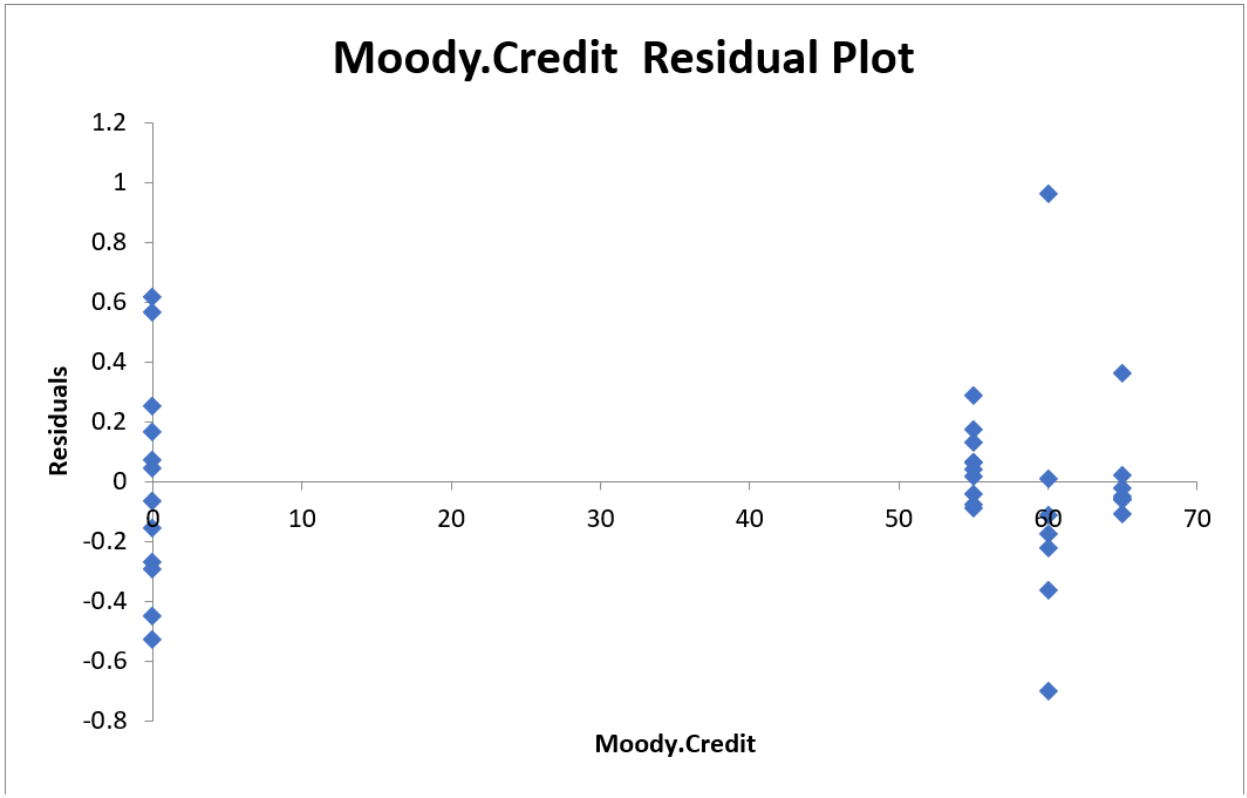

Figure 5.11 Normality of Residuals Plot for Moody Credit Score to Tobin's Q

5.2 Data Descriptive Statistics

Six gold mining companies have been assessed from 2015 to 2020 for this thesis. Table 5.1 provides the descriptive statistics of the variables, including minimum, maximum, mean, and standard deviation.

Tobin's Q represents the firm's market value of assets in proportion to their replacement value (So, 2021). Before taking the natural log of Tobin's Q, the average value was 1.362, indicating that, on average, the mining companies' assets have a higher market value compared to their replacement value. A higher market than replacement value is only sometimes the case, as there are some years when companies have Tobin's Q less than one. Twenty-two percent of the data collected have Tobin's Q values of less than one. The

annual average ROA is approximately 0.01, the average leverage is 0.19, and the average liquidity is 2.47.

Table 5.1 Descriptive Statistics of Long-Term Regression Variable Data

	N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable					
Tobin's Q	36	0.719	2.672	1.362	0.485
Ln Tobin's Q	36	-0.330	0.983	0.251	0.335
Independent Variables					
C Score	36	32.109	85.706	64.494	12.843
E Score	36	1.232	6.630	4.865	1.367
G Score	36	5.630	8.795	7.068	0.812
Control Variables					
ROA	36	-0.222	0.188	0.009	0.072
Leverage	36	0.111	0.379	0.194	0.052
Liquidity	36	0.865	4.378	2.470	0.868

Bloomberg's C Score ranged from a minimum of 32.1 to a maximum of 85.7, with an average value of 64.5 for the six gold mining companies. Although there is an extensive range of C scores, the individual firm ratings are grouped and have significantly less variation when considering the individual firms' ratings. An x-y scatter plot of the C score and Tobin's Q illustrates a slight correlation, as seen in the diagonal slope of the trend line. However, the highest C scores do not necessarily equate to the highest market value measured by Tobin's Q. Figure 5.12 plots the ESG comprehensive scores against the firms' calculated Tobin's Q value highlighted by the company.

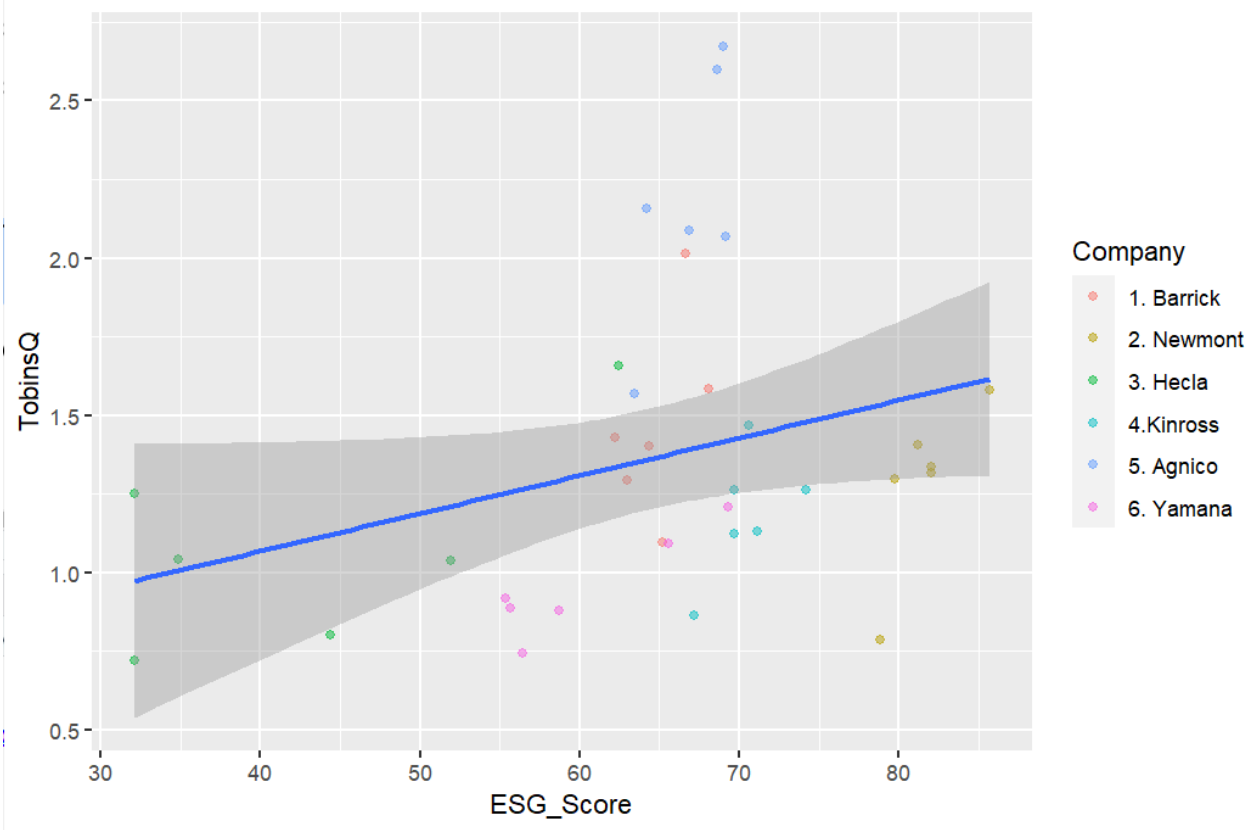

Figure 5.12 Scatter Plot of C Score to Tobin's Q

Regression analysis assumes that the observations are independent of each other. If the data is grouped by a variable, for example, by company, then observations within each company are likely similar or correlated than evaluating all observations across different companies. Clustered data violates the independence assumption, leading to biased coefficient estimates and invalid inference. Figure 5.13 shows the tight groupings of ESG ratings by the firm. Some firms have a stronger correlation between C and Tobin's Q, and some firms outperform their competitors in ESG ratings. Grouping of the data causes concern about clustered data which means adjustments to the regression may be required to account for the correlation within the companies properly.

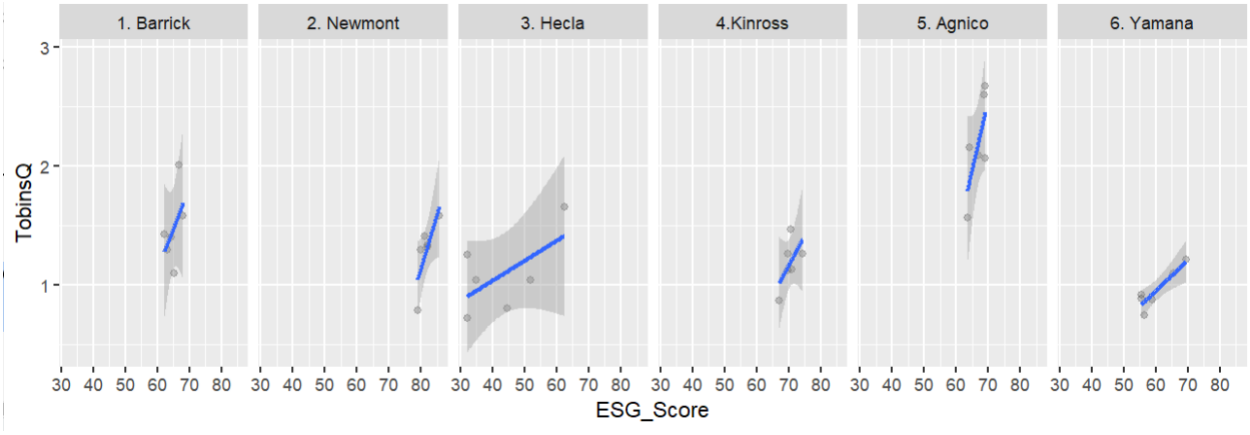

Figure 5.13 Scatter Plot of C Score to Tobin's Q segregated by firm

Grouped data leads to within-group correlation causing smaller effective sample sizes and inflated significance levels. Furthermore, grouped data causes underestimation of the standard errors for the coefficient estimates, making it more likely to find statistically significant results even when the effects are not genuinely significant, leading to false conclusions and misleading interpretations. Data grouping also raises concerns that companies may have significant heterogeneity in their characteristics, strategies, or environments. This heterogeneity can affect the relationships between the independent and dependent variables, making it difficult to generalize the regression results to a broader population or make accurate predictions. Grouped data may require more advanced statistical techniques that properly account for the clustered or correlated nature of the observations. The failure to address the clustered structure of the data can lead to model misspecification and biased results. Advanced statistical methods for analyzing clustered data, such as clustered standard errors, random effects models, or fixed effects models, address the concern for grouped datasets. Applying these techniques can help adequately account for group correlation and provide more accurate and reliable regression analysis results. This thesis applies the clustered standard errors technique to correct for the within-group correlation.

The governance and environmental scores have similar issues with grouped data as the C scores. However, G shows less correlation to Tobin's Q when evaluated in an x-y scatter plot of the company governance rating to market value, shown in Figure 5.14. The Figure shows a horizontal trend line indicating little to no correlation between the two variables. It is likely that the "expected norm" for businesses operating in the U.S. and Canada is to abide by ethical business principles and should not be rewarded for achieving a general expectation. Conversely, the environmental score illustrates a moderately positive correlation to the firm value shown in Figure 5.15. The strength of the correlation depends on the firm, as some firms like Yamana, Agnico Eagle, and Newmont have much more robust relationships between the environmental rating and market value than other firms like Barrick. Figure 5.2.5 illustrates the variations in correlation between E and Tobin's Q by company. The inconsistent correlation may reflect the difference in each firm's approach to communicating its environmental impact.

