Tax Avoidande and Corporate Risk Evidences from Germany Machine Learning Method

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ABSTRACT

The purpose of this paper is to focus on the effect of tax avoidance on corporate risk. This research contributes to the previous literatures by examining the impact of the coronavirus pandemic on corporate risk and also by making predictions though machine learning. This thesis also contributes to the litteratures by the choice of germany as a country of studies. We took a sample of 35 companies listed on the Frankfurt stock exchange over the period 2012-2021. The results of our regression show that tax avoidance does not have a significant effect on the corporate risk.

INTRODUCTION

Tax evasion has received considerable attention in recent years both in practice and academic research. The study of **Thomsen and Watrin (2018)** focusing on observing American and European companies' behavior shows that behavior, with regard to tax evasion, does not change over time. Developing countries are the first victims of this large scale of tax evasion. In addition, the recent United Nations University's study has argued that the poorer a country, the more companies are encouraged to divert their profits to countries providing tax incentive measures **(Landier and Plantin, 2017)**. At present, **International Monetary Fund**'s studies show that developing countries are three times more vulnerable than developed and rich countries regarding the possible negative effects of tax rules and practices **(Akcigit et al., 2016)**. So we are faced with harmful tax competition which promotes tax evasion, especially tax havens **(Ben Ali, 2023)**.

Let's take some real cases of tax avoidance :

2008 : UBS

2013 : offshore leaks

2015 : swissleaks

2016 : panama papers

2017 : paradise papers

The G7 is fighting againt tax avoidance to limit these practises, the loopholes exist in the law and the laws are becoming more and more complex in order to tackle this issue. Thus, during their summit in Mexico on 18 and 19 June 2012, the representatives of the G20 "asked the OECD to draw up an action plan to provide coordinated and comprehensive responses to the problem of the base erosion and profit shifting". It is clear that tax evasion is a threat to States and that initiatives must be taken as soon as possible. In 1989, the G7 established the **Financial Action Task Force**, with the aim of developing anti-money laundering strategies and ensuring their enforcement. The FATF has adopted recommendations on the prevention and repression of money laundering without binding legal force. The FATF also publishes a "black list" of non-cooperative countries and territories (NCCTs).

The internationalization of tax law has taken the path of no way back. Thus, the sovereign or even protectionist acts of States are defeated by multilateral policies by the reason of neo-liberal globalization **(letaief, 2021)**.

Especially developing countries that have introduced low tax rates to attract large investments, if they change their taxation the economy will plummet. The divergence of interests makes it difficult to adopt multilateral agreements since within the European Union and other organisations, we have the principle of unanimous voting, apart from the non-binding nature for others (UN , OECD or WTO) when they intervene in tax matters, they issue recommendations which are not binding since tax treaties today retain, as a general rule, a bilateral character which is explained both by the States' attachment to their fiscal sovereignty, to which they only intend to impose restrictions on a case-by-case basis, and the singularity of economic relations from one State to another, justify an adaptation of the tax agreement to each of the contexts encountered **(Castagnède, 2014)**. So the interests and the balance of power between countries justify bilateral agreements **(Ben Ali,2023)**.

Convention models and tax standards have been adopted thanks to international organizations such as the OECD, which have played a major role in bringing together the points of view of different countries by bringing tax systems closer together and by establishing a list of tax havens **(OECD, 2015)**.

The specialization of company activities and the separation of management from ownership lead managers, as agents of shareholders, to oversee operations, often resulting in conflicts of interest due to differing goals **(Salehi, Tarighi, & Safdari, 2018)**. Managers may conceal negative information to maintain a favorable company image and secure rewards, creating a stock price bubble that will eventually burst when bad news surfaces, collapsing stock prices **(Hutton, Marcus, & Tehranian, 2009; Moradi, Bagherpour Velashani, & Rostami, 2016)**. Another conflict exists between the government and shareholders, as taxes reduce company profits, prompting directors to minimize taxes legally **(Hanlon & Heitzman, 2010)**. Tax avoidance can increase the risk of stock price drops, as it involves accumulating bad news. Managers' opportunistic behaviors, including using tax havens, can harm the company's reputation, lead to costly investigations, and ultimately reduce stock prices and increase risk **(Graham, 2014)**. Thus, while shareholders are attracted to high profits, they must also consider corporate risks seriously. So despite tax avoidance boost investor’s profit, it has an impact on corporate risk via stock price bubble caused by the accumulation of negative informations **(Ben Ali, 2023)**.

