Exploring the effect of sustainable practices on competitive advantage in Fintech firms: A comparative analysis

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ABSTRACT,
Sustainability has been gaining significant attention in the last couple of years. Financial resources are of crucial importance if the sustainable development goals are to be met. This research explored the relationship between the implementation of sustainable practices in European fintech firms and their competitive advantage. A quantitative study was conducted on secondary data extracted from the Crunchbase database. Results showed that there is no significant relationship between sustainability practices and competitive advantage. Nonetheless, further relationships were explored to find any significant difference between the sustainable group and non-sustainable group. In the first relationship, namely the firm's age effect on their CrunchBase rank, no significant relationship was found within the sustainable group. In contrast, the non-sustainable group showed a negative relationship. Hence, indicating that as non-sustainable fintech firms age, they tend to do better in the ranking. In the second relationship, the crunch base ranking's effect on the total funding that the firms can raise, a significant relationship was found for both the sustainable and non-sustainable group. Concluding that in both groups, as companies become better ranked their ability to raise a greater amount of funds increases.

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Keywords
European Fintech, Sustainability, Competitive advantage, Financial Performance.

1. INTRODUCTION

Sustainability has been gaining significant attention in the last couple of years. Emphasized mostly as a mechanism to help tackle the greatest global challenges of current times. These challenges are primarily thought of as being environmental, due to the large amount of research being conducted regarding climate change. Nonetheless, social issues must also be taken into consideration, such as the increase global pressures determined by vast inequalities between countries, accelerated population growth with limited access to primary resources and poverty among others. This multidimensionality has renewed the concept of sustainability, requiring a wider group of actors to be committed to achieving the sustainable development goals (SDG's). This has sparked consequently, new concepts such Corporate Social Responsibility (CSR) and Environmental, Social, and Government Policy (ESG). These concepts are aiming to include all stakeholders in the process of management and policy making(Mejia-Escobar et al., 2020) while also making companies more accountable to meet such policies. This created a significant number of opportunities to make business models more sustainable.

An increase amount of financial resources that provide environmental and social benefits is necessary if the SDGs are to be met (Sachs et al., 2019). Consequently, creating a substantial opportunity for the financial industry in designing financial products that favor the expansion of sustainable finance. According to Clarke & Boersma (2016) , sustainable finance refers to financial products or services that integrate ESG criteria in their business or investment decisions. However, in the last couple of years, the financial industry has experienced a significant amount of disruption and increased competition. FinTech (Financial Technology) is gaining recognition as one of the most critical innovations in the financial industry. Its rapid evolution driven by the sharing economy, favorable regulation, and information technology have contributed to its popularity today. Gomber et al. (2017) define Fin-tech, as a neologism for describing the connection between innovative technologies (e.g., cloud computing, blockchain, and machine learning) with business activities that were traditionally considered to be part of the financial services industry. Moreover, the COVID pandemic crisis has evidenced the relevance of the link between sustainability, finance, and technology as many countries had to reconsider their traditional methods of acquiring as well as offering finance. The FinTech world with its peer- to-peer and Distributed Ledger Technology (DLT) networks and forms of direct finance, presents coherence and continuity with the ESG world. In fact, recent research shows that Fin-techs have already started to fill the financial inclusion gap through offering their services and products to traditionally underserved communities(Moro-Visconti et al., 2020). However, as visible through the ongoing debates, the question remains:

RQ: To what extent does the implementation of sustainable practices produce superiors' results in Fintech firm's performance, in comparison to when these practices are not implemented?

The paper is structured in a sequential way to guide the reader through every step of the research. In the upcoming section, the concepts are defined more thoroughly, and the taxonomies of sustainable financial products are introduced. Moreover, the theoretical foundation behind these taxonomies and their respective descriptions are provided. Section 3 describes the methods and specific set of steps that were followed in the process of executing this research project. Section 4 presents the data analysis and results section; first by identifying and describing different relationships that are visible in the extracted data sample. Second, by testing if any conclusion can be made regarding the real population with the use of this data. Lastly, in section 5 the key conclusions of the research are reiterated. Closing by emphasizing the relevance of the research and offering future direction and action for research.

2. THEORETICAL FRAMEWORK

2.1 Indicators for sustainable practices

In the research conducted by Mittal et al (2008) they utilized the act of having an organizational code of ethics as indicator for the concept of Corporate Social Responsibility(CSR) and thus sustainable practices. Their findings indicated a positive relationship between CSR and the company's reputation. Another study incorporated the CSR concept in combination with other dimensions such as TBL, to create a multidimensional indicator for sustainable practices in context of SMEs(Cantele & Zardini, 2018). The triple bottom line framework (TBL), also known as the three P's (i.e., People, Planet, and Profit) is an accounting framework which is used to measure sustainable performance on three dimensions: social, environmental, and financial (Slaper, 2011, p. 1). Following this framework, Sustainable Fin-techs can be denoted as; *firms that combine financial services with innovative technologies to increase their social, environmental, and financial performance.* Other researchers with a more specific focus on the environmental dimension of TBL, utilized the concept ecological responsibility as indicator for testing economic performance in a sample of manufacturing firms (Koo et al., 2014). Mejia-Escobar et al. (2020), argued for the use of Sustainable financial products h(SFPs) as an indicator of sustainability practices in context of

financial firms. To do so they specified the taxonomy they utilized in identifying these SFPs in the market.

The taxonomy consisted of two dimensions (see table 1). The first dimension consisted of the SFPs that are focused primarily on producing socially oriented benefits. On the other hand, the second dimension consisted of those products that are more focused on producing environmentally oriented benefits. Furthermore, categories were given, to specify the benefits that would fall underneath each dimension, such as, renewable energy and climate change adaptation for Green oriented SFPs. For this research this taxonomy will be utilized as means of an indicator for sustainable practices in FinTech firms.

