



**Hungarian University of Agriculture and Life Sciences**

**The Thesis of the PhD dissertation  
COUNTRY RISK ASSESSMENT IN MULTI-NATIONAL  
CORPORATIONS**

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# 1. INTRODUCTION

## 1.1 Research Background

The spike in country risk research leads to the updating of older models and the ongoing exploration of new models, both of which are subjects of academic debate. Country risk variables may not have changed much due to the comprehensive apprehensions of risk factors previously researched, since their role has been reaffirmed historically. However, the manifestations of the risk and its roots are changing. Formerly marginalized risks, such as the earth's defined resource scarcity limitations, are now transforming into urgent political risks for multinational corporations. Geopolitical tensions and conflicts are intrinsic to country risk assessment; nevertheless, the scarcity of resources, coupled with an increasing global population and persistent demand, accentuates the risks associated with a finite planet (Meadows et al., 1972).

The Club of Rome Report titled „The Limits to Growth,“ published in 1972, addresses the finite planet problem and its implications for country risk assessment. This report outlines the effects of living on a finite planet across various domains, emphasizing the consequences of resource depletion, pollution, famine, and political conflict. The analysis suggests that the world is continuously moving toward a crisis, asserting, „The fundamental behavioral pattern of the world system is exponential growth of population and capital, succeeded by collapse“ (Meadows et al., 1972). These issues of scarcity contribute to a challenging era of economic globalization, which will significantly impact multinational corporations.

Assessing globalization as a risk factor is challenging. Globalization complicates the causation and effects of all risk variables. Assessing the impact of an incident in a foreign country on any business operation is becoming increasingly challenging due to the complex interconnections of international relations across markets and states. The advancement of globalization has altered the economic landscape for multinational corporations, yielding both beneficial and detrimental effects for the world. Multinational corporations could meanwhile dominate markets and establish new ones by exporting their goods and services. Undoubtedly, multinational corporations faced challenges from emerging competition; yet, for Western corporations of this nature, the new markets abroad proved to be lucrative.

Global supply chains connect these extensively networked markets. As a result, new risks to supply chain continuity have emerged, driven by governmental intervention and other factors. The role of multinational corporations in the globalized world has frequently been criticized as a form of neocolonialism, raising concerns about detrimental political interference, including expropriation. Currently, the role of multinational corporations is under significant scrutiny, especially in Western nations (Bouchet et al., 2018). Conflicts, tensions, and various hostilities characterize the current global landscape for multinational corporations. A McKinsey survey reveals that business leaders view geopolitical conflict as the primary risk to economic growth. The result raises the question of whether the complexities of the existing conflicts can accurately represent the characterization of country risk variables. Moreover, conflicts that define country risk are present on all seven continents (McKinsey and Company, 2024).

The initial country and political risk models were primarily designed for military applications; however, their demand significantly increased in the commercial sector beginning in the 1970s, largely relying on expert opinions. Multinational companies, especially those based in the United States, experienced a stark realization of the need for these models after the Iranian Revolution led to the confiscation of their international assets, which coincided with the collapse of the foreign market for their products and services in Iran (Kennedy, 1987). Following the collapse of the Soviet Union, many multinational corporations aimed to capture market shares in the developing world's emerging markets, despite being aware of the inherent country risks. Although several developing nations established democratic frameworks, they continued to face ongoing political and economic instability, legal uncertainty, and the threat of political violence and social unrest, often under autocratic rule. This situation posed a constant risk of asset losses for multinational corporations, primarily due to the possibility of government interference (Kennedy, 1987). Consequently, researchers became more involved in the exploration and application of country risk models.

Some multinational corporations had in the past established teams to assess country risk within their organizations. As the global political landscape remains undefined and subject to change, these MNCs are beginning to revisit this practice, which had been largely dominated in recent decades by specialized consulting firms such as the PRS Group. As a result, researchers continue to develop numerous models for evaluating country

risk, most of which are not universally applicable to all multinational corporations. Academic and institutionalized research often focuses on a limited range of country risk factors, resulting in a lack of a comprehensive framework for companies to assess their specific country risk. This limitation largely stems from the absence of a clear regression analysis between country risk variables, which often overlap in existing models and possess varying degrees of relevance to the foreign operations of multinational corporations (Cosset and Roy, 1991).

Certainly, since a definitive prediction of the future is unattainable, a perfect model for assessing country risk will never exist. Nonetheless, the field of country risk assessment is experiencing a significant resurgence. Recent advancements in machine learning methodologies have enhanced this process. Past efforts to replicate the country risk assessments conducted by institutions and specialized experts were successful, but the results were always retrospective, reflecting past events, and continued to improve only existing models or proprietary models developed by specialized firms that assess country risk (Cosset et al., 1993). Furthermore, these reengineering efforts were based on a proven selection of general applied country risk variables; however, they are rarely considered as outcomes of widespread open-source intelligence (OSINT) data application, which this thesis addresses. Ultimately, the country risk models were never designed to incorporate more timely data on country risk variables, especially for midsize multinational corporations that could benefit from short-term results.