The rest of our research is organized as follows: next section frames the study into a theoretical framework, hypotheses development, and literature. Part three describes the research design and outlines where data is obtained and the sample selection procedure. Section four then presents the main results and implications drawn from statistical analyses and. Eventually, the last district presents the concluding remarks.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Tax avoidance is profit generator and increase shareholder’s wealth :

Tax avoidance is the legal use of the tax system to reduce payable taxes **(Pasternak & Rico, 2008)**. It does not involve illegal activities that decrease government revenues needed for public services. There are two perspectives on tax avoidance and company value. The first view sees it as value-enhancing, as it reduces the transfer of wealth from shareholders to the state, thereby benefiting shareholders **(Desai & Dharmapala, 2009)**. Consequently, many firms use tax avoidance to reduce taxable income **(Noor, Fadzillah, & Mastuki, 2010)**. The second view, based on agency theory, suggests that tax avoidance allows managers to hide negative information for personal gain, often at the expense of shareholders' interests **(Chen & Chu, 2005; Crocker & Slemrod, 2005; Armstrong, Blouin, & Larker, 2012; Salehi et al., 2017)**. Thus, shareholders and boards must implement control and incentive mechanisms to minimize agency costs **(Jensen & Meckling, 1976)**.

This is the short run impact of tax avoidance. In the short term tax avoidance generate profits which increase shareholders profit, which is their main interest **(Ben Ali, 2023).**

Tax avoidance increases corporate risk :

Despite potentially reducing financial leverage **(Graham & Tucker, 2006; Richardson, Taylor, & Lanis, 2016)**, tax avoidance significantly increases firm risk, as shown by several key studies. **Rego and Wilson (2012**), for example, examined how equity risk incentives drive corporate tax aggressiveness.

Tax avoidance generates debt risk :

The results indicate that larger equity risk incentives correlate with greater tax risk. **Crabtree and Maher (2009)** found that firms with high tax avoidance exhibit low credit in their debts. **Hasan, Hoi, Wu, and Zhang (2014)** showed that firms avoiding taxes are seen as riskier by lenders, leading to higher interest rates and debt costs. Tax avoidance can exacerbate corporate risk for several reasons. **Waluyo (2013) and Mardiasmo (2016)** define tax avoidance as legally reducing taxes by using allowable deductions, creating uncertainty about which costs are acceptable **(Dyreng, Hanlon, & Maydew, 2008; Guenther, Matsunaga, & Williams, 2017).** Discrepancies between company and tax officer perceptions can increase future tax liabilities and cash flow uncertainty, resulting in higher future tax rate volatility **(Guenther et al., 2017)**.

Tax avoidance is harmful to future cash flow :

The magnitude of tax avoidance is often seen as an indicator of a firm's investment risk. Effective tax evasion strategies require complex and ambiguous reporting, increasing uncertainty about future cash flows and reducing information transparency **(Guenther, Matsunaga, & Williams, 2016)**. Studies show that managers prefer low effective tax rates, but investments in tax reduction raise firm risk. For example, **Shevlin, Urcan, and Vasvari (2013)** found that corporate tax avoidance is linked to higher public debt costs, especially when equity holders and management aim to expropriate bondholders' wealth and when IRS audit probability is high. Badertscher, **Katz, and Rego (2013)** noted that tax avoidance increases due to the separation of ownership and control. **Chen, Ge, Louis, and Zolotoy (2019)** found that firms with higher stock liquidity engage less in extreme tax avoidance due to increased shareholder monitoring. Uncertainty in future tax liabilities, termed as future tax rate volatility, impacts the company's cash flow **(Guenther et al., 2017).**

Tax avoidance and tax uncertainty :

Dyreng, Hanlon, and Maydew (2018) found a positive association between tax avoidance and tax uncertainty, especially for companies with regular patent filings and tax haven subsidiaries. This supports the view that riskier tax positions increase the likelihood of enforced tax repayments. **Sunder (2015) and Guenther et al. (2016)** argued that as tax evasion raises the possibility of future high tax rates, lower current tax rates tend to be less persistent compared to higher tax rates.

Tax avoidance and corporate governance :

Mashaykhi and Seyyedi (2015) studied corporate governance and tax avoidance in Iran, finding no significant connection between corporate governance mechanisms (like institutional ownership, board independence, and board size) and tax avoidance. Similarly, **Salehi et al. (2018)** found that board independence and managers' investments in their own companies did not affect audit fees in Iran. These findings suggest that corporate governance mechanisms in Iran do not effectively reduce agency problems and information asymmetry, making it unreasonable to expect them to prevent tax evasion. Additionally, due to severe economic sanctions and financial strain from 2012 to 2016, many Iranian firms likely engaged in tax avoidance to mask poor financial performance. In such conditions, financial managers tend to be more risk-averse in their tax avoidance strategies to increase firm value, making lower effective tax rates more consistent than higher ones.