Table 1 - Taxonomy of SFPs

Categories for Social-Oriented Products	**Categories for Green-Oriented Products**
Affordable basic infrastructure	Renewable energy
Access to essential services	Energy efficiency
Affordable housing	Climate change adaptation
Employment generation including through the potential effect of (SME) financing and microfinance	Pollution prevention and control
Food security	Environmentally sustainable management of living natural resources and land use
Socio economic advancement and empowerment	Terrestrial and aquatic biodiversity conservation
	Clean transportation
	Sustainable water and wastewater management

2.2 The influence of sustainability practices on firm performance

There is a mix of findings on the effect that sustainability practices have on a firm's performance. Many holders of the positive relationship hypothesis maintain that sustainability practices are not only ethical for business but can also serve a strategic decision that can create competitive advantage and business success. Porter & Linde (1995) argued in favor of the implementation of sustainable practices in business, as they stated that it would improve competitiveness on two fronts. Either through cost advantages or through product differentiation along the product life cycle. Later research conducted on 348 Italian manufacturing firms, found that sustainable practices positively affect competitive advantage (Cantele & Zardini, 2018). In addition to this, they found that competitive advantage positively contributes to the financial performance of firms. Nonetheless, as show for the mix of findings in literature, the study conducted by Mittal et al (2008) found that there is little evidence that firms with a code of ethics would outperform those firms without it, on both an economic value added(EVA) and market added value(MVA) measure. Of course, it can be argued that these differences can be explained by the different indicators utilized for both the sustainability practices and the firm's performance. It is precisely for this reason that this research aims to analyze this relationship in the context of Fin-tech firms. How this was conducted and executed can be found in the following section.

3. METHODOLOGY

To gather data and conduct the analysis on the selected variables depicted in table 2, a set of steps were followed:

Table 2 – Relevant variables for this research

Variable	Description
Age	Difference between date founded and 2021/06/20 (date that the analysis was executed)
Sustainable	A created dummy variable (0=non-sustainable, 1=sustainable)
Funding	Total amounts of funds raised by the company in terms of USD
Ranking	Crunchbase ranking

3.1 Step 1 – Creating Keywords

First, the categories offered for both dimension of the SFPs' taxonomy (see table 1), were used to come up with a set of keywords that can depict *Sustainable FinTech firms* more broadly. This was done through selecting those words that came up the most in the categories of SFP's as well as recommendation offered by the supervisor of this thesis. This in hand served as a helpful tool in the process of extracting a single sample of Sustainable FinTech firms from a Database. The keywords were the following:

- 'Affordable',
- 'Accessible',
- 'Micro finance',
- 'Financial inclusion',
- 'Renewable energy',
- 'Climate',
- 'Environment',
- 'Energy efficiency',
- 'Water',
- 'Wind energy',
- 'Solar energy',
- 'Hydro'.

3.2 Step 2 – Extracting samples

The second step was to extract two samples from the Crunchbase database. This database was selected and used, due to its direct

accessibility offered by the supervisor of this thesis. Moreover, access to other databases was not feasible at the time of this research for the researcher. The scope of this research was limited to the FinTech industry and included only those companies with headquarters located in Europe, that have a CB ranking in the range 1-100,000. The result of the query when inserting only the scope (i.e., 'industry = fintech', 'headquarter region= European Union' and 'Rank ≤ 100,000) into the specifications, constituted the first sample of this research. In total 760 Fintech firms were able to be extracted. The second sample was extracted through keeping the scope in the specifications and adding the keywords from step 1, into the company description specification box. The search result came out with 70 Fintech firms that could be considered to have implemented sustainable practices, due to the nature of the keywords.

3.3 Step 3 – Cleaning data

In the start of the process of cleaning data, both samples were checked for missing values and inconsistencies. Where a missing value was present the value 'NA' was inserted and where other values were already used to account for missing values, these were consequently changed to the consistent value of 'NA'. In terms of inconsistencies, all columns were given a consistent format and title of columns were simplified to achieve a tidier data table (see table 3). Lastly, columns including data that were not part of the variables of interest for this research, were excluded.

Table 3 – Simplifying variable names

Before	After
Organization name	Name
CB Rank (companies)	Rank
Total Funding Amount in currency (USD)	Funding
Date Founded	Founded

In addition to this, two new variables were created, namely, 'Age' and 'Sustainable'. The former was created to make the 'Founded' variable more useful for the analysis. It was calculated as difference between the Founded date and the day this analysis was executed, namely, '2021-06-20'. The latter was created mainly as pre-step for step 4, that is to create a unified data frame out of the two samples. The 'Sustainable' variable is a simple dummy variable representing Fintech firms that include at least one of the keywords in their company description with a value of '1', whereas those that do not with a value of '0'

3.4 Step 4 – Unified Data frame

After completing step 3, it was not sufficient to simply compare the two samples together. First it was of great importance to check for duplicates because the samples were not independent of each other, that is that FinTech firms in the sustainable sample were part of the larger European fintech firm sample. Failing to have done so would have mean that some sustainable fintech firms would have been accounted for twice. This was done using the functionality in Microsoft Excel called 'Conditional Formatting / Highlight Cell Rules / Duplicate Value' and the column selected was 'Name'. There were indeed several duplicates, and these were consequently deleted from the data frame. The final data frame consisted of 760 firms; this was logical as the extra 70 firms were duplicates that were identified as sustainable Fintech firms.

3.5 Step 4 –Linear regression Hypothesis testing.

For conducting this analysis, the powerful programming language 'Python' was used and the syntax file was created in 'Jupyter-notebook', which can be found at the end of this report (see appendix A). This method was selected as it allowed for a more flexible approach in comparison to other more traditional software packages.

The following hypotheses were tested for, by running five linear regressions on the relevant variables.

3.5.1 H1: Sustainable Fintech firms have higher Crunchbase ranking in comparison to Non-Sustainable Fintech firms

In terms of the first hypothesis, the independent variable in case was the dummy variable named 'Sustainable'. The dependent variable 'Rank' was transformed to its square root values to approximate a normal distribution. The Crunchbase ranking was selected as indicator of competitive advantage due to the nature of the algorithm that produces such ranking. According to Stephan (2021) the algorithm takes a variety of signals into account, including but not exhausted to; the number of connections a company's profile has, the level of community engagement, funding events, leadership changes, news articles, and acquisitions. A visual representation (see figure 1) is necessary to describe the hypothesized relationship between these two variables, because the ranking values may look counterintuitive when looking only at the hypothesis statement. A lower numeric value of the variable 'Rank' would mean a higher position in the ranking. A simple linear regression is executed to test for this hypothesis.