Moreover, country risk models have not yet incorporated a monitoring function. In the model, the monitoring function could be a shorter time period during which data is collected, as is possible with OSINT. The Office of the Comptroller of the Currency (OCC) (2016), in its handbook, called for a country risk monitoring system that includes a process for recognizing when countries require elevated monitoring. Although these models were never explicitly designed for this purpose, such a function is necessary in a BANI (brittle-anxious-non-linear-incomprehensible) world. A multinational corporation operating in a foreign country faces varying degrees of exposure to this BANI environment (Cascio, 2020). In today's global landscape, a corporation does not need to have any international operations to be susceptible to country risk, as illustrated by Bouchet et al. It will similarly be affected by the global economy. This situation underscores the interplay and complexity of micro-, macro-, and environmental risks in country risk assessments (Bouchet et al., 2003).

## 1.2 Problem Statement

The main issue addressed in this thesis is that previous country risk models, which incorporate multiple variables representing different aspects of country risk, face the challenge of non-linearity in their assessments. Even selected developments that affect country risk evaluations are rarely linear due to the sensitivity of various factors. Moreover, the same event that positively impacts one variable can have a detrimental effect on another. Consequently, the relationships are often non-linear, and quantitative methods, such as regression analysis, may omit important aspects of country risk analysis to achieve statistical significance (Cosset and Roy, 1991). Additionally, many published country risk models rely on proprietary information or data that is only published annually or quarterly, which complicates the creation of a universal or tailored country risk model for companies. Although multinational corporations operate in this information age, finding and implementing relevant data for the model can be challenging. The issue with open-source intelligence data lies in the difficulty of locating, wrangling, and managing the large volumes of data required for analysis.

To create an effective risk assessment function, new models must integrate data that outlines the macroeconomic and political landscape of a company operating in any host nation within a short time frame while still producing a comprehensive and statistically relevant model. Such an effort requires addressing the challenge of non-linearity in political issues and the lack of equilibrium in various countries and their societies. Regardless of the best approach to tackle these challenges—whether qualitative or quantitative—the non-linearity of country risk remains the primary obstacle for every model.

This research examines the potential of collecting open-source intelligence data and employing methods such as sentiment analysis and neural networks, which are increasingly used in artificial intelligence research and applications, to tackle the non-linearity problem associated with country risk. The study aims to investigate the following questions:

1. Can a single multinational corporation develop and implement its own risk assessment model to evaluate the country risk level in any of its host nations?

2. Is it feasible to gather the necessary amount of open-source intelligence data within limited time frames to ensure timely risk assessment?
3. Can neural networks, which have demonstrated promising results in both general economic applications and country-risk-specific tasks, utilize this open-source intelligence data to create a country risk model capable of generating trend predictions?
4. Will this model yield significant results when evaluated using standard neural network testing methods such as LIME, SHAP, and K-fold analysis?

### 1.3 Research objectives and aims

This research examines the evolution of public data availability for model creation, acknowledging the common usability challenges associated with data collection. The data collection process is encapsulated by the term open-source intelligence, which includes all publicly accessible data from various sources. The model input derived from OSINT sources reflects the data used in the variables of previous country risk models, even though it is not explicitly designed for universal application in that context. To define OSINT, this research adopts the definition provided in the OSINT Strategy 2024-2026 report by the Director of National Intelligence: „OSINT is intelligence derived exclusively from publicly or commercially available information that addresses specific intelligence priorities, requirements, or gaps” (Office of the Director of National Intelligence, 2024b).

The appropriate timeframe for collecting data also needs to be considered. This research posits that nation risk assessment for corporations, in relation to corporate and macroeconomic data, should occur daily, weekly, or monthly. Currently, numerous data streams in country risk models rely on quarterly or annual data, rendering them inefficient for companies and a constant monitoring of country risk. This thesis assumes that, for a contemporary risk model, a data collection process involving only monthly data or longer is insufficient. Therefore, this research aims to collect data on a daily basis whenever possible. Country risk variables represent the intersection between qualitative checklist methodologies and quantitative techniques. Regression analysis and numerous quantitative methodologies exist for country risk models that warrant further investigation; however, it is posited that neural networks may effectively facilitate sentiment analysis, trend analysis, and prediction, thereby enhancing the speed and efficacy of

identifying threats arising from political shifts or societal hostility toward the company (Cooper, 1999).