Tax avoidance generate bigger difference between accountable and fiscal profit :

Aggressive tax avoidance practices can lead to a significant gap between commercial and fiscal profits, as companies aim to minimize fiscal profit through various corrections. This disparity reduces the quality of profits shown to investors, as highlighted by **Ayers, Laplante, & McGuire (2010)**. Despite appearing large, profits resulting from aggressive tax avoidance may not reflect actual profitability, tarnishing the company's reputation among investors. **Lev & Nissim (2004)** noted that taxable income predicts future stock returns, while **Goh, Lee, Lim, & Shevlin (2016)** found that more aggressive tax avoidance correlates with higher cost of equity. Taxable income serves as a predictor of future corporate performance uncertainty **(Dhaliwal, Lee, Pincus, & Steele, 2017).**

In the long run tax avoidance may increase corporate risk. Shareholders want to invest in secure companies. So there is a trade-off between the benefits and drawbacks of tax avoidance **(Ben Ali, 2023)**.

We end up by submitting our hypothesis :

H1 : tax avoidance has impact on corporate risk.

RESEARCH METHODOLOGY

We select our sample from all firm-year observations in the annual reports database for the years from 2012 through 2021. The statutory tax rates of countries in the sample data are derived from the Organization for Economic Cooperation and Development (OECD) Tax Database. As for tax avoidance, size and leverage they were collected from the financial statements. We chose this sample for data availability via annual reports and we chose Germany as country of study because Germany because this country is one of the most business influencing country in the world famous for with its **Frankfurter Wertpapierbörse (FWB®, the Frankfurt Stock Exchange)**. Added to this, Germany has the largest number of private firms in Europe and it is a strong investor protection country with stringent national accounting standards. Strong Institutional and Regulatory Framework.

Germany has a well-developed tax system, strict enforcement mechanisms, and transparent corporate governance regulations. This makes it an ideal case to study whether tax evasion affects business risk in a highly regulated environment. If tax evasion has little impact on risk in Germany, it suggests that strong institutions mitigate the potential negative effects.

Germany provides extensive and accurate financial, tax, and corporate data from official institutions such as:

- Federal Statistical Office (Destatis) – Economic and business statistics
- Deutsche Bundesbank – Financial data
- BaFin (Federal Financial Supervisory Authority) – Corporate and banking regulations
- German commercial databases – Access to financial reports of companies following IFRS and German GAAP
  This ensures that your research is based on credible and verifiable data, reducing biases and inconsistencies.
- Germany is Europe’s largest economy and a global leader in industrial and financial sectors. Studying tax evasion in such a strong economy helps understand its impact on business risk in a stable environment.
- If tax evasion does not significantly affect business risk in Germany, it suggests that similar economies with strong governance may have comparable results.
- If an impact is found, it highlights that even in well-regulated environments, tax evasion can introduce financial risks.
- Germany has a mix of:
- Large multinational corporations with sophisticated tax planning strategies
- Mittelstand (SMEs) that are highly integrated into the economy and may face different tax risks
  This allows for a comprehensive study across different firm sizes and industries, making your results more generalizable.

- We chose to deal with Germany and we selected 35 listed companies for an number of observation of 311.

Research Models :

Our mathematical model can be expressed as follow :

Risk : the corporate risk
Tax avoid : the tax avoidance measurement

$$risk = \beta 1\ tax\ avoid + \beta 2 size + \beta 3\ leverage + \beta 4\ profitability + \beta 4\ firm'loss + \beta 5\ covid + \varepsilon$$

Cash ETR Volatility: the effective tax rate of firm i in year t, which is equal to the annual standard deviation of cash tax, divided by income during the five years period.

