Analyzing the Relationship Between the Economic Growth of Fashion Companies and Their Greenhouse Gas Emissions

Introduction

Over the past few decades, sustainability and environmental degradation have become topics of great importance. The issues within these topics have become the focus of political debates, scientific journals, and international youth strikes. One of the biggest contributors to environmental degradation is greenhouse gas emissions, which have risen exponentially due to major industrialization and urbanization, essentially leading to a massive growth of environmental degradation such as greenhouse gas emissions. These emissions have a copious number of sources, one of which being factories and supply chains, specifically those involved with the fashion industry.

The fashion industry is known for its use of factories and extensive supply chains. With time, the fashion industry has seen considerable changes to the types of factories and supply chains that it uses. A supply chain is the process in which companies receive their materials, make their products, and distribute them (Abernathy et. al, 2014). This change in factories and supply chains, which will be discussed later in the paper, has led to the mild speculation that fashion companies do immense harm to the earth. Sustainability activists have argued that fashion companies are careless with their sustainability efforts and harm the environment so that they can gain the most profit possible. Multiple companies have spoken out against these claims and have begun working towards building a stronger sustainability policy. Regardless, the question remains of whether or not fashion companies do in fact harm the environment in substantial ways. In this specific research scenario, substantial harm to the environment must have an observable effect on the environment and have a lasting impact on the planet, such as the release of greenhouse gasses. The release of greenhouse gases into the atmosphere harms the

planet by contributing to global warming, changing weather patterns, and reducing the quality of air.

This research paper aims to analyze the relationship between the economic growth of different fashion companies in the clothing industry and their greenhouse gas emission rates in the United States within the years 2011-2019 by using a correlational research method. This study holds significance in the fact that fashion is a topic that can easily be contextualized and is something that many people have a general understanding of; this study can also easily be put into context due to the fact that it is a constant, recurring, and rising topic that can span out to a large audience in multiple ways and over extended periods of time. In order to understand the depth and importance of this topic, it is imperative to understand the changes in the fashion industry and its lead way into fast fashion, environmental degradation and greenhouse gas emissions, economics versus the environment, and legality with current actions.

Literature Review

Fast Fashion and Supply Chain

Within recent decades, the fashion industry has seen considerable changes, most notably in its operation and prioritization. Following the 1990's, the industry began to change its style of operation by practicing lean retailing (Global Commodity Chains and Fast Fashion, 2014). Abernathy et. al are research professors from Harvard University that explain how lean retailing is essentially a switch in the supply chain management of a company. Companies started to change their practice to lean retailing to minimize the risk of low sales (Abernathy et. al, 2014) due to the fact that fashion is a majority consumer-driven approach (Global Commodity Chains

and Fast Fashion, 2014). Lean retailing urges manufacturers to “replenish retailers’ stock on an ongoing basis” (Abernathy et. al, 2014 p. 1). Essentially, products are shipped out to companies from their manufacturers at the start of every week rather than at the start of every season.

This change in shipping frequency ultimately leads to changes in manufacturing. Alan Gunner is a business development director that has focused a good portion of his work on creating sustainable supply chains. He sheds light on the fact that it is now “more important than ever that retailers reconsider how their clothes are manufactured” (Moosa & Pham, 2019). The way companies manufacture their clothes is dependent on their supply chain, thus suggesting that companies would have to make crucial changes to their supply chain as decisions about manufacturing and distribution are implemented. (Gunner, 2019 p. 1). The recent majority switch to lean retailing in the fashion industry means that companies “are now able to produce fashion-basic and fashion garments, enhanced design plus offer greater consumer value” (Global Commodity Chains and Fast Fashion, 2014 p. 9).

Zargani goes further by saying that companies need to focus on the base of their supply chain rather than simply looking at the supply chain as a whole. Focusing on the base process of the supply chain and the initial location of the supply chain allows for a more customized and efficient supply chain (Zargani, 2019). Having this change in a supply chain will ultimately reduce greenhouse gas emissions due to the fact that there is less transportation and wasted material involved (Zargani, 2019). With less transportation and wasted materials involved, a shorter supply chain is created and makes for a new type of supply chain in the fashion industry. Ultimately, the variance in supply chains and the change in production rates in the fashion industry have led to the question of the fashion industry’s impact on the environment.