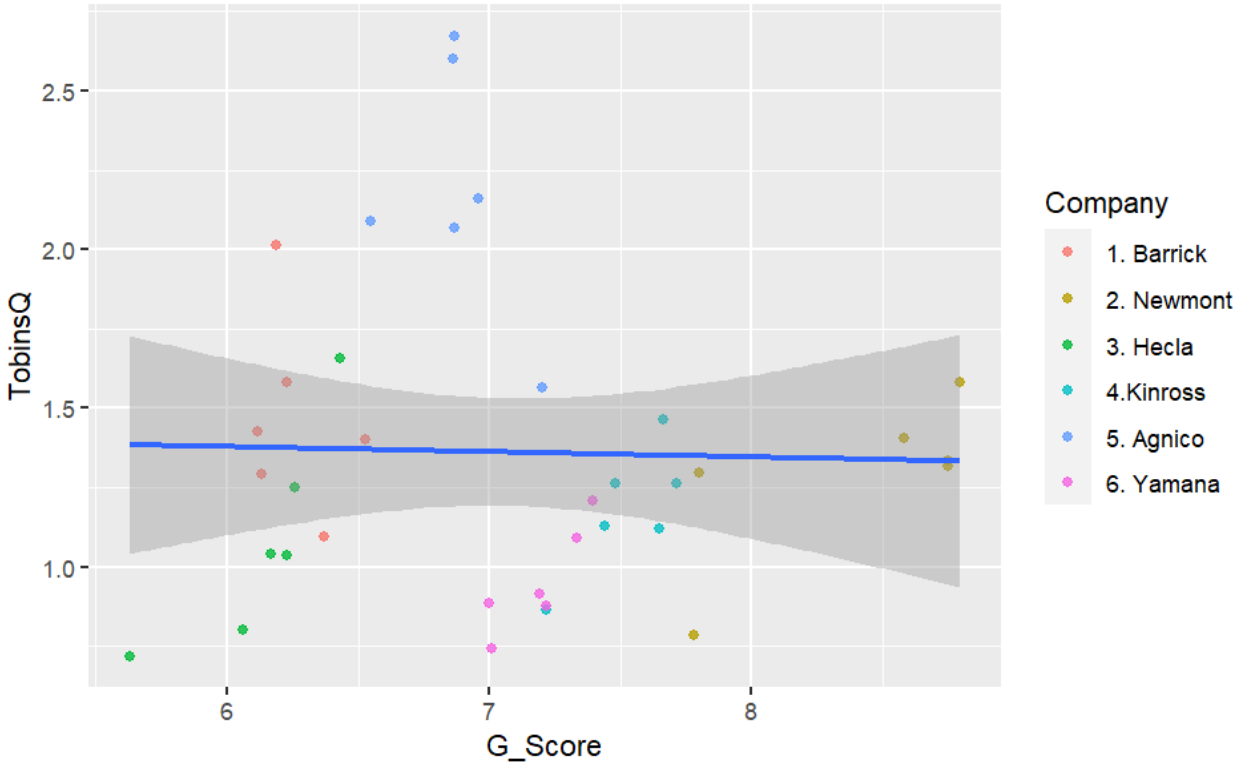

Figure 5.14 Scatter plot of G Score to Tobin's Q highlighted by company

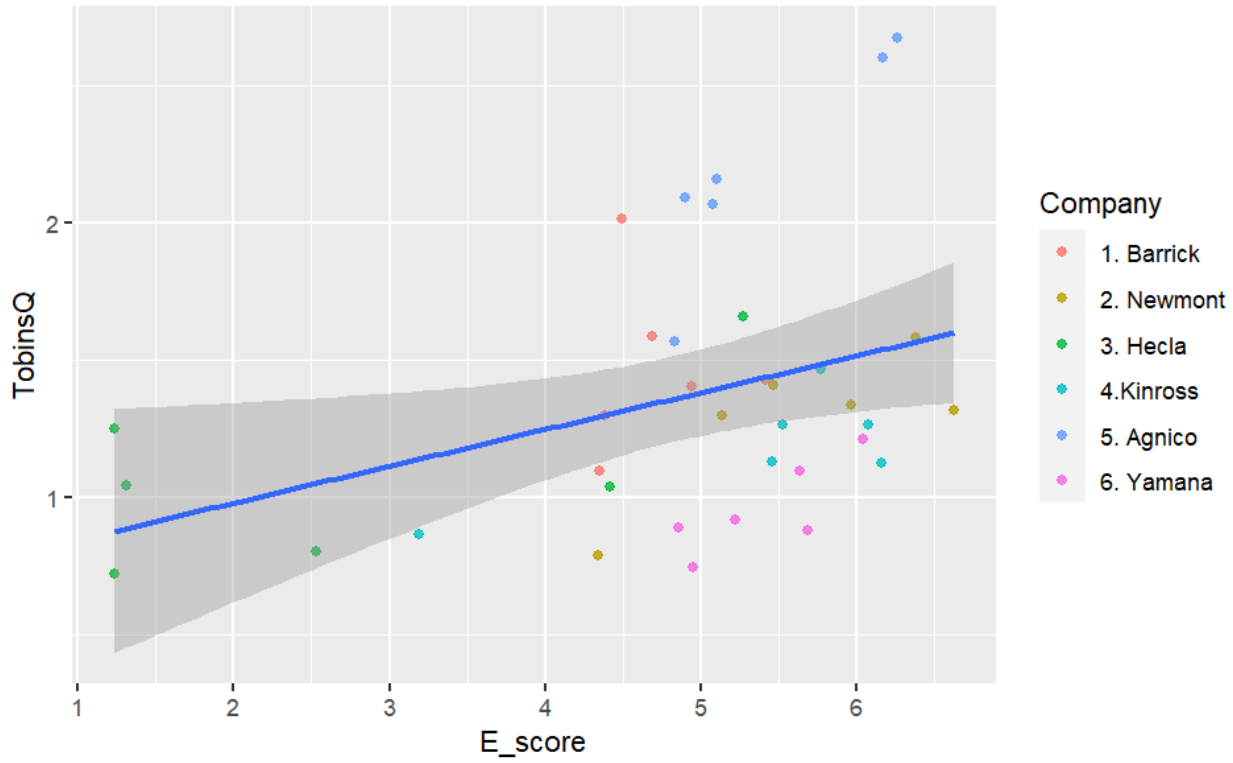

Figure 5.15 Scatter Plot of E Score to Tobin's Q highlighted by firm

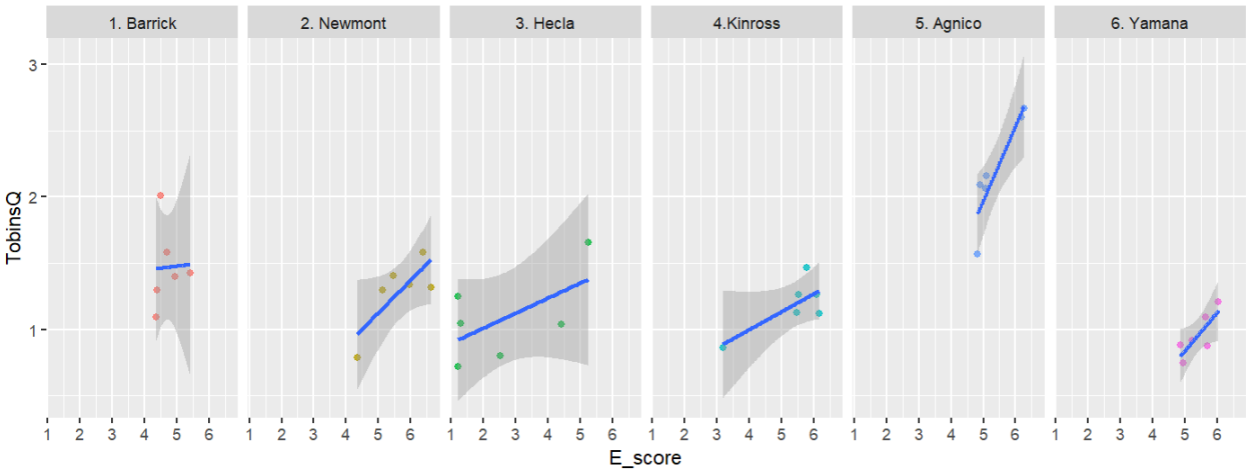

Figure 5.16 Scatter of E Score to Tobin's Q by firm

5.3 Hypothesis Testing and Analysis

5.3.1 Hypothesis 1 - C Score Positively Correlates to Market Value

Hypothesis 1 for this thesis states that: Higher Comprehensive ESG Score (C) results in greater firm financial performance, as measured by Tobin's Q for each gold mining company. Hierarchical multiple regression analysis tests Hypothesis 1 and evaluates the influence of C scores on Tobin's Q controlled by ROA, liquidity, and leverage (Equation 2.11). Table 5.2 provides the regression analysis results for Hypothesis 1 – C score has a positive and significant relationship to the firm's market value.

Table 5.2 H1 - Regression Coefficients

	Coefficients	Standard Error	t Stat	P-value
Intercept	-0.1196	0.3438	-0.3479	0.7302
ESG Score	0.0057	0.0044	1.3043	0.2017
ROA	1.3375	0.8247	1.6219	0.1150
Leverage	-0.8603	1.1026	-0.7803	0.4411
Liquidity	0.0639	0.0655	0.9755	0.3369

The hierarchical multiple regression results assessing the influence of comprehensive ESG score on the natural log of Tobin's Q, when controlling variables, indicates that none of the independent variables have a statistically significance influence on the firm's market value as measured by the natural log of Tobin's Q. The regression indicates that leverage is inversely related to market value. ROA is the leading influencer based on the values of the coefficients. The significant standard error terms and higher (greater than 0.05) p-values indicate that the selected independent and control variables are not statistically significant. The lack of statistical significance means that C score, ROA, leverage, and liquidity do not meaningfully impact a firm's market value. Furthermore, when determining the statistical significance of regression analysis, one should assess the adjusted R-squared (R^2) value. The R^2 value in regression analysis measures how well the independent variables in the regression model explain the variation in the dependent variable, adjusted for the number of predictors and sample size. The adjusted R^2 value for the comprehensive ESG score

regression is 0.204, which indicated that the selected independent variables accounted for a small percentage of the variation in the independent variable. Again, the statistical results indicate that the selected variables do not sufficiently represent changes to the market value of a firm.

Table 5.3 H1 Regression Statistics

Multiple R	0.543351059
R Square	0.295230373
Adjusted R Square	0.204292357
Standard Error	0.303054111
Observations	36

Table 5.4 ANOVA

df	**SS**	**MS**	**F**	**Significance F**
Regression	4	1.192657952	0.298164488	3.246501133
Residual	31	2.847095611	0.091841794	
Total	35	4.039753562		

5.3.2 H1 Results Discussion

The gold mining industry differs from others as investors can choose to balance their portfolio risk by investing in gold or gold mining company stocks (Ernst, 2023). For instance, as interest rates decline, investors make less money through lending and may elect to invest in commodities, specifically gold, to offset the losses from interest rates. As a result of increased demand for gold, gold mining companies experience higher profit margins, attracting more investors. This ever-changing balance of interest rates and gold investing impacts gold mining companies' market values. As a result, typical financial metrics such as leverage, liquidity, and ROA have less impact on the firm's market value than these would for other industries. Previous researchers (Surenjargal, 2022; Garcia et al., 2018) have used these metrics in conjunction with ESG ratings to derive the influence of ratings on CFP for various industries.

In addition to the influence of changes to interest rates, the stability of currency exchanges also influences the gold mining industry. As the U.S. dollar strengthens, the demand for gold decreases, lowering the price and reducing investor interest in gold mining stocks (Hecht, 2022). This external factor is uncontrollable for gold mining companies yet has a much more substantial influence on stock price and market value than other financial metrics within the firm's control. The impact of currency stability on gold price further explains the lack of significance for the selected financial metrics of ROA, leverage, and liquidity.

Another factor that drives a gold mining company's market value is changes to its reserves and resource base. The market favors growth announcements as it generally increases the long-term stability and potential for financial returns to investors. A mining firm's growth is measured as its reserve and resource bases increase. However, financial statements only include the cost of reserves and resources as part of property, plant, and equipment. Since the fair market value of reserves and resources are not captured in leverage (debt divided by total assets), liquidity (current assets/ current liabilities), or ROA (net income/ total assets), a crucial factor in a gold mining firm's market valuation needs to be included. Not properly including the resource and reserve base changes may partially explain why the regression analysis had a lower R^2 value.

Gold mining firms' market share price is influenced by more than simply their financial metrics. These firms are impacted by commodity prices, investor expectations of growth, currencies and global markets stability, with various other factors not captured in this thesis. For this reason, the variables in the regression analysis do not account for a significant amount of the changes to market value as measured by Tobin's Q.

Even though the selected financial metrics did not represent the changes to market value, neither did the changes to the comprehensive ESG score. The lack of correlation means the market generally does not notice or value changes to ESG ratings, and this may be because the ratings are for subscribers only, making the ratings private information.

Private information is less likely to influence a firm's financial performance (Kim Olbert, 2022).

For the five years assessed in this research, the selected firms spent millions of dollars investing in various ESG-related initiatives. Despite the significant expenditure on ESG, the ESG ratings remained relatively constant, changing on average by nine points out of 100. Hecla experienced the most improvement to C with an increase of thirty-three points, while Barrick's rating declined by three. The changes in ratings are not proportionate to the financial investments made by the firms. The rater's perceptions of the gold mining industry have mostly stayed the same over the five years despite the efforts of the mining firms. Although the ratings have limited improvements, the CFP of the selected firms have improved dis-proportionally to the comprehensive score, indicating that the ratings are meaningless for the gold mining firms assessed in this thesis. The regression analysis of this research supports that the ESG comprehensive scores has not influenced the gold mining firms' market value over time.

5.3.3 Hypothesis 2 - E Score Positively Correlates to Market Value

The second hypothesis established the null hypothesis as the environmental score awarded to a firm positively and significantly impacts the firm's market value. This thesis applied the same linear regression modeling technique as the comprehensive score to test this hypothesis. However, it isolated the environmental score to assess this component's relationship with firm value. This hypothesis is rejected when the E score shows statistical significance, as measured by a low p-value (less than 0.05 for a ninety-five percent confidence interval), and has a negative coefficient value.

The regression analysis results indicate no statistical significance at the ninety-five percent confidence interval for any variables. However, the environmental score is statistically significant at an eighty-five percent confidence interval, as the p-value is 0.11. This means that with a lower confidence level, the environmental score may positively influence the firm's market value by as much as nine percent (coefficient value of 0.097).

The financial variables had no statistical significance in this regression at any confidence interval. Table 5.5 lists the regression results for Hypothesis 2.

Table 5.5 H2 - Regression Coefficients

Variable	**Coefficients**	**Standard Error**	**t Stat**	**P-value**
Intercept	0.841153	0.507566	1.657229	0.107561
E Score	0.09726	0.059471	1.635416	0.112077
ROA	1.230276	1.234035	0.996954	0.326506
Leverage	-1.20499	1.682907	-0.71601	0.479342
Liquidity	0.109356	0.091606	1.193761	0.241627

The regression's statistics indicate that the regression does not adequately represent the changes to Tobin's Q, as the R^2 value is 0.155. This means that the independent variables accounted for approximately fifteen percent of the firm's market value changes. The poor correlation indicated by the low R^2 value suggests that each variable's resulting regression model coefficients may be misleading and inaccurate. If the R^2 value were closer to 1, the researcher would have high confidence that the results adequately represented the changes to the dependent variable and could draw appropriate conclusions.