Tax avoid : a proxy for tax avoidance. ((Pretax income*statutory corporate tax rate) - tax paid)/ pretax income. **Atwood et al. (2012).**

Leverage: leverage of firm i in year t., which sum of non current debt divided by the sum of assets at the beginning of the year; **(himmelberg, Petersen, 1994 ; Hall, 2002).**

Loss: an indicator variable equal to one if a firm has negative pretax income

Profitability : The pre tax income divided by total asset **Berheci, M., (2009)**

Covid : Equal to 1 if there corona virus pandemic, 0 othewise

The choice of the variables of study :

- **Tax avoidance :** We chose tax avoidance because tax avoidance practises impacts the stocks price of the company.
- **Leverage :** We chose leverage because financial leverage refers to the use of debt financing to increase the potential returns on investment, while financial risk refers to the risk that a company may not be able to meet its financial obligations due to factors such as changes in interest rates, market conditions, or its financial structure.
- **Size :** We chose size because An association between firm size, risk and return may also exist that accounts for this profitability/size relationship. Many argue that there is a risk-return trade-off; that is, higher rates of return are obtained only by taking on risk. Risk is often measured by the volatility in rates of return.
- **Firm's loss** We chose firm's loss variable because if the is at loss the risk of bankrupt is high.
- **Covid-19 :** We chose the covid variable because the covid is affecting the business world in all aspects.
- **Profitability :** We chose the profitability variable because it is important to determine the financial condition and performance of a firm. Again profitability and risk have same direction; in order to have greater profitability, we need to take greater risk. But in practice a firm must accomplish a minimum risk to achieve maximum profitability.

RESULTS

Descriptive Statistics

In order to better understand the research population and to become more familiar with the research variables, at first it is necessary to describe these the statistical data before analyzing them. The statistical description of the data is a step towards identifying the governing pattern and the basis for explaining the relationships between the variables used in the research. Descriptive statistics of the research variables including Mean, Standard Deviation, Minimum, and Maximum are presented in Table 1:

Table 1 : descriptive statistics

Variable	Obs	Mean	Std.dev	Min	Max
Risk	310	0.43	0.93	-1.77	9.8
Taxavoid	310	0.46	2.06	-4.63	32
Taxavoid2	310	-0.17	1.03	-14.02	4.79
Size	310	4.7	1.31	0.12	10.98
Leverage	310	0.38	2.68	0	40.64
Profitability	310	3.26	22.02	0	191.65

The **corporate risk** variable has a mean equal to 0.43 and a standard deviation of 0.93. We notice that the standard deviation is quite high which means that there is a big dipersion aroud the mean and the corporate risk is volatile.

The **tax avoidance** variable has a mean equal to 0.46 and a standard deviation of 2.06. We notice that the standard deviation is quite high which means that there is a big dipersion aroud the mean and the tax avoidance is volatile.

The **second measure of tax avoidance** variable has a mean equal to -0.17 and a standard deviation of 1.03. We notice that the standard deviation is quite high which means that there is a big dispersion aroud the mean and the tax avoidance is volatile.

We can state that we have a high tax avoidance rate for both measures. The first measure of tax avoidance is more risky than the second one since it has a higher standard deviation.

The **size** variable has a mean equal to 4.7 and a standard deviation of 1.31. We notice that the standard deviation is quite low which means that there is a small dipersion aroud the mean and the size values are not volatile.

The **leverage** variable has a mean equal to 0.38 and a standard deviation of 2.68. We notice that the standard deviation is quite high which means that there is a big dispersion aroud the mean and the leverage is volatile.

The **profitability** variable has a mean equal to 3.26 and a standard deviation of 22.02. We notice that the standard deviation is very high which means that there is a very big dispersion aroud the mean and the profitability is volatile.

To conclude most of our variables are volatile which states the presence of outliers.

Table 2 : frequency table of firm loss

Firm loss	Freq.	Percent	Cum.
0	287	92.58	92.58
1	23	7.42	100
Total	310	100	

The firm loss has a frequency of 7.42% out of 310 observations.

Table 3 : frequency table of covid

Covid	Freq.	Percent	Cum.
0	217	70	70
1	93	30	100
Total	310	100	

The covid variable has a frequency of 30% out of 310 observations.

Bivariate analysis :

Table 4: Bivariate analysis

	Risk	Taxavoid	Size	Leverage	Profitability
Risk	1	-	-	-	-
Taxavoid	-0.11	1	-	-	-
Size	-0.26	0.028	1	-	-
Leverage	-0.01	0.093	0.22	1	-
Profitability	0.38	0.028	-0.48	-0.12	1

In the correlation matrix, we can see there is low positive correlation between leverage and firm's loss. There is also a low negative correlation between covid and risk. In the meantime, there is a high negative correlation between size and profitability and there is also a high positive correlation between risk and profitability.

In the overall, we can see that is no multicolinearity since the values of the matrix are not very high. But this needs to be checked with the variance inflation factor.