Environmental Degradation and Greenhouse Gas Emissions

Environmental degradation has had a considerable increase within the past few decades due to industrial development, urbanization, and growth in transport (Moosa & Pham, 2019). One aspect of environmental degradation includes the increase of greenhouse gas emissions into the atmosphere. The source of supplies, types of energy used, and materials used are the main contributors to the rise of environmental degradation and greenhouse gas emissions in relation to industrial development, urbanization, and growth in transportation (Smith, 2013). Timothy Smith states that "93.7 percent of the energy used to produce women's apparel in the United States is consumed by upstream suppliers of power, textiles, fabrics, chemicals, and transportation," which is an example of how the methods used to obtain supplies and supply usage ultimately have high rates of environmental degradation in relation to the fashion industry.

Although it may be obvious that the rise in corporations and their non-sustainable methods is proportional to the increase of environmental degradation, greenhouse gas emissions, and economic growth, environmental degradation and greenhouse gas emissions can also have negative effects on corporations. Greenhouse gas emissions can do harm to corporations by causing disruptions in trade and supply chains, while also increasing the possibility of damage costs (Smith, 2013). This forces companies to spend even more money on their supply chains and trade systems, essentially lengthening the supply chains and creating more greenhouse gas emissions. This provides an example as to how economics and sustainability are often seen as 'butting heads' because both are not able to prosper at the same time. Environmental degradation "is often exploited by businesses and special interest groups, which in turn influences sociopolitical action and policy" (Herman, 2015 p. 5). This can be exemplified in the fact that the

government takes action in regulating businesses and has implemented certain policies that are directed towards businesses and special interest groups, specifically focusing on their sustainability efforts, such as carbon taxes (Smith, 2013). This again shows how economics and sustainability do not always go hand in hand, forcing corporations to focus only on one aspect rather than trying to include both. Preceding research has ultimately been able to show that environmental degradation and greenhouse gas emissions have increased due to the desire for economic success.

Economics Versus the Environment

Alam and Paramati are economists who explain that "economic growth is highly associated with increased energy use," which ultimately leads to an increase in environmental degradation, as explained by Smith. Alam and Paramati additionally state that trade openness (the collection of imports and exports set by gross domestic product, also known as GDP) has a negative correlation with energy consumption, which ultimately shows how different economic systems have different relationships with the environment. In relation to trade openness, "CO_2 emissions have the highest correlation with oil and GDP per capita and the lowest with trade openness" (Alam & Paramti, 2015 p. 11). When GDP per capita is at its peak, carbon dioxide emissions and oil consumption are also at their peak, indicating how economics and sustainability do not always work well together. Likewise, "GDP per capita is significantly correlated with oil and CO_2 emissions and least correlated with financial development" (Alam & Paramati, 2015 p. 11). This further proves that GDP per capita is increased when oil consumption and carbon dioxide emissions are increased as well, both of which ultimately cause environmental degradation; the fact that GDP per capita has a low correlation with financial

development also shows that a country's economic output is not a strong indicator for how economically advanced the country actually is.

When looking at the change in economics over time, modern neoclassical economics (a system of economics that determines the cost of items based on its production cost, essentially stripping retail down to a "supply and demand" theory) is not able to handle current ecological problems, again providing an example of how economics and sustainability do not pair well (Davis, 2017). Neoclassical economics does not operate in a way that takes the welfare of the environment into proper consideration, thus making it incapable of handling the newly emerging issues associated with environmental degradation. In contrast, the conservation hypothesis from Alam and Paramati claims that the environment can be taken care of while the economy continues to grow. They use this hypothesis in opposition to the widely accepted growth hypothesis, which argues that "the reduction of energy use will hamper economic growth" (Alam & Paramati, 2015 p. 3). This implies that downsizing retail companies and their supply chains will ultimately hinder economic growth. The best way to support the conservation hypothesis is to focus on the private sector and stray away from government regulations (Davis, 2017). Overall, it can be reasoned that government-regulated economics does not tend to focus on the environment.

Legality / Limitations and Current Actions

Alam and Paramati claim that government officials tend to care more about economics rather than focusing on the environment. One example of this can be seen in a discussion about the Green New Deal; Alexandria Ocascio Cortez states that "the connection [the government] draws between climate change and the economy seems like an indictment of capitalism and

government overreach" (The Green New Deal, 2019 p. 1). This exemplifies how government officials view caring about climate change as a complication that would harm the economy, rather than looking for a solution that could benefit both the economy and the environment. Critics of the Green New Deal argue that it would have ramifications for both individuals and businesses due to the fact that it is so expensive, ultimately causing disruption between government officials on the matter. Discussion on the Green New Deal provides a general example for how a lack of awareness of environmental degradation creates more benefits in terms of economics. However, there are different types of legal issues that affect environmental degradation and economics as a system, such as copyright laws and intellectual property rights.