Table 5.6 H2 - Regression Statistics

Multiple R	0.501567
R Square	0.251569
Adjusted R Square	0.154997
Standard Error	0.451744
Observations	36

Table 5.7 H2 - ANOVA

	df	**SS**	**MS**	**F**	**Significance F**
Regression	4	2.126433	0.531608	2.604997	0.054899
Residual	31	6.326247	0.204072		
Total	35	8.45268			

5.3.4 H2 - Results Discussion

The second hypothesis speculated that a higher environmental score resulted in higher financial performance for gold mining companies in the U.S. and Canada. In theory, a firm's environmental score represents its risk of harming the environment. Firms in the extractive industries naturally pose a greater environmental risk than other industries. For this reason, the environmental scores for the selected gold mining companies cannot be a perfect score of ten as there will always be inherent risks for the industry. The highest environmental score was 7.5 out of 10 for Newmont, and the lowest was 1.3 for Hecla in 2017. On average, E scores improved by two points (twenty percent) in the five years.

Despite the relatively significant improvements to environmental ratings, the correlation to a firm's financial performance was not evident in this research. The disconnect between E and CFP may indicate that the market needs to be made aware of the environmental improvements made by the mining companies and pay attention to changes in ratings. The improvements to the rating scores may not necessarily indicate that firms are more environmentally cautious or made improvements, as it may be that the rating criteria changed over time, causing higher ratings. Regardless of the reason for the changes to environmental ratings, there is no evidence to support the correlation between CFP and E scores according to the regression analysis of this thesis.

5.3.5 H3 - G Score Positively Correlates to Market Value

The third hypothesis proposed that a higher Governance Score (G) results in greater firm financial performance, as measured by Tobin's Q for each gold mining company. Regression analysis tested this hypothesis per Equation 2.13. The results of this regression indicate an inverse relationship between G and Tobin's Q, as the correlation coefficient is -0.099. For this regression, leverage also presents an inverse relationship with a correlation coefficient of -2.27, similar to the hypothesis 1 and 2 results. Table 5.8 lists the regression analysis results for testing Hypothesis 3.

Table 5.8 H3 - Regression Coefficients

Variable	Coefficients	Standard Error	t Stat	P-value
Intercept	2.17079	0.830942	2.612446	0.013739
G Score	-0.09882	0.100218	-0.98603	0.33175
ROA	1.587374	1.248786	1.271133	0.213137
Leverage	-2.27426	1.726591	-1.3172	0.197426
Liquidity	0.128121	0.095501	1.341579	0.189478

Like the other regression models, Hypothesis 3 does not provide statistically significant results as none of the p-values for the independent and control variables are less than 0.05, required for ninety-five percent confidence. The selected variables account for merely eleven percent (R^2) of the change to the market value of a firm.

Table 5.9 H3- Regression Statistics

Statistic	Value
Multiple R	0.46013
R Square	0.21172
Adjusted R Square	0.110006
Standard Error	0.463614
Observations	36

Table 5.10 H3 - ANOVA

	df	SS	MS	F	Significance F
Regression	4	1.789601	0.4474	2.081531	0.107192
Residual	31	6.663079	0.214938		
Total	35	8.45268			

5.3.6 H3 - Results Discussion

Bloomberg quantitively measures corporate governance based on board member diversity, tenure, over boarding, and independence. Bloomberg assesses a board's composition to determine how well a board is positioned to provide a diverse perspective and supervision of management (Bloomberg, 2020). Although tenure and diversity of

board members are essential for a well-balanced view of the company and may provide insights on improving the firm's performance, most investors are more concerned with who is on the board. A single well-known and respected board member with decades of mining experience is more likely to impact the value of a firm than strictly noting the diversity of the board of directors.

he governance score is meant to measure the ethical business practices of a firm. Unfortunately, the metrics used by Bloomberg to assess a firm's board structure need to do more to evaluate the firm's ethical behavior. Disruptions to production due to labor strikes or conflicts with the local communities are likely a better metric for determining a corporation's culture and ethical priorities. Nonetheless, the metrics selected by Bloomberg and the publicized governance ratings do not impact a corporation's financial performance. The lack of correlation may be due to investors' perception of the rating structure as improperly measuring ethical behavior. Alternatively, the investors may generally expect businesses to prioritize human rights and ethical practices without needing to reward them for meeting this expectation as Hawn et al. (2018) described.

5.4 Long-term Impact of ESG Ratings Discussion

ESG rating firms have the difficult task of quantifying a company's qualitative and obscure aspects of business in a meaningful way such that investors may quickly estimate the risks involved in their expected returns. If ESG ratings were critical to investors' decision-making, then changes to a firm's rating would likely impact the firm's market value over time. Contradictory, this thesis's research and investigation of the impact of ESG ratings on a firm's market value indicate that the ratings have no tangible impact on the corporation's financial performance. None of the ratings, whether comprehensive, environmental, or governance, significantly influence of CFP for the six gold mining companies assessed from 2015 to 2020. Of the three ratings assessed in this work, the environmental pillar was closest to making a measurable impact. The market value of a company may relate to environmental performance as consumers, investors, and society

continuously stress the importance of ensuring a clean inhabitable planet for future generations to enjoy. However, in the long term, there is no evidence to support that the market values a company based on a rater's opinion of the firm's ESG performance.

CHAPTER 6

METHODOLOGY FOR QUANTIFYING ESG METRICS

Chapter six describes the new methodology for quantifying ESG metrics and the process for assessing gold mining firms. This chapter will briefly describe the existing ESG rating process, differences between prominent rating agencies, and deficiencies in the current methodologies. A newly proposed methodology will be discussed providing recommendations for improving ESG metrics specific to the mining industry. A technical discussion and implications of the research results will also be included in this chapter.

As previous iterated, regardless of the rating criteria is private knowledge, as a consequence it is difficult to do any stat analysis about the metrics used. Barring the lack of public disclosure of criteria, these are the critical criteria for doing a meaningful assessment.

6.1 Current Rating Agencies Methodology for Evaluating ESG

ESG ratings are complex analyses of the intricate interactions between a firm and its surroundings. ESG rating firms take hundreds to thousands of data points, analyze them, and try to derive a single score that illustrates to the market the historical and potential future risks associated with a firm's performance. Generally, the data collected consists of publicly published documents prepared by the firm, such as sustainability reports or third-party audited reports. Some rating agencies also request private information from the firm through questionnaires or interviews. The ESG rating agent must assess the data to determine the risk of an incident, accident, or change in perception impacting a firm's market value. The rater assesses the risks associated with a firm's environmental and social impacts as well as its governance structure. E, S, and G is considered pillars upholding a firm's overall ESG comprehensive score. After gathering the data, the analyst must

determine the key criteria for each of the three pillars before assigning weights to the pillars to derive an aggregated ESG score.

The environmental pillar consists of data related to the company's environmental impact. It may include emissions related to climate change, pollution, waste management, management of natural capital, or opportunities to implement clean energy. The social pillar relates to how the firm manages its employees, external stakeholders' opposition, and social opportunities for communities. Health and safety, community relations, and product safety comprise a firm's social pillar rating. The governance pillar reflects a firm's corporate governance policies and corporate behavior, including ethical practices. Most raters select four or five key criteria for each pillar to group the data under for rating purposes based on the industry and firm specifically. The analyst next determines the weighting for each key criterion based on the nature of the industry and the analyst's opinion to derive E, S, and G pillar scores. Analysts then aggregate the individual pillar scores into a single ESG Rating. Figure 6.1 illustrates an example of the ESG Rating hierarchy by MSCI, where each pillar has key criteria and associated data points to derive a final pillar rating.

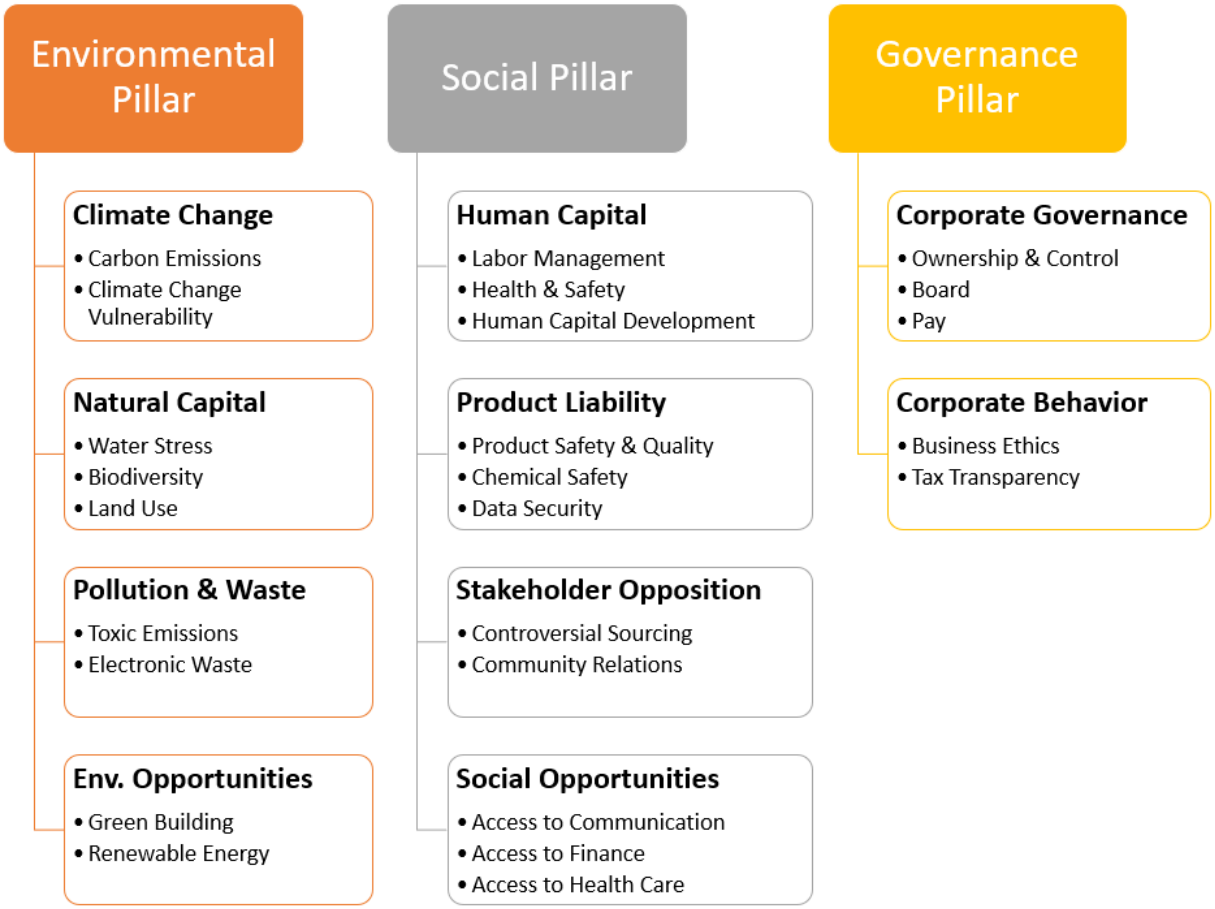

Figure 6.1 ESG Ratings Model Hierarchy *(MSCI, 2022)*

Each rating agency may select different key criteria for each pillar by industry and firm, causing variation in ratings between agencies. Most ESG raters consider climate change and carbon emissions a key environmental criterion for all industries. However, not all raters consider air quality a necessary criterion for evaluating a mining firm's ESG risk, even though these topics threaten miners' compliance with environmental regulations. Most raters consider the health and safety of employees and the demographics of human capital as key social criteria. Not all raters attempt to quantify external stakeholder engagement through community relations or social capital, which is crucial for mining companies to obtain their social licensing. According to National Environment Protection Act, mining companies must engage in at least four stakeholder engagements per year with

local communities to obtain and retain federal permitting (Executive office of President, 2013). Human rights within the supply chain have been a central focus for the World Gold Council and other standard-setting firms, but human rights are not a part of ESG ratings for all firms. Some rating companies may group human rights as a governance criterion under business ethics, while others consider it a key criterion for social rating. Governance ratings predominately focus on board structure and company policies and procedures. Financial strategies and management credibility, which should be significant in determining investment risk, are rarely selected as a criterion within the governance pillar or evaluated for ESG ratings. Table 6.1 illustrates the variations in key criteria among the several prominent ESG Rating firms.

Table 6.1 Key Criteria for ESG Ratings

	Key Criteria	Moody's	Bloomberg	Sustainalytics	S&P Global	MSCI	FTSE Russel's
Environmental	Physical Climate Risks	X			X		
	Carbon Transition - Climate Change	X	X	X	X	X	X
	Water Management	X	X	X		X	
	Natural Capital - Land Use	X		X	X	X	X
	Waste and Pollution	X	X	X	X	X	X
	Air Quality		X	X			
	Resource Use			X			
	Product Governance			X			
	Energy Efficiency			X			
	Biodiversity			X		X	X
	Resource Use - Supply Chain			X			
	Environmental Opportunities					X	
	Total Key Criteria	**5**	**4**	**10**	**4**	**6**	**4**
Social	Customer Relations	X					X
	Human Capital	X		X	X	X	X
	Demographic and Societal Trends - Diversity	X	X		X		
	Health and Safety	X	X	X	X	X	X
	Responsible Production	X					
	Human Rights - Supply Chain			X		X	X
	Community Relations			X		X	X
	Data Privacy and Security			X			
	Access to Basic Services			X		X	
	Social Capital				X	X	
	Stakeholder Opposition - Controversial Sourcing					X	
	Total Key Criteria	**5**	**2**	**6**	**4**	**7**	**5**

Table 6.1 Continued

	Key Criteria	Moody's	Bloomberg	Sustainalytics	S&P Global	MSCI	FTSE Russel's
Governance	Financial Strategy and Risk Management	X			X		
	Management Credibility and Track Record	X				X	X
	Board Structure, Policies and Procedures	X	X	X	X	X	
	Organizational Structure	X				X	
	Compliance and Reporting	X					
	Compensation		X				
	Shareholder Rights		X				
	Audit Risk & Oversight		X				
	Business Ethics			X		X	X
	Bribery and Corruption			X	X		X
	Transparency & Reporting				X	X	X
	Insurance				X		
	Total Key Criteria	**5**	**4**	**3**	**5**	**5**	**4**

Overall, ESG ratings lack repeatability as the criteria used in the evaluation are proprietary, the data evaluated is only sometimes public information, and the raters have the freedom to change the criteria weighting based on their assumptions or perceptions of the industry or company. In addition to the analysis not being repeatable from outside the firm, there is significant variation in evaluations between rating agencies. In spite of the lack of ability to duplicate results and inconsistencies between raters, companies perceive value in being rated as a potential to attract investors and lenders (Gallup Survey, 2022) and a positive rating creates an opportunity to build customer loyalty (Accenture, 2021). However, the lack of transparency in the composition of the rating causes the mining companies to be unable to define a path for improvement clearly.