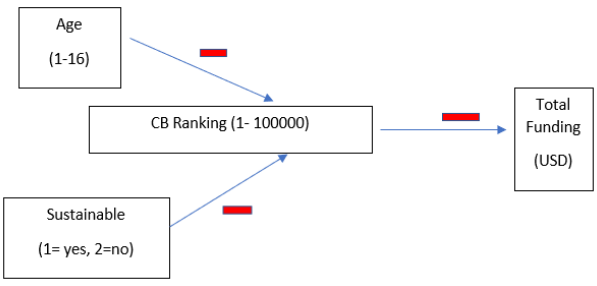

Figure 1. Visual representation of Hypotheses

3.5.2 H2: Older Fintech firms have higher Crunchbase ranking than younger Fintech firms

While the first hypothesis utilized the unified data frame, the second and third hypotheses utilized split samples. The split samples represent in one group the 'Sustainable fintech firms', and on the other the Non-sustainable fintech firms. Thus, 70 and 690 firms respectfully. Appendix B identifies the firms that are listed underneath each group. A linear regression is executed on each of the groups to test for this hypothesis. This model includes

the variable 'Age' transformed into its square root values. Doing this, an analysis is conducted on to what extent does the age affect the ranking of Fintech firms, and a comparison between the two groups is made.

3.5.3 H3: The higher the Crunchbase ranking of a Fintech firm the higher their total amount of funding achieved.

The third hypothesis deals with the argument that the Rank of a firm also positively affects their financial performance. The caveat with selecting the Fintech industry in this research is that most of them are at the start up or young growth stage of the lifecycle. In addition to this, most of them are privately owned companies. Hence, there is a lack of financial data on Fintech firms available to the public. Subsequently, valuation methods such as comparable ratios and discounted cash flow analysis cannot be utilized to conduct this analysis. Nonetheless, an indicator for the financial performance was found within the datasets, namely the variable 'Funding', which describes the total amount of funding they have managed to raise in terms of USD. This indicates that the independent variable is 'Rank' and dependent variable is 'Funding'. However, here again the transformed values were utilized to approximate Gaussian distribution. The log base 10 of the variable 'Funding' was taken to achieve this.

4. DATA ANALYSIS AND RESULTS

4.1 First Hypothesis

To initiate the analysis of the first hypothesis, it was adequate to begin with a general description of the data in the model. The variable 'Rank' was transformed by taking the square root of its values to approximate a normal distribution. The histograms showed visible differences in the distribution of ranking between the two groups (i.e., sustainable fintech and non-sustainable fintech). One can be identified by the slight negative skewness in the histogram of the non-sustainable fintech group (see figure 2). This becomes even clearer when looking at the descriptive statistics in table 4. For the sustainable group, the average squared rooted rank is 183.58 compared to 188.47 of the non-sustainable group, giving an initial impression that the sustainable fintech firms score on average better on the rankings in comparison with non-sustainable fintech firms. Looking at the median for each group it seems that most firms in the sustainable group score better in the ranking in comparison to their counterparts. In addition to this, the deviation from the average ranking is bigger in the case of the non-sustainable group indicating a bigger spread.

Table 4 – Descriptive statistics

Group	Variable	Mean	Median	SD
Sustainable	Sqrt_Rank	183.58	178.88	61.36
Non-Sustainable	Sqrt_Rank	188.47	193.43	75.50

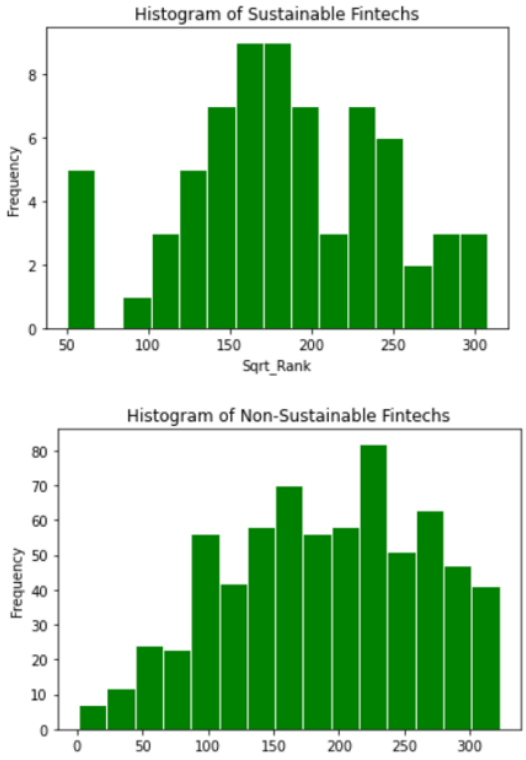

Figure 2. Rank distribution comparison

To test if general conclusions were able to be drawn from these differences, a simple linear regression was conducted to determine whether the dummy variable 'Sustainable', that is if the firms are sustainable or not, affects the Crunchbase ranking that they have. The hypothesis for this first regression was that *Sustainable Fintech firms have higher Crunchbase ranking in comparison to Non-Sustainable Fintech firms.* Results showed (see table 5 and 6) that 0.1% of the variation in Crunch base ranking can be accounted for by the 'Sustainable' predictor variable, with a model significance of $F\ (1, 758) = 0.275, p > 0.05$. Thus, it can be concluded that the overall model has little to no explanatory power about the dependent variable. When looking more closely at the coefficients of the first model, it is visible that the predictor variable 'Sustainable' ($B = -4.89, t = -1.10, p > 0.05$) negatively affects the numeric value of the transformed variable 'Rank' in the sample. Meaning that sustainable fintech's in the sample score higher in the rankings on average. However, the results are not statistically significant, so it is not possible to reject the null hypothesis. Thus, it can be concluded that there is little to no evidence for a relationship between sustainable practices and the Crunchbase Ranking of European fintech firms, which is taken as an indicator of competitive advantage for the purpose of this research.