Copyright laws and intellectual property rights are provided under the legal system and can massively affect environmental degradation. The Indiana Journal of Global Legal Studies claims that "changes in copyright law specific to the fashion industry would significantly lower the environmental impact of the industry." Intellectual property rights allow for easier access to gain copyright laws and change the requirements to get a copyright law, which would decrease the amount of environmental degradation in terms of the fashion industry. When there is a lack of intellectual property rights and copyright laws for the fashion industry, there is an increase in fast fashion (inexpensive clothing made efficiently to keep up with new fashion trends, usually using non-sustainable efforts) due to the fact that companies are more easily able to duplicate the fashion trends that high-end companies put out (The Domino Effect, 2017).

The fashion industry has seen considerable changes in its manufacturing process, with the recent switch to lean retailing. This switch to lean retailing alters the base of the supply chain, which

ultimately harms the environment more than previous retail processes in the past. Environmental degradation and greenhouse gas emissions have grown with the rise of industries and urbanization, both of which depend on corporations and their supply chain management. This causes economics and sustainability to often be seen as rivals, rather than being able to work together. Economists have claimed that environmental degradation can be minimized while the economy continues to grow if companies leaned into the private sector and deviated away from government regulations. There is an overarching theme of apathy from government officials when dealing with environmental degradation. Different property rights and copyright laws have the possibility of minimizing the amount of environmental degradation caused by fashion companies. Fashion companies play a large role in the economy, which has led to the question of how they impact the environment and how much the government should regulate them. This research paper fills the gap of whether or not fashion companies emit more greenhouse gasses if they have larger economic growth. I hypothesize that the higher the economic growth of a fashion company is, the higher their greenhouse gas emissions will be.

Method

A correlational research method was chosen due to the fact that the basis of this research project is to see if there is a correlation of any kind between the revenue of a fashion company and its greenhouse gas emission rates. Correlational research allows for the use of different types of statistical analysis, including but not limited to a least squares regression analysis. A least squares regression analysis is a method of statistical regression analysis that reduces the sum of the squares of the residuals in the results of specific equations. This method of analysis was used

in light of the fact that it allows for the data to be plotted and linearized while also minimizing the vertical space between the data points. Inspiration for using this method of statistical analysis was also taken from authors Moosa and Pham, who wrote about the effects of environmental degradation on healthcare expenditure. Their use of least squares regression analysis was used in the context of comparing elements of environmental degradation to elements of economic growth, which is similar to the comparison in this research paper.

In order to fill the gap of how the economic growth of fashion companies affect their greenhouse gas emission rates between the years 2011-2019, it is essential to find the greenhouse gas emission rates of different fashion companies from these specific years. These companies will include *H&M, Burberry, Kering, Adidas, Levi,* and *Gap-Louis Vuitton Moët Hennessy (LVMH)* was initially included in this list of companies but was later considered an influential outlier that could not be included in the final data analysis. They were considered an influential outlier due to the fact that they did not fit in an appropriate window when graphed with the other companies. Additionally, the revenue of each of these companies mentioned above between the years 2011-2019 needs to be found. These two components can then be analyzed by finding a least squares regression line.

The greenhouse gas emission rates of each individual company were all found from one source. The Carbon Disclosure Project, more commonly known as CDP, was very generous in their contributions and was kind enough to navigate me through their website. A CDP account was then made in order to gain access to the yearly reports of each company. By searching through every yearly report of the companies specified above, the specific corresponding amount of greenhouse gases in metric tonnes was found and recorded.

After all the greenhouse gas emissions had been recorded, the revenue of each company was also recorded into a data table. The revenue of each company was found by searching for each company individually and looking through their year-end financial reports.

Once all hard data had been collected, it was decided that a least squares regression line would need to be found in order to see if there was a causation or correlation. The average greenhouse gas emission for each company (excluding *Levi*) between the years 2011-2019 was found, along with the average revenue for each company (excluding *Kering, H&M*, and *Adidas*) between the years 2011-2019. The aforementioned companies are excluded from the above generalization due to the fact that there were gaps in the data that could not be filled; *Kering* did not disclose any information on their revenue for 2011 and 2019, and *H&M* and *Adidas* did not disclose any information on their revenue for 2019. However, the averages of these companies were still able to be found with the sufficient data that had already been collected. After finding these averages, it was decided that *LVMH* would not be included in the analysis due to the fact that they were such an influential outlier. The averages were then graphed, and a least squares regression line was found.