MIT Sloan Sustainability Initiative launched the Aggregate Confusion Project to evaluate and improve ESG measurement quality (Berg et al., 2022). The motivation for the Aggregate Confusion Project came from MIT researchers who found significant divergence in ESG ratings associated with a difference in measurement, scope, and weights. The researchers also found a "raters effect" where a rater's overall opinion of the company or industry affects the rating indicating that the ratings can be biased (Berg et al., 2022). When evaluating the correlation between six prominent rating agencies (KLD, Sustainalytics, Moody's, Refinitiv, S&P Global, and MSCI), MIT researchers found the correlation to be 0.61 as compared to 0.99 between credit rating agencies (Berg et al., 2022). The divergence in ratings creates confusion in the marketplace in determining which company to invest in, but also for the companies to determine which initiatives to pursue that would improve their rating.

Another significant area for improvement in the raters' approach to evaluating ESG is that they are attempting to compare all industries on the same criteria and scope. Measuring an application developer's ESG performance should have a different set of criteria than evaluating a company in the extractive industry, as there is a higher risk for environmental and social impact based on the industry. Not all industries have the same potential impact, and depending on the rater's perception of the industry or company introduces a bias that keeps the rating from being quantitative and objective. None of the rating agencies require a technical expert from the industry to review the assessment from a competent or realistic perspective of what is technically possible.

6.2 Recommended Rating Criteria - Specifically for Mining

MIT researchers recommend more aggressively regulating the ESG rating agencies to ensure more comparable and representative results. Nonetheless, comparing all industries against a single list of criteria is difficult. Existing ESG ratings focus on checking a box instead of clearly understanding and valuing the technical complexity of each industry. Most raters discount the extractive industries because of the analysts' perception of the

industry. As a result, the ratings of most mining companies rarely change or improve over time, even though the firms implement new processes, technologies, or policies to reduce ESG risks as shown in Figure 6.2. Not all industries have the same potential impact on the environment or society and should not be compared as if they are the same. A more tailored approach that considers the conditions of the operation and the industry constraints would bring greater clarity and value to ESG ratings.

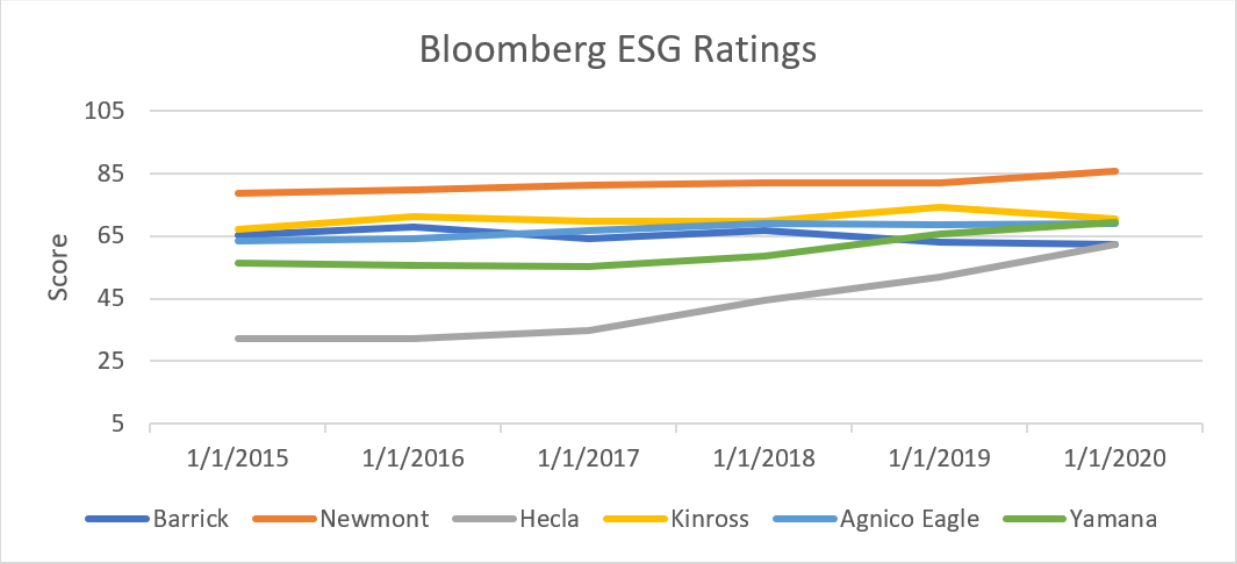

Figure 6.2 Bloomberg ESG Ratings for Selected Gold Mining Firms 2015 to 2020

For example, in mining, there is a limit to what is technologically possible for reducing Scope 1 carbon emissions. The rating agency might look for a statement about future reductions without considering whether the reduction is realistic or possible. In that case, the firm's commitment to reducing emissions may be "greenwashing" its announcements to achieve a higher ESG rating, and the rating would be meaningless as no realistically achievable reduction path exists. Furthermore, the rating agency does not consider if prior commitments are achieved. Conversely, if the rater considers what is technologically possible for a given operation and tracks the progress, then the rating would indicate advancements over time and measure how much further the operation can go to achieve the highest level of sustainability.

Even within the same industry, not all operations have the same capacity to impact ESG in the same way or quantified against a checklist. A surface mine in Canada differs from an underground operation in South Africa due to differences in ore body lithology, government regulation, access to infrastructure, and technology to support the chosen mining method. As such, the environmental and social risks are extensively different. Depending on the country, political positions and degree of regulation vary widely from highly regulated and well enforced to little or no mining regulation and may lack enforceability. Even within the U.S., each state and county may impose different regulations and requirements for permitting making it challenging to compare neighboring mines. Each operation has limitations to what is possible for minimizing ESG risks. Furthermore, different commodities have different processing techniques or mining methodologies which makes it impossible to compare across the entire mining industry. Consequently, instead of comparing all mining operations to each other, each operation should be compared to the best possible version of itself. This "ideal" ESG measure should consider the type of operation, location, regulatory environment, and currently available technology applicable to the operation. Using the best possible outcomes as ESG metrics for each mine site eliminates the need for a single measuring stick to apply broadly and imperfectly to the entire industry. Again, this methodology demonstrates progression over time and more clearly identifies the opportunities for ESG improvement specific to each firm. Investors could then compare the status and progress of firms in achieving the optimal ESG performance to other firms internal or external to the selected industry because the rating illustrates potential risk without the bias of the rater's opinion.

Modeling the best possible ESG performance requires extensive industry-specific knowledge to establish and calibrate the proper metrics. Sections 6.2.1-3 proposes the environmental, social, and governance criterion list for evaluating a mine site and suggests the application process. Although there are many different mining techniques, for simplicity, this thesis will discuss the concepts more generally using a hypothetical

large-scale, open pit oxide ore gold mine in Nevada as the example for application.

6.2.1 Proposed Methodology - Environmental Criteria

Environmental risk evaluation is crucial for mining due to the nature of the industry and the magnitude of financial risk. Mining will always have an environmental impact. However, proper mining techniques reduce the risk of a catastrophic or irreversible event. The risk of environmental impact considers the receptor areas of land, air, water, natural habitat also known as biodiversity, and social impacts associated with climate change.

6.2.1.1 Environment - Land

The aspects associated with quantifying impact and risk are land disturbance or footprint of the property, percent depletion of the reserve, reclamation, and solid waste management. Total land disturbance is not simply the size of the permitted operating boundary, but the actual footprint of the property including administrative buildings, mechanical shops, processing facilities, access roads, areas for waste dumps, and the operating areas of the mine. Ideally, the mine operator would not unnecessarily disturb the natural environment beyond what is absolutely necessary. Has the miner considered the placement of buildings to be in proximity to the active mine areas to reduce the footprint? Or could the footprint be decreased using in-pit backfilling for a waste dump as opposed to permitting a new area? Reducing and limiting the mines' active footprint also considers concurrent-reclamation. If areas are reclaimed, then the land disturbance and risk of harm due to active mining areas are decreased thereby improving the environmental score. In addition to the actual size of the mining footprint, permitting also considers the impact intensity. Land disturbance for a parking lot poses significantly less risk than a hazardous waste dump. Land disturbance is measured in hect-acres and is expected increase during exploration to development, reach its peak during operational years, and ideally be as close to zero as possible for post-mine closure.

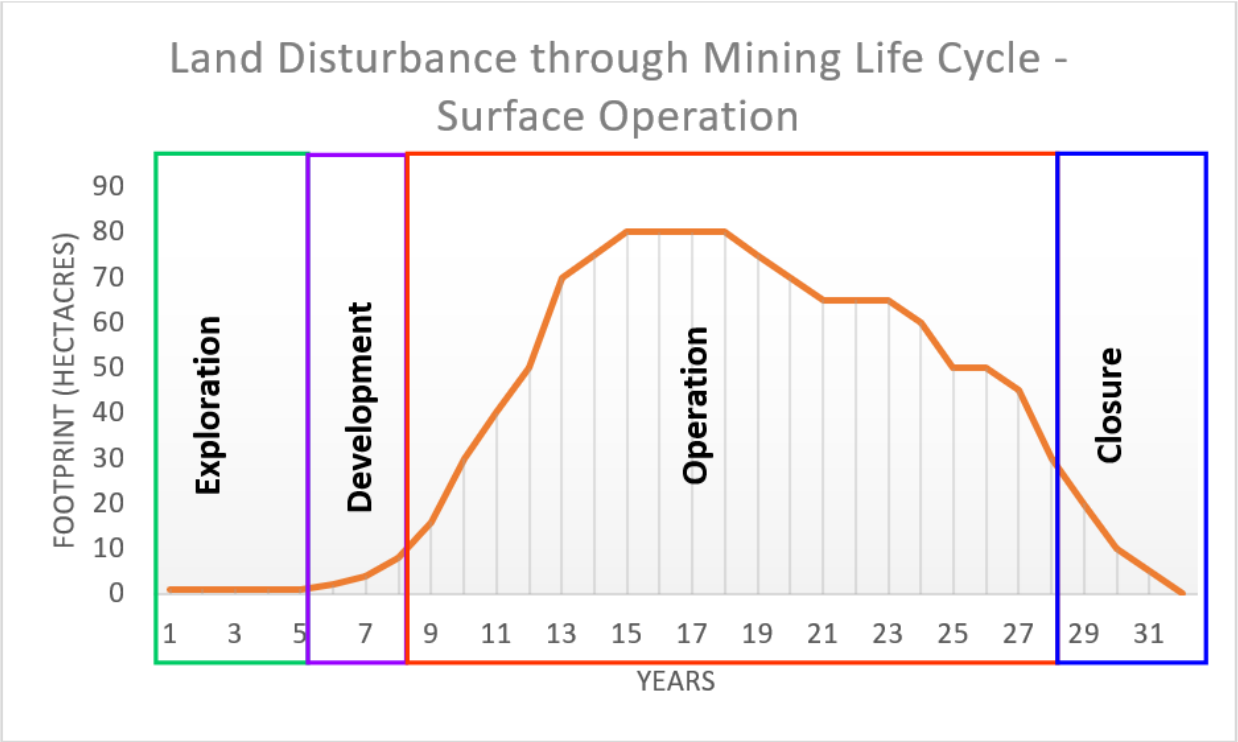

Figure 6.3 Potential Case Land Disturbance through the Mine Life Cycle

Figure 6.3 depicts a potential profile of land disturbance for an open pit mining operation throughout the mining lifecycle. During exploration, the land disturbance should be minimal and relates to the construction of drill pads or needed sampling from trenching. The development stage includes constructing the processing facility, administrative buildings, and pre-stripping operations of the mine. As the mine enters operational phase, multiple pits or laybacks may be started which dramatically increases the footprint of the mine compared to the exploration stage. A mine operator may elect to initiate the operation with a smaller designed footprint and expand the operation over time by investing in exploration drilling. As the firm grows in market share it can afford to reinvest in the operation to expand the footprint. The decreases in land disturbance that occur during the operating years of the mine reflect concurrent reclamation that may occur at a mine site. During the latter years of operation, it is likely that mining companies will begin more extensive reclamation of non-active mining areas, waste dumps, and preparing the pit

for implementing the final reclamation plan. The closure time period is the time required to decommission processing facilities and remove structures from the property in addition to the final reclamation of the property. Different mining techniques such as underground operations or coal mining, will have a very different land disturbance profile than the ideally modeled surface metal operation in Figure 6.3. The purpose of measuring land disturbance is not to limit the disturbance to zero, but to hold mining companies accountable to adhere to their reclamation plans and encourage concurrent mine reclamation. If a mining company expands its land disturbance without taking the proper precautions, such as completing an environmental impact assessment (EIA), and notifying shareholders then its environmental land disturbance score is decreased.