Table 5 – Model 1 Summary

Model	*R^2*	*Adj R^2*	*F*	*p of F*
1	0.000	0.001	0.275	0.600

Table 6 – Model 1 Coefficients

Model		B	SE	t	p
1	(intercept)	188.47	2.829	66.608	0.00
	Sustainable	-4.89	9.32	-0.52	0.60

4.2 Second Hypothesis

The second regression model is a simple linear regression including the transformed predictor variable 'Age' and the transformed dependent variable 'Rank'. The hypothesized relationship is that *Older Fintech firms have higher Crunchbase ranking than younger Fintech firms.* Already from the results of the previous regression, it was concluded that there was little to no evidence that sustainable fintech firms have better CrunchBase ranking than non-sustainable ones. Nonetheless, the second hypothesis explores the effect of Age on Ranking, while comparing the sustainable fintech group to the non-sustainable group. From the scatterplots in figure 3 and 4, it appears that as sustainable companies become older their ranking becomes worse, whereas with the non-sustainable group the opposite seems to be the case. As non-sustainable fintech firms age they seem to start doing better in the rankings. To test if general conclusions can be drawn from these differences, two simple linear regressions were conducted, one for each group, to determine whether the variable 'Age' affects the Crunchbase ranking that the firms have. Results in the sustainable group showed (see table 7 and 8) that 0% of the variation in Crunch base ranking can be accounted for by the 'Age' predictor variable, with a model significance of $F\ (1, 68) = 0.806$, $p > 0.05$. Thus, it can be concluded that the overall model has little to no explanatory power about the dependent variable. When looking more closely at the coefficients of this model, it is visible that the predictor 'Age' ($B = 10.35$, $t = 0.90$, $p > 0.05$) positively affects the numeric value of the variable 'Rank' in the sample. Meaning that sustainable fintech firms in the sample score worse in the rankings as they age. However, the results are not statistically significant, so it is not possible to reject the null hypothesis. Hence, it can be concluded that there is little to no evidence for a relationship between Age and the Crunchbase Ranking, in terms of the sustainable European fintech group.

Table 7 – Model 2 Sustainable group summary

Model	*R^2*	*Adj R^2*	*F*	*P of F*
2	0.01	-0.00	0.806	0.37

Table 8 – Model 2 Sustainable group coefficients

Model		B	SE	t	p
2	(intercept)	158.90	28.44	5.59	0.00
	Sqrt_Age	10.35	11.53	0.90	0.372

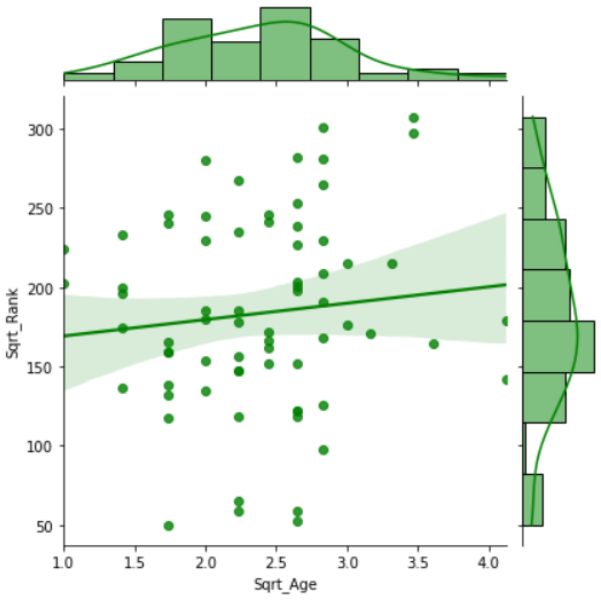

Figure 3. Relationship of Age on Crunchbase rank in Sustainable Fintech firms

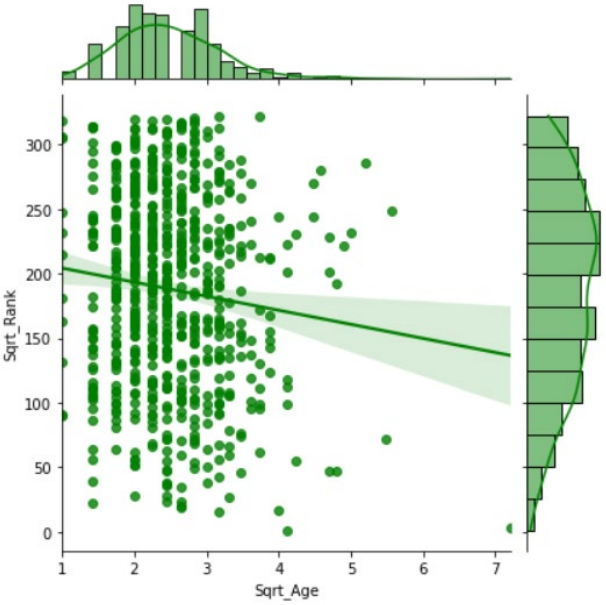

Figure 4. Relationship of Age on Crunchbase rank of Non-Sustainable Fintech firms

On the other hand, the results of the non-sustainable group showed (see table 8 and 9) that 0.01% of the variation in Crunchbase ranking can be accounted for by the 'Age' predictor variable, with model significance of $F\ (1, 682) = 7.93$, $p < 0.05$. Thus, it can be concluded that the overall model has little explanatory power about the dependent variable, however the results of the model were significant. When looking more closely at the coefficients of this model, it is visible that the predictor 'Age' ($B = -10.89$, $t = -2.82$, $p < 0.05$) negatively affects the numeric value of the variable 'Rank' in the sample. Meaning that non-sustainable fintech firms in the sample score better in the rankings as they age. The results are statistically significant, so it is possible to reject the null hypothesis. Thus, it can be concluded that older non-sustainable fintech firms score higher in the

ranking compared to younger ones. In fact, we are 98% confident that the real value of β for the Sqrt_Age variable will fall between the values -18.50 and -3.30.

Table 9 – Model 2 Non-sustainable group summary

Model	*R²*	*Adj R²*	*F*	*P of F*
2	0.011	0.010	7.93	0.01

Table 10 – Model 2 Non-sustainable group coefficients

Model		B	SE	t	p
2	(intercept)	215.26	10.05	21.42	0.00
	Sqrt_Age	-10.89	3.87	-2.82	0.005

Due to the significance of this model, its assumptions were further tested. A Durbin Watson test was executed to test autocorrelation between the residuals. This test statistic ranges from the value 0 to the value 4, where values around 2 would represent no correlation between the residuals. The results showed that this model had a value of 2.158, thus, representing little to no correlation between the residuals and therefore satisfying one of the regression assumptions.