Variance inflation factor :

Table 5 : Variance inflation factor

Variable	VIF	1/VIF
Size	1.03	0.96

Profitability	1.03	0.97
Covid	1.02	0,98
Leverage	1.01	0.98
Firm loss	1.01	0.99
Taxavoid	1.01	0.99
Mean VIF	1,02	

From the table we can the values of variance inflation factor are under 3.

So we can state the absence the multicolinearity.

Breusch/Pagan and cook-weisberg test :

Table 24 : Breusch/Pagan and cook-weisberg test

	Breush and pagan	Cook-Weisberg
Khi-2	18.84	379.36
p-value	0.00	0.00

From the results shown in table, we notice that the Breush/pagan and the Cook-Weisberg tests are very significant (p-value <5%).

So we can state can state the presence of autocorrelation and heteroskedasticity problems at the error term level. In order to correct the two problems, we opted for a « generalized least square » (GLS) estimation method. This method provides us with more balanced regression coefficients.

Results of our hypothesis :

Table 26 : Multivariate analysis

Risk	Coefficient	t-value	p-value
Taxavoid	-0.19	-0.67	0.5
Size	-0.02	-3.29	0.001***
Leverage	-0.007	-0.21	0.831
Firm loss	-0.21	-1.03	0.305
Covid	0.03	1.17	0.242
Profitability	0.008	11.84	0.000***

***significatif at the rate of 1%
**significatif at the rate of 5%
*significatif at the rate of 10%

From the table we can see that tax avoidance does not have a significant impact on corporate risk and added to this it has the lowest impact on corporate risk (p-value> 10%). This can be explained by :

-Strict Tax and Legal Framework: Germany has a strong and well-enforced tax system, which reduces uncertainty related to tax evasion. Companies can better anticipate and manage any potential consequences.

-Economic and Financial Stability: Germany's stable economy and strong institutions may mitigate the risks associated with tax evasion, making it less of a concern for investors and creditors.

-Corporate Culture and Compliance: The German business culture emphasizes transparency and tax compliance, which could reduce the volatility and unpredictability associated with tax evasion.

We notice also that firm's size and profitability have a very significant impact on corporate risk and have the highest impact from all the variables (p-value < 1%).

The study examined the relationship between larger equity risk incentives and greater tax risk, finding a positive association between the two. Crabtree and Maher (2009) similarly discovered that firms engaging in high levels of tax avoidance tend to have lower credit ratings for their debts. Hasan, Hoi, Wu, and Zhang (2014) analyzed large American banks and observed that firms with extensive tax avoidance practices are perceived as riskier by lenders, leading to higher interest rates on bank loans. This suggests that tax evasion can increase debt costs for firms.

Moreover, tax avoidance strategies often involve navigating complex reporting systems, which can introduce uncertainty into a firm's future cash flows and reduce information transparency **(Guenther, Matsunaga, & Williams, 2016)**. **Dyreng, Hanlon, and Maydew (2018)** found a positive correlation between tax avoidance and tax uncertainty, further highlighting the potential risks associated with tax avoidance practices.

In the context of corporate governance, **Mashaykhi and Seyyedi (2015)** conducted a study in Iran and found no significant relationship between certain governance mechanisms such as institutional ownership, board independence, and board size with tax avoidance. Similarly, **Salehi et al. (2018)** concluded that board independence and managerial investments in companies they oversee do not influence audit fees in the Iranian market.

Let's compare the actual results with the litterature :

Tax avoidance's coefficient, whose coefficient is equal to -0.19, is not significant with a p-value equal to 0.5. The results are similar to Iran's findings this is because Both countries engage in trade relations, with Germany being one of Iran's significant trading partners within the European Union. Economic ties cover various sectors, including machinery, chemicals, and manufacturing.

Robustness test :

Effective Tax Rate (ETR) lies in its incorporation of deferred taxes, providing insights into future tax obligations. Specifically, by encompassing deferred taxes, ETR captures permanent differences. Generally, permanent book-tax differences arise when firms employ highly aggressive tax planning strategies, such as utilizing tax havens or engaging in income shifting. However, our study's objective is to comprehensively investigate indicators and trends of tax avoidance. ETR is defined as the ratio of total income tax expenses (including current and deferred taxes) to pretax book income. To identify tax avoidance, companies are required to disclose their effective tax rate. The statutory tax rate represents the rate imposed by law on taxable income within a specific tax bracket, whereas the effective tax rate denotes the proportion of income actually paid after considering tax breaks, including loopholes, deductions, exemptions, credits, and preferential rates. A higher ETR signifies lower tax avoidance. The ETR for a given firm "i" in year "t" can be expressed as follows:

$$\mathbf{ETR} = \frac{\mathbf{TXT}}{\mathbf{PI}}$$

Table 28 : Robustness test

Risk	Coef.	t-value	p-value
Taxavoid2	-0.0097	-0.38	0.707

According to this table, the second measure of tax avoidance does not have a significant impact on corporate risk (p-value > 10%). So the results converge.