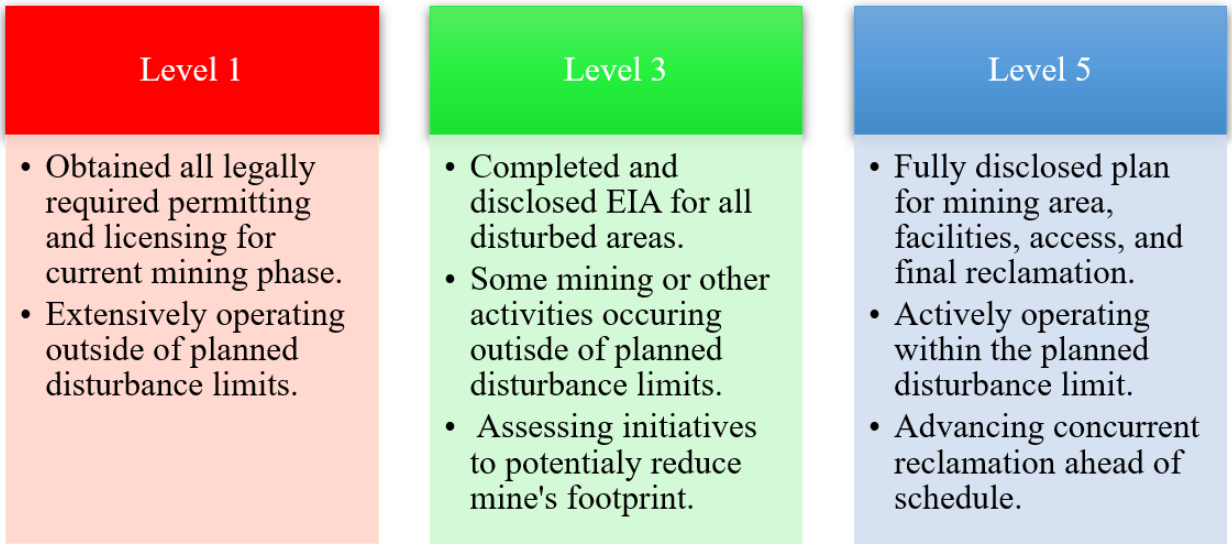

Figure 6.4 Environmental – Land Disturbance Score Card

In addition to measuring land disturbance, the firm's depletion of the reserve is an environmental impact related to land. Reserves indicate the amount of material that is economically, legally, and socially feasible to mine. As the mine depletes the reserve and approaches the end of the mine life, then one must consider the impact of having a mine on care and maintenance as opposed to fully reclaiming the mine. This becomes an assessment of sustainability; how does the company's actions meet the needs of society today without

depriving the ability of future generations to meet their own needs. In a case where a mine has measured resources that have not been classified as reserves due to metal prices or other economic factors making the property unable to continue operations, it may be advantageous for future generations if the mine is kept on care and maintenance. Keeping a mine in perpetual care and maintenance without a justifiable resource base or reasoning, raises suspicion in the marketplace that the mining company is not responsible in caring for the environment. Conversely, if a mine has depleted all known resources and reserves, it should undergo full reclamation as soon as possible to achieve a sustainable use of the land.

Mining companies should also consider the sustainability of their operations in terms of how quickly they deplete their reserves without replenishing them. For companies to achieve a higher sustainability score they should demonstrate their intentions of expanding their resource and reserve bases either through merger and acquisitions or internal exploration programs. Most mining companies disclose their annual expenditures for exploration and their mine closure plans and expenses in their annual financial statements. The SEC requires mining registrants to disclose mineral resources, reserves, exploration results as part of its annual reports of forms 10-K or 20-F in compliance with the SEC's mining disclosure rules in Subpart 1300 of Regulation S-K (Dorsey & Whitney LLP, 2023). SK1300 also requires the disclosure of exploration targets and that all resource and reserve information be reviewed by a qualified person. The information must be filed in a technical report as an exhibition to the relevant Commission filing when disclosing for the first time or when there is a material change in the estimates (U.S. SEC, 2020).

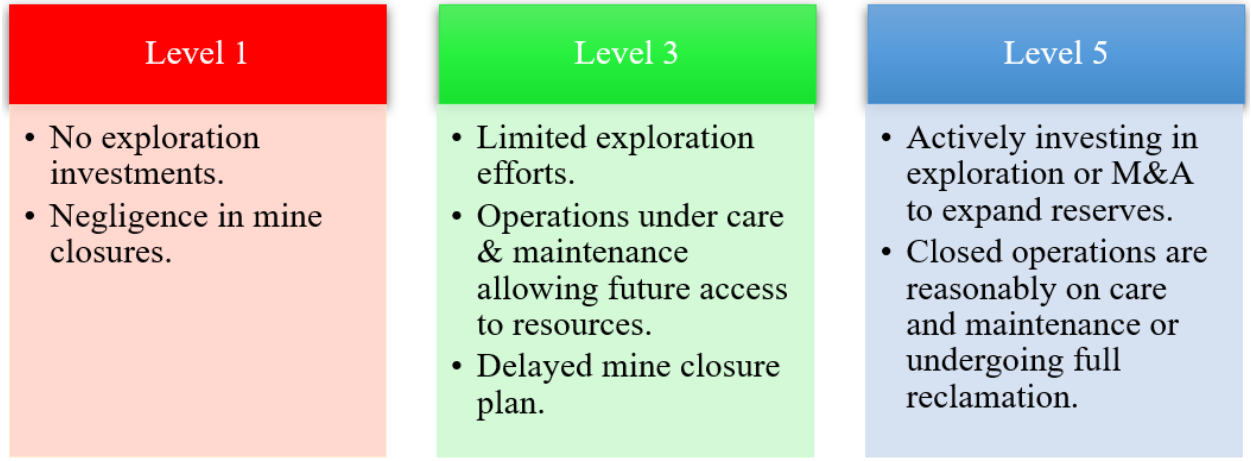

Figure 6.5 Environmental – Sustainability of Resource Score Card

Another crucial aspect to land management under the environmental pillar for mining companies is the proper disposal of solid and hazardous waste materials. During mining operations, waste rock is removed from the pit to create access to the ore below. The waste rock is typically stored in a waste dump in close proximity to the mine to decrease the haulage distance without limiting access to the identified orebody. In some instances, the waste rock will contain sulfide minerals that when exposed to oxygen and water will chemically react creating Acid Mine Drainage (AMD) by reducing the water pH commonly within the range of two to six (Bigham & Cravotta, 2016). AMD is a hazardous substance as it may contain toxic metals which leads to the degradation of water quality, injury to aquatic life, pollution, and corrosion (Bigham & Cravotta, 2016). As such, miners must pay close attention to the potential of acid mine drainage from waste dumps and active mining areas. In the United States, the Environmental Protection Agency (EPA) in coordination with most States requires that miners disclose the plan for managing acid rock drainage and annual compliance documentation containing information about where the acid potential rock is stored, measurements of water quality from the waste dumps, and other pertinent information (EPA, 1994).

Hazardous waste material may be generated during the mining and processing stages. In the U.S., there are numerous laws and regulations specifically addressing hazardous waste classification, storage, and proper disposal under the Code of Federal Regulations. Section 313 of the Emergency Planning and Community Right-to-Know Act established the Toxics Release Inventory (TRI) program in which all U.S. facilities must submit TRI data to the EPA by July 1 of each year (EPA, 2023). Information contained in these reports are accessible to the public through the EPAs website (https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools#tridata-facilities). Unfortunately, the TRI data focuses on the volume of material and does not differentiate the material by toxicity or hazardous level like the European Union. For mining companies, the lack of classification between the toxicity of released material causes the TRI to be elevated over other industries as all material handled is reported under the TRI. Meaning the TRI increases with production but does not accurately reflect the environmental impact of the hazardous materials. The TRI classifies material based on concentrations of certain elements making the in-situ ore body a hazardous substance subject to reporting requirements. Not all countries have as rigorous regulations and structure as the U.S. for handling and disposing of hazardous materials, nor the public disclosure of the information. Therefore, a more accurate measure of environmental impact from hazardous material considers a company's non-compliance with state and federal regulations.

Depending on the location, property ownership, and local governing regulations each operation may have a different set of legal requirements for handling and reporting hazardous materials. However, the commonality for all operations in the U.S. is the legal requirement to disclose any instances of non-compliance in the company's annual financial statements. The credibility of these statements are governed under the Dodd-Frank Wall Street Reform and Consumer Protection Act, which holds the company's executives criminally liable for the accuracy of these reporting's (111th Congress, 2010). The environmental risk related to waste and hazardous materials is measured in the frequency

and severity of non-compliance reported. If a firm demonstrates a pattern of non-compliance with regulations, then the rating should be decreased. Likewise, a firm which has a non-compliance event that results in damages in excessive of USD 1,000,000 should have a lower ESG rating than a firm that has USD 100,000 in damages or is in full compliance with regulations.

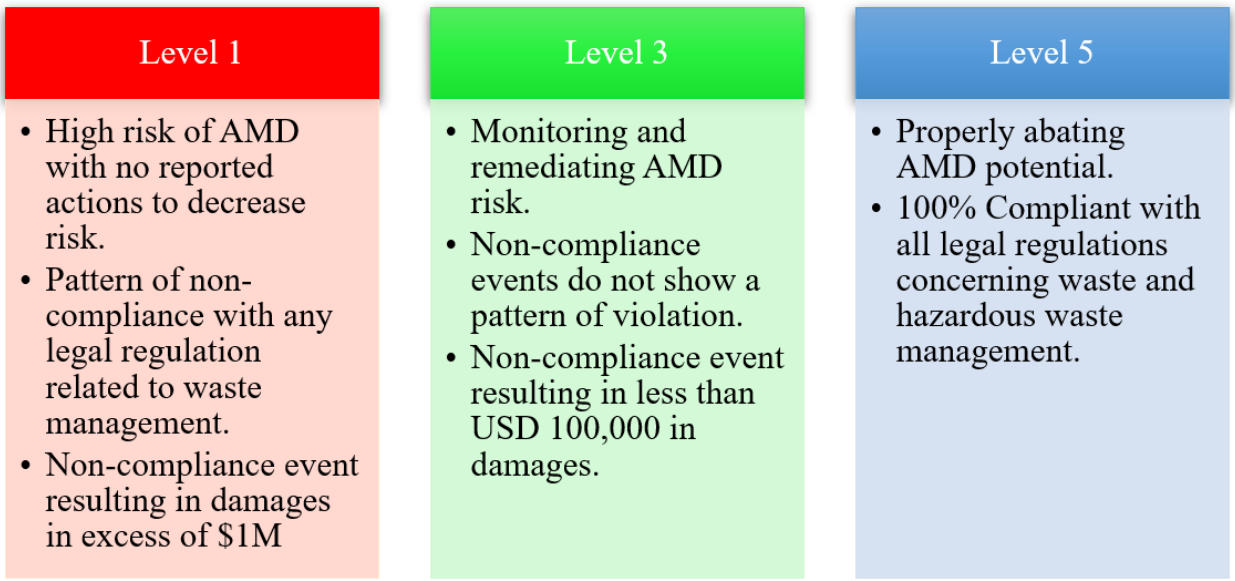

Figure 6.6 Environmental – Waste Management Score Card

6.2.1.2 Environmental - Tailings Management

In addition to solid and hazardous waste, a sulfide gold ore processed in a concentrator at the mine generates processing wastes, called tailings. Tailings are a waste-product of mining and have varying amounts of water depending on the processing technique and storage containment method. Tailing Storage Facilities (TSF) may contain a slurry, paste, or filtered tailings (*What are tailings*, 2023). Minimum design requirements are regulated by government agencies. Some of the most devastating environmental impacts have occurred because of a tailings impoundment collapse or breach. In response to the catastrophic collapse of the TSF at Vale's Corrego de Feijao mine in Brumadinho, Brazil, the Global Industry Standard on Tailings Management (GISTM) was formed by the

Investor Mining and Tailings Safety Initiative led by the Church of England Pensions Board and the Swedish Council on Ethics in collaboration with ICMM members. This standard aims to achieve "zero harm to people and the environment" and "zero tolerance for fatality" through the application of 15 principles and 77 requirements (Global Tailings Portal, 2020). The standard is meant to prevent the catastrophic failure of TSF and to implement best practices in planning, design, construction, operation, maintenance, monitoring, closure and post closure activities (ICMM & UN, 2020). GISTM has provided the standard and encouraged more than 700 mining companies to voluntarily disclose information and conform to the recommended policies. A company that adheres to the requests for disclosure of information and actively pursues implementing the GISTM standard is more likely to be viewed favorably by investors because of the increased transparency and proactively decreasing its environmental risk. Although the GISTM has no legal authority to force companies to comply with the standard, the voluntary disclosure of information on the Global Tailings Portal website should be viewed as a positive effort by the company to be more sustainable resulting in a higher ESG rating. Figure 6.7 provides the score card for the handling of tailings in relation to the environmental score of ESG.

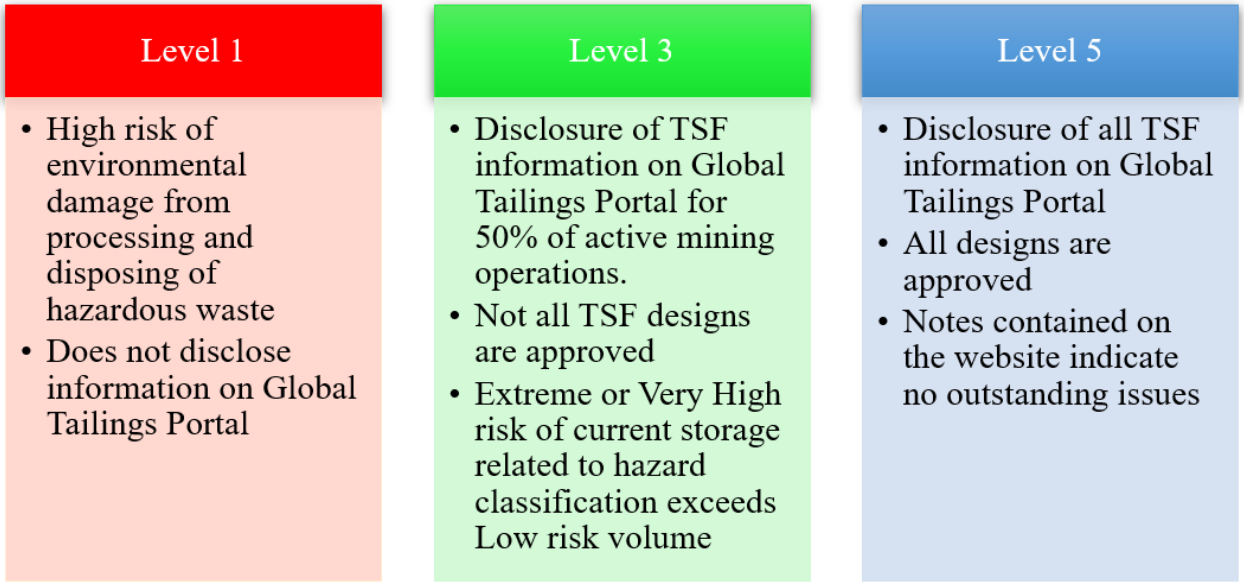

Figure 6.7 Environmental – Tailings Management Score Card

6.2.1.3 Environmental - Air and Water Quality

Assessment of a firm's water and air quality are more complex as firms are not legally required to publicly disclose this data in the US. However, the Clean Air Act of 1970/1977 (CAA) provided laws and regulations designed to protect human health and the environment by specifying strict requirements of air quality and tolerances for pollutants. The EPA works with its federal, state, and tribal regulatory partners to monitor and ensure compliance with the CAA. Similarly, the Clean Water Act (CWA) is the primary federal law governing water pollution in which the EPA monitors compliance. The goal of these Acts is to enforce quality requirements to the most significant pollution problems, improve transparency and accountability by providing public access to data (EPA, 2020). The EPA has the authority to write citations to companies that are out of compliance with the Acts but also has the authority to give cease and desist orders that halt an operation. Each state or territory in the U.S. manages the publication of the data providing public access to the compliance information from the EPA. A higher E Score should reflect full compliance with the Acts as a lower score should indicate the firm has been issued an order to stop operations as shown in Figure 6.8.