4.3 Third Hypothesis

For the third hypothesis it was important to explore if the ranking of fintech firms affects the amount of funding they can achieve. Like the previous hypothesis a comparison was made between the two groups. The third regression model is a simple linear regression including the transformed predictor variable 'Rank' and the transformed dependent variable 'Funding'. The hypothesized relationship is that *the higher the Crunchbase ranking of a Fintech firm the higher their total amount of funding achieved.* From the scatterplots in figure 5 and 6, it appears that in both the sustainable companies as well as the non-sustainable companies a negative relationship is present between 'Rank' and 'Funding'. As European fintech firms increase their numeric value for 'Rank' (i.e., worsen in their Crunch base ranking) the amount of funding that they can achieve decreases. Or as the hypothesis will imply the higher the CrunchBase ranking of a fintech the higher the total amount of funding achieved. To test if general conclusions can be drawn from these differences, two simple linear regressions were conducted, one for each group, to determine whether the transformed variable 'Rank' affects the transformed variable 'Funding'. Results in the sustainable group showed (see table 9 and 10) that 45% of the variation in total amount of funding achieved can be accounted for by the 'Rank' predictor variable, with a model significance of *F (1, 68) =57.42, p<0.01*. Thus, it can be concluded that the model has a very high explanatory power about the dependent variable. When looking more closely at the coefficients of this model, it is visible that the predictor variable 'Rank' (*B=-0.0075, t=-7.76, p<0.01*) negatively affects the variable 'Funding'. Thus, a higher numeric value for 'Rank' (i.e., a worse position on the ranking) produces a drop in total funding achieved. With a p value lower than 1% for both the model and the coefficient, the null hypothesis can be rejected. In fact, we are 98% confident that the true value of β for the variable 'Sqrt_Rank' will lie between -0.009 and -0.006.

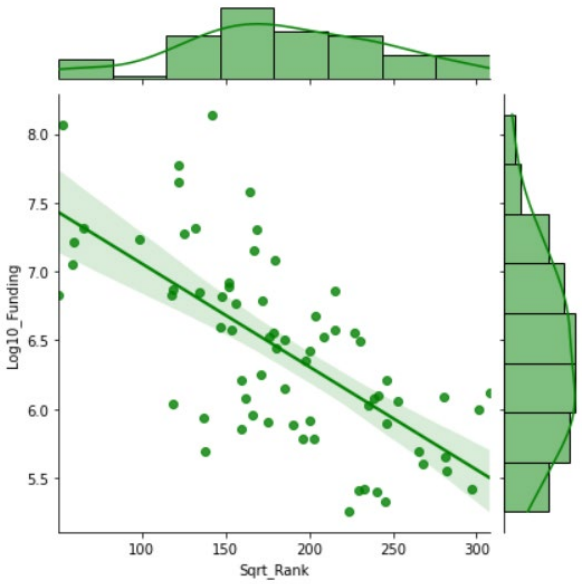

Figure 5. Effect of 'Rank' on 'Funding' in Sustainable Fintech firms

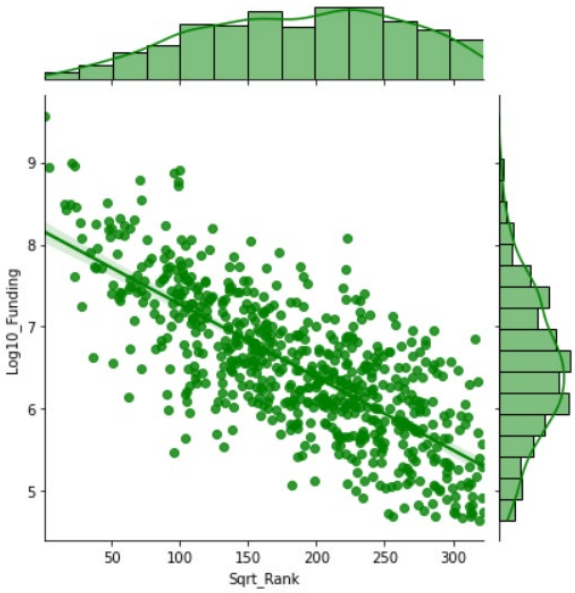

Figure 6. Effect of 'Rank' on 'Funding' in non-Sustainable Fintech firms

Table 9 – Model 3 Sustainable group Summary

Model	*R²*	*Adj R²*	*F*	*p of F*
3	0.46	0.45	57.42	.00

Table 10 – Model 3 Non-sustainable group Coefficients

Model		B	SE	t	p

3	(intercept)	7.81	0.191	40.87	0.00
	Sqrt_Rank	-0.0075	0.001	-7.76	0.00

In terms of the non-sustainable group, the results showed (see table 10 and 11) that 56% of the variation in log 10 base of 'Funding' can be accounted for by the square rooted transformation of 'Rank', with a model significance of *F (1, 657) =852.2, p<0.01.* Thus, it can be concluded that the overall model has a very strong explanatory power about the dependent variable. When looking more closely at the coefficients of this model, it is visible that the predictor variable 'Sqrt_Rank' (*B=-0.0089, t=-29.19, p<0.01*) negatively affects the numeric value of the variable 'Log10_Funding' in the sample. Thus, a higher numeric value for 'Log10_Rank' (i.e., a worse position on the ranking) produces a drop in total funding achieved. With a p value lower than 1% for both the model and the coefficient, the null hypothesis can be rejected. In fact, we are 98% confident that the true value of β for the variable 'Sqrt_Rank' lies between -0.009 and -0.008.

Table 10 – Model 3 Non-sustainable summary

Model	*R²*	*Adj R²*	*F*	*p of F*
3	0.56	0.56	852.2	.000

Table 11 – Model 3 Non-sustainable Coefficients

Model		B	SE	t	p
3	(intercept)	8.16	0.061	134.39	0.00
	Sqrt_Rank	-0.0089	0.000	-29.19	0.00

The third model was significant for both the sustainable fintech group and non-sustainable fintech group. Therefore, other linear regression assumptions were tested for. Autocorrelation was tested using Durbin-Watson test. In terms of sustainable group, the results showed that this model had a value of 2.183, indicating little to no serial correlation between the residuals and therefore satisfying one of the regression assumptions. Similar to this, the value for the non-sustainable fintech group was 1.936, hence also indicating no serial correlation in this group.