Discussion and Analysis

Following the analysis of the aforementioned data with a least squares regression line, it can be concluded that there is a small positive correlation between the economic growth of a fashion company and its greenhouse gas emission rates. However, it should be taken into consideration that a limited amount of fashion companies were used and that the data used to find economic growth was restricted to the years 2011-2019, so this conclusion is not supported

with total accuracy. Figure 1 allows for an organized representation of the greenhouse gas emissions of the different companies used in this research project between the years specified above. Additionally, Figure 2 allows for an organized representation of the revenue of the different companies used in this research project between the years specified above.

Figure 1: Greenhouse Gas Emissions of Each Company in Metric Tonnes from 2011-2019

	Burberry	**Kering**	**H&M**	**Adidas**	**Levi**	**Gap**
2011	2903	42612	11466	10431		25383
2012	1790	13273	17543	9417	10404	24104
2013	1334	15078	15379	12169	11115	18897
2014	1760	18682	16435	12249	12039	24449
2015	1662	17502	10723	13047	11906	31275
2016	2013	17716	9308	11703	9880	29572
2017	2126	19229	10492	12017	9484	23811
2018	2119	21034	12484	11702	9301	26320
2019	2086	14406	11818	12388	10140	27818

Figure 2: Revenue of Each Company in US Dollars from 2011-2019

	Burberry	**Kering**	**H&M**	**Adidas**	**Levi**	**Gap**
2011	1936162		18589500	18586000	4762000	14664000
2012	2395372	10370529	21181900	19141000	4610000	14549000
2013	2578540	10636496	22909700	19250000	4682000	15651000
2014	3005501	10949528	23799200	19320000	4754000	16148000
2015	3254455	12639459	24004400	18782000	4494000	16435000
2016	3244136	13520543	25509500	21347000	4553000	15797000
2017	3567904	16612548	27696630	23983000	4904000	15516000
2018	3525337	16099221	23232370	25882000	5575000	15855000
2019	3508568				5763000	16580000

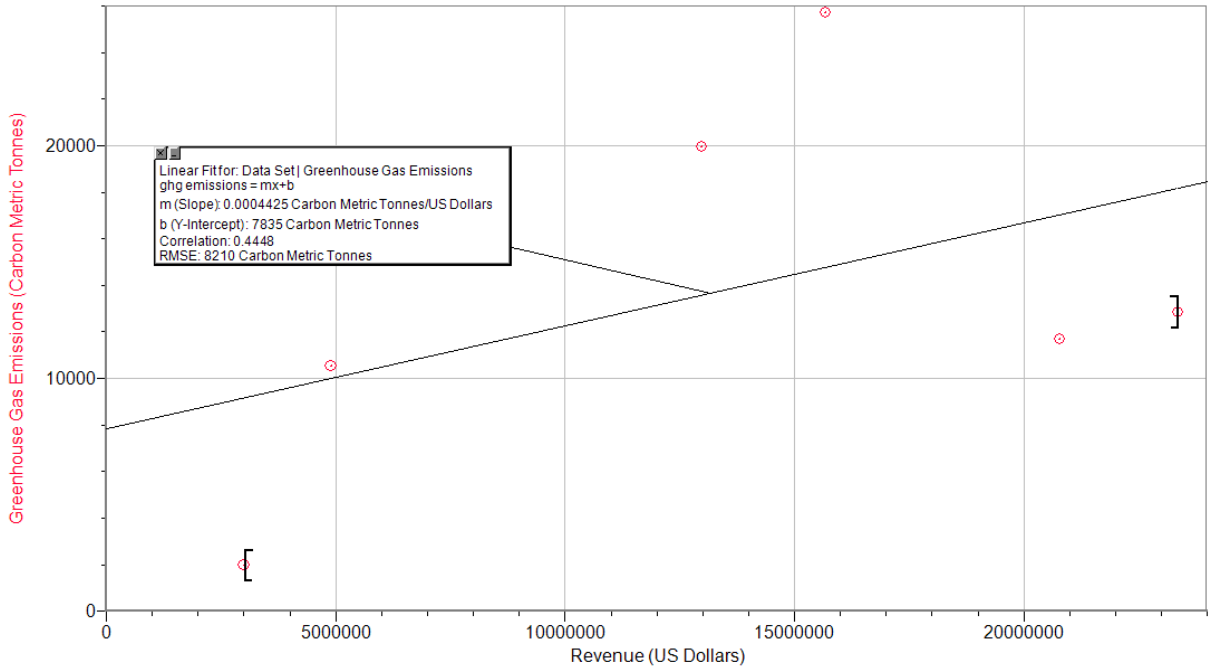
After the averages of each company were taken for both the greenhouse gas emissions and the revenue, they were placed into a data table to make graphing easier (see Figure 3).