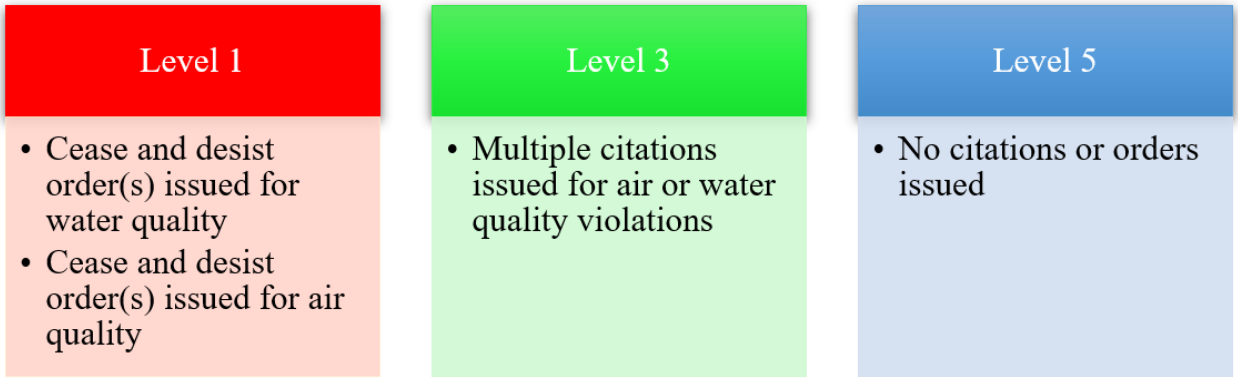

Figure 6.8 Environmental – Air & Water Quality Score Card

6.2.1.4 Environmental - Energy Efficiency

In addition to air quality, particularly CO2 emissions, energy source is an important metric to consider for ESG ratings. Again, regulation plays a significant role in what is possible for a mining company to implement. Not all governments will allow a company to install solar panels or wind turbines within the operations permitted limits as it would decrease the demand for state-owned electric supply. According to the Lawrence Berkeley National Laboratory, utility-scale solar power produces between 394 and 447 megawatt hours per acre per year (Eisenson, 2022). The U.S. mining metals industry consumes approximately 552 trillion British thermal units (Btu) per year (BCS Incorporated, 2007). Meaning that the U.S. metals mining industry would require approximately 400,000 solar panels to convert from fossil fuels for a sustainable energy source. The limited energy production per acre of land required, dependency on weather, high capital cost to implement, and requirement for energy storage capacity makes renewable energy sourcing unrealistic for most mining operators. Some operations are limited to power supplied from diesel generators, which emits more CO_2 than even coal fired power plants, due to its remote location. In an ideal circumstance, a mining operation would implement some form of renewable energy or have access to clean energy from the local municipalities that use natural gas, hydroelectric, or nuclear fusion. In reality, clean energy is not currently possible for all operations.

Another issue to measuring energy as a metric of ESG is the difference in consumption based on the processing and mining technology applied at the operation. For instance, a copper oxide mine may use solvent extraction electro-winning to plate the copper which uses more energy at the mine site to produce copper. But in comparison to a copper concentrate that must be transported to a smelter, heated, cast into an anode, and then electro-refined into a copper cathode, the solvent extraction electro-winning (SXEW) copper consumes far less electricity from a holistic perspective to produce. Considering the holistic energy consumption, the mine operation using an SXEW process should have a low

energy consumption ESG rating because the entire energy consumption across the supply chain is less than the alternative.

Previous research and development efforts have provided the gold industry with new processing technologies to decrease energy and chemical consumption. For example, bioleaching has been investigated for low-grade gold ores that would otherwise be uneconomic to produce. Bioleaching effectively oxidizes sulfide gold ores allowing the material to be leached with cyanide instead of processing in a concentrator or autoclave thus reducing energy consumption (Wang et al., 2021). Similar to the advancement of SXEW processing changing the holistic energy consumption for certain copper ores, bioleaching may reduce the energy consumption required for gold production in the future. Not all gold mines can utilize bioleaching, especially operating mines that have invested capital to pursue traditional extraction techniques. However, for a low-grade sulfide gold deposit in early stage of development may benefit from bioleaching and be rewarded from an ESG rating for considering a lower energy consuming extraction process.

For metal mining, the comminution process of grinding the material is the highest consumer of energy (BCS Inc., 2007). To effectively measure the energy consumption of a mine operation, one should consider the trend in consumption. For instance, measuring the company's electrical power consumption per unit of production year over year would be more meaningful than considering the total amount of energy consumed which would include chemical from blasting and diesel consumption from equipment. This metric may have issues when considering a mill process that grinds the material as the rock hardness also becomes a factor. However, when a firm sees the trend of higher energy consumption per unit of production, it should be prompted to consider potential site efficiency improvements. For example, a firm with an increasing trend to energy consumption may investigate holistic energy consumption, including mechanical and chemical efficiency. The firm may consider changing its blasting techniques to reduce energy consumed in the milling process. In cases where the increase in energy consumption is directly related to

reduction in the head grade of material to the mill, it would be reflected in the firms' annual financial statements which also provide production information.

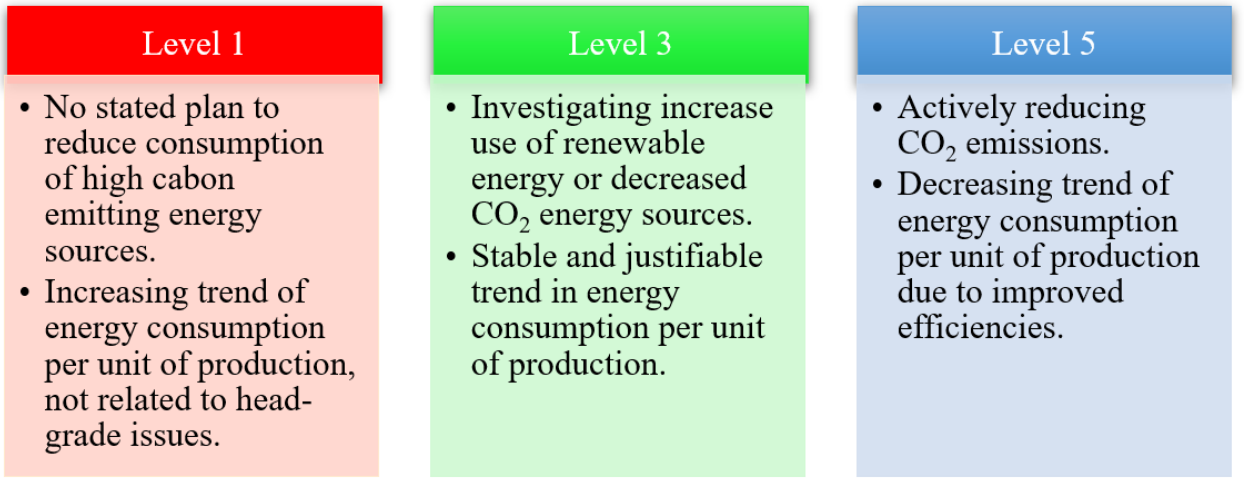

Figure 6.9 Environmental – Energy Score Card

6.2.1.5 Environmental - Biodiversity

Land disturbance is inevitable for mining which also means that biodiversity may be impacted. The Smithsonian National Museum of Natural Science defines biodiversity as the variety of all living things and their interactions broken into three interdependent levels: species, genetic, and ecosystem biodiversity (*What is Biodiversity?*, 2023). As mining alters the landscape, specifically the ecosystem of the area, there may be consequential impacts to species and genetics of the area. In order to minimize the impacts to the environment and the ecosystem in which the mine operates, mining companies in the U.S. and parts of Central America are required to conduct and publish an Environmental Impact Assessment (EIA), Environmental Assessment (EA), or Environmental Impact Statement (EIS) depending on the size of the project prior to the decision to proceed with the proposed project (*EIA Technical Review Guideline: Non-Metal and Metal Mining*, 2011). An EIA requires public participation and a description of all the details of the mining project, environmental setting, potential impacts, assessment of potential impacts,

mitigation and monitoring, and an environmental management plan. The EIA also explicitly details the mine reclamation plan as well as the financial obligation to achieve a successful closure and reclamation. The governments that agree to the EIA Technical Review Guidelines have the right and ability to monitor results for compliance through inspection and prosecution if necessary. The enforceability for compliance allows an EIA to be a credible source for measuring ESG performance. The metrics for measuring compliance relates to the connected permits and citations for violations.

Biodiversity offsets have been developed and implemented by several international mining companies, including Newmont and Rio Tinto, to achieve "no-net-loss" in biodiversity. These firms offset the impact from their mining operations by protecting a comparable threatened forest or active restoration of lost habitats (Virah-Sawmy et al., 2014). Ideally the offsets should be a "like-for-like" habitat preservation, but "out-of-kind" can be acceptable when the offset provides more significant biodiversity than the affected area (Gardner et al., 2013). The best practice for implementing a biodiversity offset considers the following: 1) equity, 2) irreplaceability and vulnerability, 3) long-term conservation outcomes, 4) transparency, and 5) good science (BBOP, 2013). The efforts to support biodiversity and environmental conservation goes beyond legal regulations and should positively influence a company's ESG score as described in Figure 6.10.

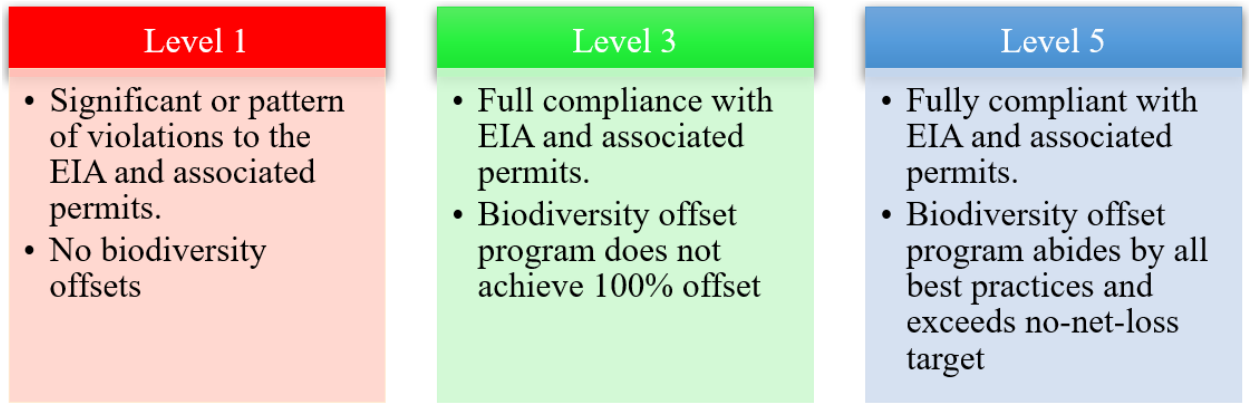

Figure 6.10 Environmental – Biodiversity Score Card

6.2.2 Proposed Methodology - Social Criteria

The assessment of social risks for a company can be categorized as either internal to the company, which includes employees and board members, or external to the company, such as local communities, NGOs, or stakeholders.

6.2.2.1 Social - Internal Stakeholders

To measure the risk a company poses to its employees can be assessed by its compliance to federal, state, and local regulations. Within the U.S., the Mine Safety and Health Administration (MSHA) audits each underground mine at least four time a year and a surface mine at least twice per year, but may inspect operations more frequently if it receives complaints or suspects that the operation is not in compliance (Federal Mine Safety and Health Act of 1977, 1977). MSHA has the authority to issue citations for any violations and fine the company accordingly. According to the Dodd-Frank Wall Street Reform and Consumer Protection Act and Item 104 of Regulation S-K, mining companies are required to file periodic reports, and in conjunction with its annual financial statements, disclosing their compliance to MSHA regulations for U.S. mining operations (111th Congress, 2010). The required disclosures include the following: number of citations or orders, total fees associated with citations, violations for not abating previous citations, "imminent danger" citations, and repeated or pattern of violations of mandatory health or safety standards. MSHA orders are particularly important as these require the operation to cease and desist all production.

Even though health and safety violations are disclosed for U.S. mines, the number of MSHA citations and associated fees do not effectively indicate a lower injury rate (Yorio et al., 2014). Citations can range from improperly securing a trash can lid to inadequate fall protection provided to employees. The experience of the MSHA inspector and their relationship with the mine operator may also influence the number of citations and frequency of inspections. Furthermore, the citations issued by an inspector are often

challenged by the miner and can be overturned. The issues of MSHA citations of not being predictive of the safety rate, number of citations do not differentiate severity, and the potential for overturning the ruling of citations make using MSHA citations a poor metric for measuring a mine's safety. Instead, this thesis proposes that utilizing total reportable incident rate (TRIR) as a better metric for employee safety.

The U.S. Bureau of Labor Statistics (BLS) provides incident rates of nonfatal occupational injuries by industry. The incident rates the number of injuries and illnesses per 100 full-time workers. According to BLS, the average TRIR for all industries is 1.8 and 0.6 for the gold mining industry (BLS, 2021). Social ESG ratings should then compare each mine site to the average TRIR for gold miners in the U.S. where a TRIR above average is downgraded and below the average is rewarded.

In addition to reporting any violations of health and safety risks, MSHA also requires the disclosure of any complaints received concerning unfair compensation, wrongful termination, or discrimination. These items are part of the Miners Rights protected by the Federal Mine Safety and Health Act of 1977 (Code of Federal Regulations, 1991). If a company receives multiple complaints concerning abuses to miners' rights, then its social rating should be negatively impacted as a reflection of poor culture.