5. CONCLUSION

The objective of this research was to deepen understandings of the link between sustainable practices and competitive advantage of firms. What made this research different was that it focused on Financial technology firms, and these were mostly in their younger entrepreneurial stages. Some previous studies focused on analyzing larger sized firms, which had more financial data available to the public and therefore other indicators of performance were utilized. Another relevant difference was that this research utilized a sustainable financial product taxonomy to indicate sustainable practices. In contrast, most of the previous studies utilized more familiar concepts such CSR and ESG. The SFP taxonomy served subsequently as a tool in the process of creating key words that could identify sustainable practices in fintech firms. Furthermore, the Crunch base ranking was utilized as an indicator of competitive advantage in fintech firms due to the nature of the algorithm that produces it. The sustainable fintech firms were therefore compared to a non-sustainable group of fintech firms throughout the entirety of the analysis. Results showed no significant relationship between sustainability practices and the CrunchBase ranking. Nonetheless, further relationships were explored to find any significant difference between the sustainable group and non-sustainable group. The first relationship was that of the age of the firm on the CrunchBase ranking. Here, no significant relationship was found within the sustainable group. Whereas in the non-sustainable group a significant relationship was found, indicating that as non-sustainable fintech firms age they start doing better in the ranking. The second relationship was that of the effect of the crunch base ranking on the total funding that the firms can raise. In this analysis a significant relationship was found for both the sustainable and non-sustainable group. Concluding that in both groups, as companies become better ranked their ability to raise a greater amount of funds increases. With a slightly steeper slope experienced by the non-sustainable group in comparison to the sustainable group. Moreover, the non-sustainable group can achieve higher amount of funding on average in comparison to sustainable fintech firms. Of course, this can be the case due to the innovative business models of these sustainable fintech firms, whom may be less trusted by investors.

There are clear limitations to this research. To initiate, only those firms that were listed in the CrunchBase database were analyzed. Therefore, other databases should be utilized to test for any differences. In addition, only the fintech firms that had their headquarters located in the European Union were selected. Hence, differences might exist in other regions, such as the United States market for example. The second limitation is that the relationship of age to ranking should be further explored given the innovative nature of the business models. More time and data are needed to explore this relationship much more accurately. Perhaps a longitudinal quantitative study would be more adequate.

This research adds to the current body of knowledge as it continues the debate moving forward regarding sustainable practices and competitive advantage. The results add to the already great amount of mix findings that have been previously published. Thus, more research must be conducted to be able to arrive at a more concrete conclusion. Another practical contribution is the creation of a more specified sustainability indicator for the financial industry. It is also of practical relevance both for investors and entrepreneurs. Entrepreneurs can use this information as a tool to better set their strategies to attract higher amounts of funding for their startups. On the other hand, investors can add those relationships that were found to be significant, to their algorithms that identify top performers in the fintech industry.

6. ACKNOWLEDGMENTS

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APPENDIX A – PYTHON SYNTAX

```
cd C:\\Users\\rober\\Documents\\University of Twente\\Bachelor thesis\\Datasets

import math

import numpy as np

import scipy.stats

import pandas as pd

import matplotlib

import matplotlib.pyplot as pp

import seaborn as sns

%matplotlib inline

import statsmodels

import statsmodels.api as sm

import statsmodels.tsa.api as smt

import statsmodels.formula.api as smf

from IPython import display

from ipywidgets import interact, widgets

import re

import mailbox

import csv

from sklearn.linear_model import LinearRegression

from sklearn.model_selection import
train_test_split

from statsmodels.stats.outliers_influence import
variance_inflation_factor


fintech = pd.read_csv('fintech.csv')

fintech.head(200)

fintech. Log10_Funding.astype(float)

fintech.Sqrt_Age.astype(float)


susfintech= fintech.query('Sustainable == "1"')

susfintech['Sqrt_Rank']. describe()

susfintech. Log10_Funding.astype(float)


nonsusfintech= fintech.query('Sustainable == "0"')

nonsusfintech['Sqrt_Rank'].describe()

nonsusfintech. Log10_Funding.astype(float)


fig, ax=pp.subplots(figsize=(6,4))

ax=pp.hist(susfintech['Sqrt_Rank'],
bins=15,color='g', edgecolor='w')

pp.title('Histogram of Sustainable Fintechs')

pp.xlabel('Sqrt_Rank')

pp.ylabel('Frequency')

pp.show()


fig, ax=pp.subplots(figsize=(6,4))

ax=pp.hist(nonsusfintech['Sqrt_Rank'],
bins=15,color='g', edgecolor='w')

pp.title('Histogram of Non-Sustainable Fintechs')

pp.xlabel('Sqrt_Rank')

pp.ylabel('Frequency')

pp.show()


reg1='fintech.Sqrt_Rank ~ fintech.Sustainable'

reg1output= smf.ols(reg1,fintech).fit()

print(reg1output.summary())


reg2='susfintech.Sqrt_Rank ~ susfintech.Sqrt_Age'

reg2output= smf.ols(reg2,susfintech).fit()

print(reg2output.summary())

sns.jointplot(x=susfintech['Sqrt_Age'], y=
susfintech['Sqrt_Rank'],color='g', kind= 'reg')


reg3='nonsusfintech.Sqrt_Rank ~
nonsusfintech.Sqrt_Age'

reg3output= smf.ols(reg3,susfintech).fit()

print(reg2output.summary())
```

```
sns.jointplot(x=nonsusfintech['Sqrt_Age'], y=
nonsusfintech['Sqrt_Rank'],color='g', kind= 'reg')

reg4='susfintech.Log10_Funding ~
susfintech.Sqrt_Rank'

reg4output= smf.ols(reg4,susfintech).fit()

print(reg4output.summary())

sns.jointplot(x=susfintech['Sqrt_Rank'], y=
susfintech['Log10_Funding'], color='g', kind='reg')

reg5='nonsusfintech.Log10_Funding ~
nonsusfintech.Sqrt_Rank'

reg5output= smf.ols(reg5,nonsusfintech).fit()

print(reg5output.summary())

sns.jointplot(x=nonsusfintech['Sqrt_Rank'], y=
nonsusfintech['Log10_Funding'], color='g',
kind='reg')
```