Figure 3: Average Greenhouse Gas Emissions and Revenue for Each Company

	Burberry	**Kering**	**H&M**	**Adidas**	**Levi**	**Gap**
GHG Emissions (Metric Tonnes)	1977	19948	12849.77778	11680.33333	10533.625	25736.55556
Revenue (US Dollars)	3001775	12975474.86	23365400	20786375	4899666.667	15688333.33

Figure 4 allows for a visual representation of the relationship between both variables. As shown below, there is a correlation coefficient of 0.4448, concluding that there is a positive relationship between the greenhouse gas emissions and revenue of fashion companies. When using the below least squares regression line to predict future relationships, the results will typically be off by 8,210 carbon metric tonnes; this is taken from the Root Mean Square Error (RMSE) on the graph. In a real-world context, this means that when future researchers take the revenue of fashion companies to predict what their greenhouse gas emissions in carbon metric tonnes will be using this equation, they have an 8,210 unit window for error. Although this may seem like a large amount at first, the results are still able to hold validity due to the fact that the numbers being worked with for greenhouse gas emissions are greater in comparison to the RMSE.

Figure 4: Greenhouse Gas Emissions vs. Revenue



These results hold significance in the fact that they support the initial hypothesis that fashion companies would have higher greenhouse gas emission rates if they had larger amounts of revenue. Previous research has looked into the effects of fashion companies on oil spills or outsourcing, but this research paper now fills the gap of fashion companies affecting greenhouse gas emissions. These results ultimately further the implication that the rise of fashion companies and their change in supply chain has done more harm to the earth than previously thought. It is able to show that an industry that is seemingly harmless can cause substantial damage to the earth, and can do so in ways that are not deemed obvious. This furthers the significance of these results due to the fact that an increase in greenhouse gas emissions leads to changes in weather patterns and reduction of air quality, both of which cause harm to the planet.

From this research, it is implied that the current culture and the constant change in fashion trends have and will continue to contribute to environmental degradation through greenhouse gas emissions. The ongoing changes in pop culture and fashion trends forces fashion companies to constantly revise their products and discard products that could be noted as out-of-date. It also implies that different types of supply chains affect the environment differently due to the fact that the rise of environmental degradation from fashion companies started when several notable fashion companies switched to lean retailing, which is essentially a change in the supply chain of a company.

Conclusion and Further Insight

This data suggests that there is a weak positive correlation between the economic growth of fashion companies and their greenhouse gas emission rates. This conclusion relates to the previous research on this subject by instilling the idea that the economic growth of a company affects factors beyond the extent of its own company, specifically within social and political sectors. Previous research has looked at how environmental degradation and greenhouse gas emission rates are able to affect education, healthcare costs, and politics. Additional preceding research has looked at the effects of a company's oil consumption on its carbon dioxide emission rates. The conclusion that stems from this research paper is able to expand on previous research by drawing a specific connection between fashion companies and how their actions affect environmental degradation and greenhouse gas emission rates. The resulting impact of the economic growth of a company goes beyond affecting the economy as a whole or individuals in that discipline, it is able to affect communities as a whole through multiple sectors; rather than

assuming that the economic growth of a company only affects the company itself, it can now be seen that the economic growth of a company impacts multiple sectors such as sustainability, which ultimately affects other sectors due to the fact that sustainability and environmental degradation impact numerous parts of life.

Future researchers can utilize the conclusion drawn from this paper as background information for their own paper. Researchers can enhance this research by looking into whether or not certain types of fashion companies have a stronger correlation than others (such as fast fashion versus high-end fashion, or athleisure targeting companies versus business casual targeting companies). Further research can also look into specific greenhouse gasses that fashion companies emit, such as carbon dioxide. Branching out of fashion, future researchers can look into the question of whether or not certain types of supply chains cause more environmental degradation than others.

This research paper and the conclusions taken from this study serve importance in society with the direct connection it makes between the economic growth of fashion companies and their greenhouse gas emission rates, as well as the implications it gives. The direct connection between the economic growth of a fashion company and its greenhouse gas emission rates holds importance because it allows consumers to see the impact that companies have on the environment, ensuring that they are able to make an informed decision on where they buy their clothing. The aforementioned implications allow clothing brands to make informed decisions on the type of supply chain they plan to use, as well as how often they will replenish their materials. The conclusions brought from this paper can help fashion companies and their consumers make

more informed decisions, ultimately helping to regulate corporations' treatment of the environment.

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