Machine Learning Results

This is the algorithm that I followed to get the results :

-Split Data into Training and Testing Sets :

set.seed(123) # Set seed for reproducibility trainIndex <- createDataPartition(data$risk, p = 0.8, list = FALSE) training_data <- data[trainIndex,] testing_data <- data[-trainIndex,]

-Build the Linear Regression Model

lm_model <- lm(target_variable ~ ., data = training_data)

-Evaluate the Model :

predictions <- predict(lm_model, newdata = testing_data)

-Assess Model Performance :

mse <- mean((testing_data$risk - predictions)^2) print(paste("Mean Squared Error:", mse))

-Visualize Results :

plot(testing_data$risk, predictions, main = "Actual vs. Predicted", xlab = "Actual", ylab = "Predicted") abline(0, 1, col = "red")

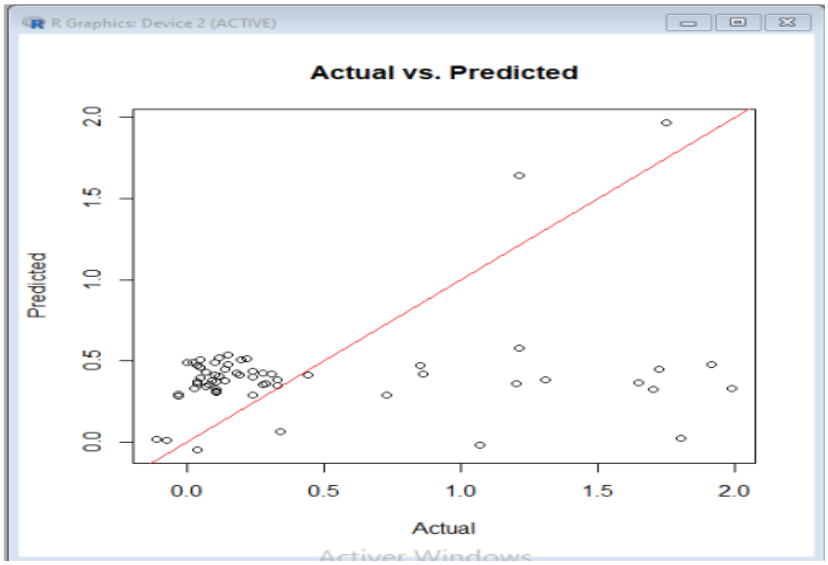

Figure 7 : Machine Learning Results

With machine learning we made predictions based on the dataset, and we can conclude that most of the predicted values does not exceed 0.6 risk rate.

CONCLUSION

We saw the relationship between tax avoidance and corporate risk. We saw that tax avoidance can boost investor's profit but it can also put the company in real risk such as debt's risk and cash flow risk.

Throughout the litterature we saw the impact of financial leverage, firm's size, firm's loss, covid-19 and profitability on corporate risk.

We have presented the characteristics of our study sample which is composed of 35 listed companies in the Frankfurt stock exchange as well as the data collection method via annual reports ranging from the period of 2012 and 2021, and the choice of Germany as country of study given that the litteratures about Germany is not rich apart from data availability.

We tried to present the empirical results of our research. In particular, we carried out a multivariate analysis and two additional analyzes to examine the relationship between tax avoidance related to corporate risk and the various factors that may influence tax avoidance. We concluded that tax avoidance has no impact on corporate risk. Thus we reject our hypothesis.

Businesses may use my results to justify more aggressive tax strategies, reduce compliance costs, or reassure investors that tax evasion does not increase financial risk. Politicians could leverage the findings to argue for tax policy reforms, either advocating for stricter enforcement or more flexible regulations based on the stability of firms in Germany.

This research contributes to the previous literatures by examining the impact of the coronavirus pandemic on corporate risk and also by making predictions through machine learning. This thesis also contributes to the litteratures by the choice of germany as a country of studies.

This research can be extended by studying the impact on different juridictions like anglo-american vs continental juridictions and also the middle east and asian juridictions. We can can also extend our research by studying the impact of earnings management on corporate risk.

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