APPENDIX B – LIST OF FINTECH FIRMS BY GROUP

Sustainable	Non-Sustainable
200crowd	[credi2]
Advise Only	21strategies
AREX Markets	2gether
awamo	2local
Baobab Group	4finance
Betalo	A3BC
Bilendo	AASA Global
Blocksize Capital	Acatus
BUX	Accelerated Payments
byebyerent	Accountable.eu
CarePay International	Accounteer
Chatex	Active Asset Allocation
CityTaps	Addiko Bank
ClimateTrade	Advancing
Cooler Future	Adyen
Descartes Underwriting	Afterbanks
DizzitUp	Agicap
DreamQuark	AID:Tech
ECrowd!	Aiia
elsa.care	Aikido Finance
elyps	Airbank
epeer	A-KRDO
eSignus	Akredo
EthicHub	AKUR8
Evarvest	algoreg
Finnu	AllianceBlock
finreach solutions	Alpha Fintech
FiveDegrees	Altpocket
Forget.finance	anfix
GoParity	Anycoin Direct
Grandhood	Anyfin
GRANDMA	ANYTIME
iFunded	Apeiron Investment Group
Insurely	Aplazame
Internet of Coins	Arbor Fintech
invest.com	Arboribus
Jenji	ArchVentures SA
Kard	Arf
kevin.	Arkane Network
Koosmik	askRobin
LIBEEN Smart Housing	Assure Hedge
Likvido	Atani
LoanXchain	Atomic Wallet

Loudspring	Avanseo
Lucas	AWARE7
MatchUpBox	Axyon AI
Micappital	Ayomi
Mintos	b.fine
Mitigram	B2B Pay
NÃ¤ktergal	Backbase
Neo (getneo.com)	Balio
Niko Technologies	Banco Bilbao Vizcaya Argentaria
Oradian	Banco Santander
Polkastarter	Bancore A/S
Qred	Bankera
Ramp	Bankify
SPOKO	Bankin'
Stabelo	Bankse
Stoer	BankZee
StudentFinance	Banxware
The Many	Barion Payment
The NAGA Group	BBVA
TradeSocio	Beesfund
TRINE	Beesy
Upvest	Beez
Vaamo Finanz AG	Beseif
we.trade	Besepa
Wealth Square	Betmarkets
Yourpay ApS	Betterway
Zaver	Bewa7er
	Bewater Funds
	BillFront
	Billhop
	Billie
	BillTech
	Binance
	Birdylabs
	Bit2Me
	BITA
	Bitbond
	Bitfury Group
	BITLEVEX
	BitOfProperty
	Bitpanda
	Blackmoon Crypto
	Blanco Services
	Blockpit GmbH
	Blocksquare
	bnc10
	Bnext
	Bofink

Bolden
Bondora
bonify
Booste
BorsadelCredito.it
Borza terjatev
Brickblock
BrickFunding
Bricknode
Brightly Ventures
BrikkApp
Brocc
Bruno
bsurance
Buddy Payment
BudgetBakers.com
bunq
Bynk
Cambrist
CANDIS
Capcito
CAPEX.com
Capital Cell
Cappy
Captio
Card Dynamics
Cardlay
Carl
Cash Credit
Cashbee
CashDirector
Cashforce
CEED Tech
Centrifuge
Change Donations
Change Invest
Changelly
Cinnober Financial Technology
Circit
Clark
Cleverea
Cobase
Cobee
CoinCasso
coindex
Coinffeine
Coinhouse
Coinify

CoinLoan
CoinMetro
Coinpanion
Coinsbit.io
Combine
Companisto
COMPEON
Compte Nickel
Confidas
Confido
Corlytics
CostPocket
Coverflex
Coverfy
Coya
CR2
Creamfinance
Credia
Credimi
CrediNord
Credits
CrediWire
CrescItalia
Cringle
Criptalia
CrossLend
CrowdDesk
CROWDESTOR
CrowdFundMe
CRX Markets AG
Crypterium
Cryptio
CryptoMood
CryptoTax
CurrencyFair
Dandelin
Datamolino
Datia
debtify
Declarando
Deed
DEGIRO
Dejamobile
Deposit Solutions
DFi Labs
Dfns
Diaman Tech
Digicash Payments

Digipulse
DigiShares
Digital Claim
Digital+ Partners
Direkto
Divilo
DocDigitizer
Doconomy
Dooer
DoxyChain
Dreams
DUNFORCE
DX Compliance
Eagle Alpha
easyGOband
EasyPol
Econans
eKuota
Elinvar
Elkstone Capital Partners
Elorus
Elrond
Enfuce
Enterpay
Envoy Group
Epiphany
Epsor
Equiduct
essDOCS
EstateGuru
Etvas
Eucaps.com
Eurazeo
Evercity
Eversend
EvoEstate
Expensya
Exporo
Exscudo
FAAREN GmbH
Factris
Fagura
FairMoney
Feelcapital
fees
Fellow Funders
ff.next (previously Family Finances)
figo

Finabro
FinAi
Finamatic
Finanbest
Finanzarel
Finanzcheck.de
Finanzchef24
Finanzguru
Finary
Finclude
FinCompare - Smarter Business Finance
FINEXITY AG
FinFrog
Finiata
Finizens
FinKey
FinLab
finleap
finleap connect
FinList
finmid
Finnest
Finoa
Finologee
Finom
FINQware
FinScience
Fintastico
Finteca
Fintech Payments | The first marketplace of Fintech & Insurtech solutions
FinTecSystems
Fintecture
Fintel
fintonic
Fintura
Finturi
finway
Flanks
flatex
Flender Peer-to-Peer Finance
Flow Your Money
Fonoa
Forexfix
Fourthline
Fraugster
Fuell
fulfin