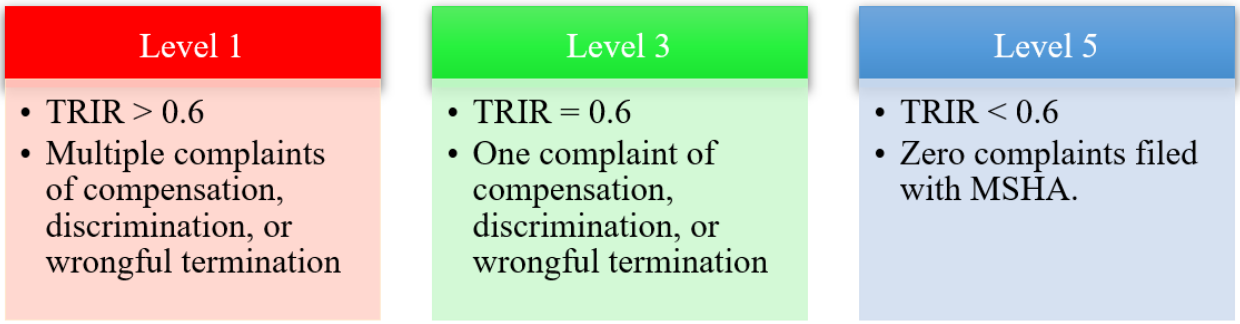

Figure 6.11 Social – Internal Stakeholder Score Card

6.2.2.2 Social - External Stakeholder

Quantifying a miner's relationship with external stakeholders, particularly local communities, is challenging as each miner has a different approach to obtaining and maintaining its social license to operate. Many mining companies focus on providing infrastructure, access to medical clinics, educational programs, and supplying potable water to local communities. These items are particularly important for evaluating ESG performance. It is also crucial to consider the longevity and permanency of these community benefits. After the mine closes, will the benefits to the communities remain? The transition from company sponsored to self-sustained or government supported is crucial. A company that meets the immediate needs of the community by providing a temporary health clinic is good, but one that contributes to establishing a permanent hospital or clinic should be rewarded for considering the long-term value for the community.

Providing local communities with amenities is positive, but it is essential that companies listen to the needs of the community to meet their specific needs or address concerns. The National Environment Protection Act of 1970 (NEPA) established the minimum requirements for stakeholder engagement that all companies must follow. NEPA recommends a minimum of four stakeholder engagement meetings aimed to transparently provide information (2013). For assessing a firm's ESG and social engagement, the rating should consider the frequency and breadth of engagement beyond the minimum legal requirements. When a company is recognized externally for its support of local communities, this should signify a higher social rating. Figure 6.12 provides a suggested score card for evaluating a firm's external social commitment.

Figure 6.12 Social – External Stakeholder Score Card

6.2.3 Proposed Methodology - Governance Criteria

Corporate governance is a measure of a firm's ethical business practices, its culture, and its ability to manage its affairs. Current measures of governance primarily focus on board structure, policies and procedures, and transparency in reporting. One could argue that the presence of policies and procedures does not ensure the quality of the company's ethical behavior. Similarly, the composition and tenure of board members does not indicate a lack of corruption. To quantitatively measure how well a corporation governs its affairs and conducts ethical business practices, one should consider the number and severity of business ethic complaints and legal prosecutions. For instance, a company that is prosecuted for money laundering, fraud, tax evasion, or bribery signals the market that the management is incapable of appropriately conducting business. The governance rating should decline at the time a complaint is filed and remain degraded until the courts have reached a verdict. The decline in rating is reflective of the increase in risk of financial losses due to the litigation and resulting damage to the firm's reputation. If the firm is found not guilty, then the rating should return to a previous higher rating. A guilty verdict should result in an additional deduction to the firm's governance rating until the firm begins to rebuild its reputation.

In addition to good business ethics, corporate governance reflects the culture of a company. Employees who feel connected to the company's values and mission and have positive relationships with their peers are less likely to resign (Farnsworth, 2023). A low employee turnover rate can be a clear indication of a positive workplace culture. The inverse can be true as well. A high turnover rate of employees can indicate a toxic or oppressive workplace culture. Less quantifiable indications of a positive workplace culture can be high levels of morale, trust and autonomy, communication and transparency, collaboration, and work-life balance (Farnsworth, 2023). These attributes tend to attract top performing employees and keep them engaged, thus increasing a firm's profitability (Zemke, 2022). The BLS provides annual average job opening rates by industry and region as an indication of labor turnover. According to BLS, the average turnover rate in the U.S. as of 2022 was 6.8 percent, while mining turnover rate was 5.5 percent (U.S. BLS - Table 16, 2023). Some mining companies provide their turnover rate information as part of their annual sustainability report. The firm's turnover rate can be compared to the average turnover rate for the mining industry for the year to derive a proper governance score that reflects workplace culture as described in Figure 6.13.

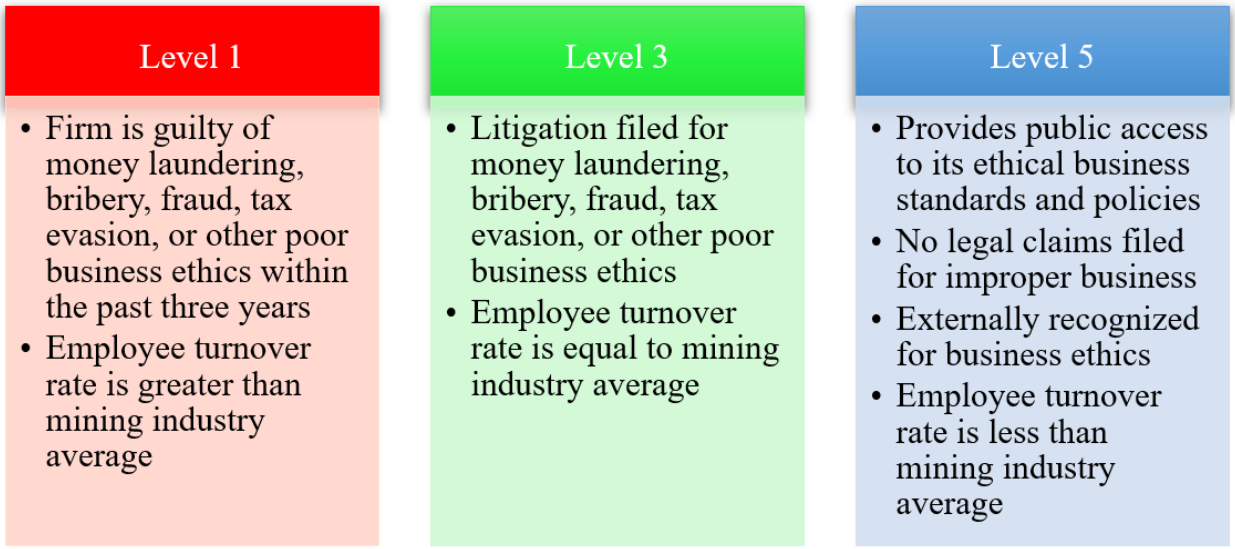

Figure 6.13 Governance Score Card

6.3 Compiling ESG Scores

This proposed methodology compares a mine site's current status against each criterion of the best possible environmental, social, and governance performance indicators, with a five being the best score and one being the least optimal. Summing each criterion score establishes a single E, S, or G pillar rating for the property. The individual pillar scores are then added, instead of arbitrarily weighting them, to obtain a comprehensive ESG score. The mining industry inherently poses a more substantial risk to the environment that could lead to financial losses for the company than changes to governance. Since this thesis suggests evaluating more environmental attributes of a company, the E score naturally accounts for a more significant portion of the comprehensive rating.

Results for each criterion ranking should be made public. The transparency of ratings and exclusion of weightings provides mining companies with specific feedback for areas of improvement. It informs investors of the technical risks associated with the specific mining project.

In order to aggregate the individual site scores to a firm's overall rating, one has to consider the market perception of the importance of each asset. For a junior mining company, advanced-stage exploration projects significantly influence its market value, and consequently, the ESG risks may pose a crucial variable for investment decisions. Conversely, exploration projects for a large-scale miner may have less influence on its market value. Therefore, further research on how investors value mining assets is required to properly aggregate ESG scores from individual operations to a final firm rating. This thesis provided suggestions for evaluating the ESG performance of mining operations. However, the rating suggestions from this research are not directly comparable to Bloomberg ratings evaluated in Chapter 5, as Bloomberg scores reflect overall firm ratings and are not site-specific.

CHAPTER 7
CONCLUSIONS AND FUTURE RESEARCH

This chapter compares and contrasts the research results to the stated objectives of this thesis. It also discusses this research's limitations, implications for the gold mining industry and investors, and recommendations for future research.

7.1 Research Conclusions

ESG practices are a hot topic for investors with two opposing views. Some supporters of ESG claim that a firm that pursues sustainable practices experiences a greater financial performance than its competitors (Steinhaeuser, 2022; Whelan, 2021; Velte, 2017). Conversely, anti-ESG proponents claim that ESG threatens investment returns and uses economic power to implement business standards beyond those required by law (Donefer, 2023). As of June 2023, fifteen U.S. states have passed laws prohibiting "non-pecuniary factors" in making investment decisions for state pension funds (Gombar, 2023). For instance, investors making decisions based on ESG ratings may not be acting in the best interest of the members and beneficiaries. In 1970, Friedman developed the trade-off theory that proposes adding additional financial costs related to CSR. This then creates a competitive disadvantage. Friedman (1970) stated that a corporation has a social responsibility to its investors to increase its profits; thus, expenditures not legally required, related to increasing production, or reducing costs have a trade-off between the firm's objectives. The focal point of whether companies should be promoting or rejecting ESG is the debated concept of more elevated ESG performance leads to higher financial returns. General perception is that investors favor and reward companies for their ESG ratings or performance. However, the costs associated with implementing ESG do not inherently improve a firm's production or profitability resulting a loss in net earnings for a firm if investors do not actively provide financial compensation through increased stock price.

Within the last decade, thousands of research documents have investigated whether ESG performance is linked to corporate financial performance (CFP). The results are highly variable based on industry, region and applied financial metrics. However, studies have yet to investigate the gold mining sector specifically in the U.S. and Canada. This thesis aims to specifically assess six gold mining firms in the U.S. and Canada over the period of 2015 to 2020 and determine if they experience financial benefits from their ESG performance in the short- and long term.

This research applies a case study approach to evaluate the link between ESG performance and CFP for Newmont, Barrick, Agnico Eagle, Hecla, Yamana, and Kinross. By evaluating these six firms, this study can complete a more detailed assessment of the relationship between ESG and CFP for some of the world's largest gold producers.

If the market positively responds to ESG in the short term, then a firm should experience an increase in its stock price within a few days of announcing ESG information. This thesis utilizes an event-study approach to evaluate the short-term market response. It investigates the market response to 170 ESG-related announcements published by the firm or other external news outlets. Each event was assessed based on the difference between the actual and the estimated change in firm stock price over a three-, five-, seven-, and eleven-day event windows. The study employed changes in the gold price, market index, and a competitor's stock price to derive the estimated change in the evaluated firm's stock price.

Of the 170 events evaluated, only sixteen displayed statistical significance that the event caused a meaningful and measurable market response. Three of the six mining companies–Newmont, Agnico Eagle, and Hecla–had a single significant event. However, Newmont's and Hecla's events were likely influenced by preceding financial announcements and should not be used to make general conclusions. Agnico Eagle's single event caused a slight decline in the stock price of approximately two percent, indicating an adverse market reaction to its positive ESG initiative. Like Newmont and Hecla, Yamana had no

significant ESG event, meaning the market was unresponsive to ESG publications from these three miners. Barrick had three significant events that, on average, displayed adverse market reactions, reducing its stock price by 2.5 percent. Kinross had the most ESG announcements not influenced by financial statements or reserve updates. Accordingly, Kinross had ten significant events, the most of any firm evaluated in this thesis. On average, the market positively responded to Kinross' ESG performance and rewarded them with an increase of nearly four percent above the expected market return. However, three of the ten events had adverse market reactions by the actual return underperforming relative to the expected change in stock price. There do not appear to be any commonalities between the three events that resulted in adverse market reactions directly related to Kinross or the source of the publications. Further studies of extenuating circumstances within the market or influence from news concerning a competitor may provide insight to explain the adverse market reaction. Kinross's ten significant events from its fifty-eight announcements equate to seventeen percent of the announcements triggered a measurable change in its share price.

The short-term event study analysis results indicate inconsistent market reactions to positive ESG performance by the selected gold mining firms. After removing the events likely influenced by financial statements, fifty percent of ESG-related events triggered an adverse market reaction. Furthermore, fifty percent of the companies assessed showed that the market was unresponsive to their ESG information. Of the companies that experienced a significant impact from ESG, the market responded weakly negatively to Barrick and Agnico Eagle, while it weakly positively rewarded Kinross. The adverse market reaction to Barrick's and Agnico Eagle's ESG announcements supports the trade-off theory, as the market punished these firms for the additional costs associated with ESG initiatives. However, this study has insufficient evidence to show that the market consistently punishes firms for ESG, as only six out of 170 announcements (or three percent) triggered a significant adverse response.

Kinross was the only firm that, on average, received a financial benefit for ESG performance. It took a different approach to communicate its ESG performance as it had the highest percentage of announcements related to ESG compared to its competitors. Kinross also had the most consistency in making announcements separate from financial disclosures. The routine disclosure of information through press releases, transparency of ESG on its website, and external recognition for its performance has likely conditioned the market to expect ESG-focused expenditures. Kinross experienced positive responses varying from an increase of 2.5 to 9.6 percent above the estimated return. Thirty percent of the responses decreased its stock price by 1.7 to 3.5 percent below expectations. There was a varying degree of market response, but overall ESG announcements resulted in a benefit to Kinross. Xie et al. (2023) speculated that a firm that frequently and consistently publishes ESG information experiences less negative impact than its competitors when publishing new ESG data, which according to this assessment, is valid for Kinross. This thesis proposes that for other firms to benefit from ESG initiatives, they should condition investors to expect these additional costs through numerous routine disclosures, not in conjunction with financial statements.