Fund Recs
Fundsfy
FundShop
Fundvisory
Fundwise
GamerHash
Geowox
getquin
Getsafe
Gini
Givve
Global Fintech Solutions
GlobelMoney
Goin
GOLDBAUM
GrowIN Portugal
GrowishPay
HappyPal
HeavyFinance
Heliad Equity Partners
Hellas Direct
Herdius
HeyTrade
H-FARM
hi.health
HiHi!
Hive Project
hiveonline
Holvi
Housers
Hrmony
HUBUC
Husky Finance
Ibancar
iBanFirst
iconicchain
ID Finance
ID-Pal
Ikbenfrits.nl
Ilavska Vuillermoz Capital
Indy
INLOCK
Inside Secure
Instant Factoring
insureQ
Insurwiz Technology
Invesdor
Investing.com

Investory
InvestSuite
InvoiceSharing
IPOhub
isaac10 GmbH
Itiviti
iZettle
Izicap
Jarvis Network
Jeff
Julaya
Juni
Just Me Technologies
Kaiko
Kapilendo
Keyrock
KICK ECOSYSTEM
Kira Core
Klarna
KLEAR LENDING AD
Klein Data Research
KleverApp
Koalaboox
Kommerce
kompany
Kreditz
Kyckr Limited
LaFinBox
Lana
Lanbyte
Leapfunder
LeasLink
Leetchi
LegionPay
Lemon Way
Lendahand
Lendica
Lendify
Leveris
Libeo
Limonetik
Lingua Custodia
Linked Finance
Linxo Group
LIQID
Liquid Token
Livetopic
LoanBook Capital

Lovys
Lunar
LUXHUB
LVS Brokers
Lydia
Lysa
MagniFinance
Mambu
Mansa
Margin
Mark ID
Mash
MassUp
MatiPay
Maytana
MDOTM
Medius
Meteo Protect
Metrosoft
Midex
Milepay
Minna Technologies
MioAssicuratore
Mitto
Moank
modefinance Srl
Modifi
Modularbank
Mollie
Monedo
Monetise
moneymeets
Moneymour
Monify
Monkee
Montonio Finance
Monyq
Mooncard
Moonfare
Moonshot Insurance
More Money
Morpher
Moss
MUST Platform
Mutter Ventures
My Money Jar
MYMOID
MyMonii

Mynt
Myos
MyWallSt
N26
NA
NAGA
Nalo
nBanks
Nemuru
Neo Moon
Nesta
Nethone
NewBanking ApS
nextmarkets
NGRAVE
Ninety Nine
Ninja Lender
NoBanx
norbloc
NORD.investments A/S
Nordic Eye Venture Capital
Nordigen
Nordkap
Novo Holdings
Novofina
NPEX
Nuri
October
Ohpen
Open Payments
OpenLedger
Oper
OpSeeker
OptioPay
Otly!
Owlin
PÃ©ntech - Digital Factoring
Pacific
Pagantis
Paiblock
PAIR Finance
Palico
ParaSwap
Particeep
PaxFamilia
PayAccept
Payaut
payconiq

Payflow
PayinTech
PAYMILL
Paymium
Payplaza
PayPlug
Paytailor
Paytweak
PayU
Payworks
Pennylane
Pensionera.se
Pensumo
Penta
PEY
PHI Token
phyre JSC
Pibisi
PIGARI
PiPiT Global
Pixpay
PlasmaPay
PlatePay
Pleo
Plexian
Pliance
Polaroo
Poleecy
Pom
Preseries
Pretto
primeCROWD
Proof Suite
Prosus & Naspers
PumaPay
Qbitia
Qonto
Qover
QuantCube Technology
QuantsUnited
Quantumrock
Quidax
qunb
Quppy
Qvalia
RAETI FINANCIAL SERVICES SPAC
Raise Partner
Raisin

RAISING
Raison
re:cap
ready2order
Rebellion Pay
Rebtel
Receeve
ReceiptHero
Recharge.com
RECHNUNG.de
Red Flash Mobile AB
REDi Ai
Reloadly
Revault
Revo Technologies
RightNow
Risika
RollingFunds
SA HEOH
Safello
SafeRE
Saffe
Salarify
Salv
Sanctify Financial Technologies
Satispay
Savedo
savedroid
SAVR
Saxo Bank
Scalable Capital
SEB Venture Capital
Sedicii
SeeDCash
Segguroo
Selma Finance
Sentinels
Sepior
SESAMm
sevDesk
Shareline
Shine.fr
ShufflUp
Sigmastocks
Silverfin
Silverflow
Silvr
simplesurance

Sinba
Skenario Labs
SlimPay
SMACC
Smart Bill
SMEO
Smile&Pay
Socilen
Software Group
Soisy
Solarisbank
Solfy
SPARQ
Spendee
Spendesk
Splitty Pay
Spotcap
StakeWise
Startup Stock Exchange
Startupxplore
Steven
Stocard
StockCrowd
Stockpoint
Strawpay
Streamdata.io
Subaio
Supply Finance
Swan
Switcho
Tacotax
TagPay
Talenter.io
Tapp
Taxdoo
TaxDown
TerraPay
The Capital Platform
Thinksurance
ThreatMark
Tickendy
Tink
Tobi
Toborrow
Tokeny Solutions
TontineTrust
Topos Network
Trackinsight

Trade Republic
TradeIn
TradeLink
Tradeworks.io
Trality
TransferMate Global Payments
Traxpay
TreasuryXpress
treefin
Trezeo
Trioteca
Trisbee
Trivi
Trustap
TrustChain Systems
Trustly
Turff
Twisto
TXC Markets
Unilend
United Finance
Unnax
Untie Group
Upflow
Utrust
VAI Trade
Valoo
Vantik
Ventis
Ventury Analytics
Verestro (formerly uPaid)
Verse
Vinter
Virteo NV
ViteSicure
Viva Wallet
Vive
Vivid Money
Vizor
Vybe
Waizer
Walliance
Walnut Algorithms
Wawllet Enterprises Limited
WE.VESTR
wealthpilot
wefox
Welltrado

	Werthstein
	WeSavvy
	WeShareBonds
	wikifolio
	worig
	Workinvoice
	Worldcoo
	Worldcore
	Wrapp
	Xempus AG (formerly xbAV AG)
	Xolo
	Yolt
	Young Platform
	Younited Credit
	YouPass
	YouTransactor
	Zank
	Zeitgold
	ZEN FinTech
	Zero1
	Zervant
	ZignSec
	Zolo
	Zyfro