None of the unfavorable ESG events evaluated in this thesis caused a measurable market reaction for the firms assessed from 2014 to 2021. Contrary to previous works by Capelle-Blancard and Petit (2017), Kruegger (2015), and Ketola (2022) that showed the market actively punished firms for negative ESG news, this research shows that the market is unresponsive to negative ESG publications. The severity of the negative event may influence these findings as no catastrophic, environmentally damaging event occurred for these six gold mining firms from 2014 to 2021.

On average, when evaluating the short-term event study's results based on the ESG category, each category demonstrated a weakly positive impact on the firm's stock price. Eight percent of the ESG announcements triggered a measurable market response, making a weak correlation between ESG and CFP.

The market responded noticeably to six of the forty-eight comprehensive ESG events assessed in this thesis. On average, the market response increased the firm's stock price by 1.63 percent above the expected market return for a three- or five-day event window. However, fifty percent of the significant comprehensive ESG events decreased the firm's stock price. All the comprehensive ESG events assessed provided a positive perception of the companies, including events like the release of sustainability reports, awards for leading industry sustainability performance, or top ratings by DJSI. These events should signal to the market that the firm prioritizes ESGs. This thesis hypothesized that the market generally values transparency and ESG performance, so ESG-related events should significantly impact a firm's stock prices. The evaluation of comprehensive events in this research does not provide sufficient evidence to support this hypothesis of a positive and significant relationship between comprehensive ESG announcements and a gold mining firm's market value. Similarly, the results indicate that the market was unresponsive to negative ESG announcements.

Only two of the sixty-eight social events assessed in this thesis triggered a measurable market response. Both significant events resulted in a positive market response, showing an average increase in the firm's market value of 5.4 percent. The gold mining companies assessed in this research demonstrated a prioritization of their impact on society and local communities, as forty percent of the ESG announcements included references to social interactions. Unfortunately, the market acknowledged only four percent of the social announcements. This low response rate indicated a weakly positive market response to social components of ESG information. It is insufficient from this study to affirm that the market consistently acknowledges a firm's positive social performance or rewards them through an increase in its share price in the short term.

This research investigated the market response to thirty-eight ESG events focused on environmental impact for the six gold mining firms. Only five events (or thirteen percent) demonstrated a significant market response. Except for one event, the environmental

announcements resulted in an average loss in the firm's stock price of 1.8 percent. The one positive response increased the firm's stock price by more than seven percent in a five-day event window. The adverse market response to positive environmental events aligns with Kruegger's (2015) and Xie et al.'s (2023) conclusions that improving environmental performance increases the firm's costs and restricts shareholder profits. The conflict between achieving higher environmental performance and maximizing shareholder profits is evident in the significant events assessed in this thesis but not consistent for all environmental announcements.

One governance-related announcement triggered a noticeable market reaction from the sixteen events assessed. The significant event resulted in a CAR of 2.55 percent to Kinross' stock price above the expected return over a seven-day event window. The six percent success rate of governance announcements positively impacting a firm's CFP indicated that the market had been generally unresponsive to changes in governance. The results from this thesis support Kruegger's (2015) and Capelle-Blancard and Petit's (2017) findings that the market has been unresponsiveness to a firm's positive ESG or governance behaviors. Furthermore, this research confirms Hawn et al.'s (2018) conclusion that CSR, specifically corporate governance policies, had become an expectation from the market resulting in the companies not being rewarded for governance.

Generally, the results from this research indicated that the market inconsistently rewarded or punished firms for ESG performance and was largely unresponsive. Only eight percent of ESG announcements made by gold mining firms from 2014 to 2021 triggered a significant market reaction. Kinross' frequency and consistency of announcing ESG-related information demonstrated a higher success rate than the information that triggered a market reaction. Investors likely expect and anticipate ESG-related costs from Kinross and, therefore, did not punish the firm for not maximizing shareholder profits as other firms may experience. Regardless of the frequency or market expectations, increasing costs to improve environmental performance triggered an adverse market reaction. The

inconsistent, weakly positive market responses to ESG news did not support the hypothesis that the market provides financial benefits to firms with greater ESG performance.

This thesis applied regression modeling to assess the long-term relationship between ESG ratings and CFP. Tobin's Q was selected as the financial measure of CFP as it measures the firm's ability to expand its business and sustain long-term success (Luo & Bhattacharaya, 2006). Separate regression models evaluated the influence of the independent variables: environmental (E), governance (G), and comprehensive (C) scores, as multicollinearity between the variables existed because E and G were components to calculate C. ROA, liquidity, and leverage were control variables in the regression model. This research hypothesized a significant positive correlation between the ESG ratings and the gold mining firm's financial performance from 2015 to 2020.

The regression analysis revealed that for the six gold mining companies assessed, the control variables and comprehensive ESG scores did not influence the firms' CFP. The gold mining industry is unlike other financial investments in which ROA, ROE, leverage, liquidity, and other easily measured variables drive a firm's market value. Gold prices, fluctuations in interest rates, international market stability, and the strength of the U.S. dollar all influence an investor's interest in investing in the gold mining industry. Speculation of reserve growth is another factor that drives investment decisions. However, these factors are outside of the firm's control, yet they significantly impact a gold mining firm's market value. The financial metrics included in this thesis did not capture the influence of these factors in the regression analysis of ESG correlation to CFP, which may explain the low correlation coefficient and insignificance of the control variables to Tobin's Q.

The mining companies assessed in this thesis spent millions of dollars investing in various ESG-related initiatives over five years. Despite the significant expenditure on ESG, the comprehensive ESG ratings remained relatively constant, changing on average by nine points out of 100. Although the ratings have limited improvements, the CFP of the

selected firms have improved disproportionally to the comprehensive score, indicating that the Bloomberg ESG ratings are meaningless for the gold mining firms assessed in this thesis. The regression analysis of this research supports that the ESG comprehensive scores did not influence the gold mining firms' market value over time.

Similarly, this thesis found no correlation between a firm's environmental score and financial performance. The gold mining firms evaluated provided multiple environmental reports and disclosures, some of which exceed the legally required disclosure of information. Even with the transparency of risks associated with environmental impact and active mitigation taken by the firms, the improvements or down grading in ratings did not reflect a change in financial performance or alter the market value.

Governance ratings aim to reflect risks to the firm's value due to improper ethical business practices. Bloomberg measures governance based on board member diversity, tenure, and independence (Bloomberg, 2020). These factors used by Bloomberg to rate the mining companies' governance showed no correlation to a firm's market value. The lack of correlation may be due to investors' perception of the rating structure as improperly measuring ethical behavior. Alternatively, investors may generally expect businesses to prioritize human rights and ethical practices without rewarding them for meeting this expectation, as Hawn et al. (2018) described.

In this research, ESG ratings of the six gold mining companies showed no significant or measurable impact on a firm's financial performance between 2015 and 2020. If ESG ratings were critical to investors' decision-making, then changes to a firm's rating would likely impact the firm's market value over time. Therefore, this thesis hypothesized a positive and significant correlation between ESG and CFP. Contradictorily, this research on the impact of ESG ratings on a firm's market value indicates that the ratings have no tangible impact on the corporation's long-term financial performance.

The lack of measurable influence of ESG ratings on a firm's market value indicates that the ratings have not adequately captured financial risks valued by investors. The extractive

industry inherently poses a greater risk of environmental impact, which may lead to greater financial repercussions than other industries may experience. Therefore, evaluating a mining firm's ESG performance must exceed the current qualitative generalized approach and include a more technical assessment of performance to determine ESG risks.

This thesis recommends that an ESG analyst evaluates each mining operation's ESG performance considering what is technically possible, financially feasible, and legally required. Every mine has a different ore body lithology, government regulation, access to infrastructure, and technology to support the chosen mining and processing methods. Furthermore, each site has varying limitations to what is possible for minimizing ESG risks. Considering the differences between mining operations, establishing a single metric for all sites to measure ESG risks is inappropriate and illogical. Instead, each site should be treated as the unique operation that it is and assessed based on what is possible for that operation. As such, ESG risks should consider the current status of the operation compared to its best possible outcome, where these risks are minimized to the limit possible.

Given the unique aspects of each mine site, from lithology and mining methods to regulatory structure and financial flexibility, there will be varying opportunities to implement ESG. The distinctive list of ESG metrics depends on the unique risk profile for each property or advanced-stage project. Scoring each property must consider the technical, financial, and regulatory restrictions when determining the best possible outcome. The challenge then arises of aggregating scores across multiple international operations at various stages of production. Exploration projects can substantially influence a firm's stock price because of market speculation, especially for mid-tier or junior miners with limited operating assets. The ESG rating for a junior mining company's exploration project may need to be more significantly weighted for compiling the company's ESG score than it would for a large-scale mining firm. Future research should investigate the influence of various projects to determine an appropriate weighting structure to combine operational scores into a firm-specific rating. This thesis aims to provide suggestions for quantifying

ESG considering the technical details of the mining industry.

7.2 Future Research

This thesis found that the market has inconsistently responded to ESG announcements and has not provided any long-term benefits to high ESG performers in the gold mining sector from 2014 to 2021. There are multiple instances where the market has punished the gold mining firms assessed for expenditures related to environmental improvements that conflicted with the firm's goal of maximizing shareholder profits. The case study approach allowed for a detailed review of announcements regarding six large- and medium-scale gold mining firms in the U.S. and Canada. However, it did not consider any interference from other news relating to competitors or macroeconomic events that may influence a firm's stock performance. Expanding upon this research may include consideration of information that indirectly affects a firm's market value, such as competitor's ESG events. This work did not evaluate the form of publication being a blog, press release, or other social media announcement. Future work may investigate which form of publication resulted in the most considerable impact for a firm that would help establish optimal communication strategies for companies.

Future researchers can also apply the same case study approach to investigate market reactions to ESG for other mining companies from various regions to determine if the response is location dependent or to public junior mining firms to determine if market response depends on firm size. In addition to investigating region-specific and size-specific results, researchers may utilize the case study approach to study the influence of a mining company's ESG performance on CFP within different commodities such as base metals, coal, or rare earth elements. The gold mining industry may be unique in how many firms participate and publish ESG-focused information since the LBMA requires it for access to its trading platform. In contrast, other commodities do not have the same requirements, and researchers could have a baseline of firms that do not participate in ESG to compare the financial results to firms that publish ESG information. Different commodities may

experience a more responsive market to ESG publications if not all participants are required to provide such information.

Changes in a market index do not drive the value of gold mining companies as other industries may experience. For the event study to provide defendable results, this thesis modified the market model for estimating stock performance to account for the influence of gold price and a competitor's valuation, as changes in the market index (NYSE) did not adequately predict the gold mining firm's stock performance. Future research may investigate other drivers of gold mining companies' stock prices to improve the expected stock return model. For instance, referencing a gold index instead of the NYSE may improve the expected return model and alter the findings to indicate that other ESG events were statistically significant. If future researchers improve the estimation model, then a shorter estimation period of 120 days may be applied instead of the entire dataset.

Future research could also investigate the average duration an investor holds a gold mining firm's stock. For instance, if the average shareholder trades the mining company stock within thirty days of the purchase, then a 120-day estimation model may not capture the influence of ESG performance as the model eliminates more minor reactions as part of the error term. An improved estimation model may reduce the event window duration depending on the average time of shareholder ownership.

Future evaluations of the short-term market response to ESG announcements may utilize a synthetic control method. Establishing a group of competitors that generally experiences approximately the same fluctuations in stock price over time allows a researcher to determine if an event caused the selected firm to have a different change in market value compared to the control group. Coinciding events within the control group and the investigated ESG announcement would need to be accounted for and removed from the control group. Synthetic control modeling can be used to evaluate the long-term impact of ESG performance if a control group has not disclosed ESG-related information. However, within the mining industry of North America, most mining companies provide

sustainability reports or other ESG-focused information making this application of synthetic modeling impossible.

This thesis evaluated the long-term influence of Bloomberg ESG ratings on gold mining companies' CFP. However, this does not necessarily imply the same results for other ESG raters. Sustainalytics, in particular, assesses more ESG criteria than Bloomberg and collects private information from mining companies to derive its ESG ratings. Investigating the relationship between other ratings and CFP may provide insight into which rating agency has the most market influence.

The variables selected in this thesis for the long-term regression model analysis did not meaningfully influence the gold mining firms' CFP. Further research could investigate other control variables such as gold price, interest rates, currency exchange rates with the U.S. dollar, or changes in the firm's reserves. Selecting control variables that statistically correlate to the firm's Tobin Q value strengthens the validity of the results for determining the influence of ESG ratings on the firm's financial performance.

This research specifically focused on investor response to ESG performance by evaluating the changes in stock price or market value. However, the financial benefits of ESG performance may be associated with increased ease of permitting or expedited social licensing for future projects, which raises a firm's profitability due to the time value of money. Comparing the time taken to permit a project between a firm that does not participate in ESG with one that has historically publicly disclosed ESG information would provide definitive proof that ESG performance reduces permitting time, thus making the firm more profitable.

This study assumed that gold mining firms receive a higher gold price when they have access to the LBMA Aurium trading platform, which motivated them to pursue sustainability. Future research may investigate if a price differential between gold trading platforms exists, indicating a financial benefit for abiding by LBMA responsible sourcing requirements.

Finally, this thesis did not evaluate the costs of implementing ESG initiatives. Future researchers could investigate the annual expenditures of ESG to determine if a higher cost of ESG per unit of production resulted in higher profitability. Or a researcher could evaluate the percentage of production costs related to ESG compared to the value of a company to determine if a relationship exists between ESG performance and CFP.

This research found that the market has been unresponsive to ESG information relating to gold mining firms in the U.S. and Canada. Furthermore, these gold mining companies' long-term financial performance is unrelated to Bloomberg ESG ratings. However, evaluating the influence of ESG performance on a company's financial performance is a complicated matter that researchers can address from various approaches. Additional research may provide further insight into how investors, consumers, and the general public value a company's management of ESG risks.

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APPENDIX A

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APPENDIX B

ORIGINAL DATA

The original data assessed in this thesis has been published for reference.

The short-term event study data can be found in the EventStudyData-SJ Thesis file. Each ESG-focused event is listed in this file on the List of Events tab. The companies' associated daily percent change in stock prices, LBMA PM fixing for gold price, and the New York Stock Exchange are all listed in the Market Data tab.

The supporting data and calculated variables for long-term regression analysis are available for each firm in the LT Regression Data - SJ Thesis file.