The elements of country risk have primarily been examined in isolation, and few country risk models attempt to integrate them inclusively. Additionally, the emerging use of open-source intelligence data collection and machine learning techniques in country risk assessment remains underexplored within the broader academic context. This work seeks to make a modest contribution to this fascinating field of country risk research. As Python has become a leading programming language for machine learning and artificial intelligence libraries, the next generation of quantitative country risk researchers has significant opportunities to develop machine learning applications for assessing country risk. This research also integrates libraries like TensorFlow and Keras within a R programming language environment (as outlined in Figure 4 and Appendix 8.3). Therefore, this thesis aims to create a model for assessing country risk that leverages these newly accessible data streams and methodologies, addressing the question if a universally applicable country risk model for multinational corporations can be developed.

#### 1.4 Research hypothesis

The research background and problem statement led to the formulation of the hypotheses. If the country risk model developed in this thesis can be applied by multinational corporations to every country in the world, utilizing neural networks and individually collected OSINT data, and doing so without the need for expert opinions or external quantitative input on a daily basis, the findings would support the proposed hypotheses (as outlined in Table 1 below).

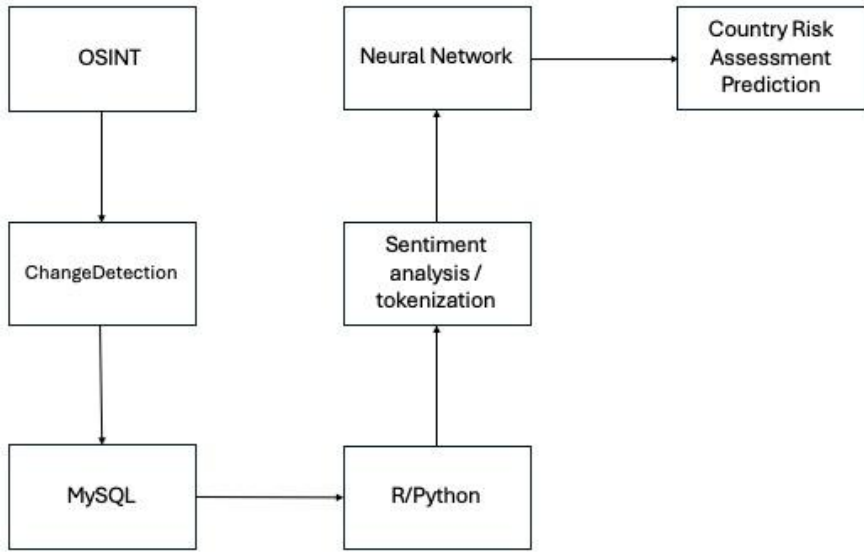
<b>Hypotheses</b>	
<b>H1.</b>	A neural network analysis framework can be developed for the purpose of country risk assessment utilizing individual collected daily open-source intelligence data that give a significant trend prediction.
<b>H1.1</b>	The proposed neural network demonstrates statistically significant predictive performance, as evidence by model interpretability techniques such as LIME (Local Interpretable Model Agnostic Explanations), SHAP (Shapley Additive Explanations) and the results of a K-fold analysis.
<b>H1.2</b>	The model effectively addresses and overcomes the limitations of linear assumptions inherent in traditional quantitatively country risk assessment methodology.
<b>H2.</b>	The model will perform better in one-day-ahead predictions than in weekly and monthly predictions.

**Table 1.** Hypotheses of the study / Source: Author elaboration (2025)

### 1.5 Research framework

The central concept of this research involves the daily collection of open-source intelligence data from five exemplary countries to assess the risks associated with each country through sentiment analysis. The findings from this analysis will serve as the foundation for a trend analysis conducted using a deep neural network. The open-source intelligence data is categorized into seven variables, which are developed by merging variables from prior research. Established frameworks of country risk were utilized to formulate these variables, and the choice of neural networks as a quantitative method is informed by their successful application to economic issues (Cooper, 1999) and the contemporary interest in leveraging artificial intelligence to explore longstanding questions, such as a universal country risk model.

It is anticipated that the research hypothesis will yield significant results, leading to the development of a model that can be refined further. However, the outcomes of this study will be constrained by the availability of data, as the collected open-source intelligence varies in scope for each selected country. The variables aim to create a comprehensive framework that encompasses all sources of conflict within a country.



**Figure 1.** Research Framework *Source:* Author

## 2. MATERIAL AND METHOD

### 2.1 Data integration into the CR model

The duration between the accumulation of country risk and its materialization varies differently. In hindsight, numerous scholars often acknowledged the shortcomings of certain country risk models, as the threat may have been anticipated had the model incorporated an additional variable or source of information. MNCs have recognized that protests and political changes can occur rapidly, particularly with sociopolitical risk, but have yet to discover a way to efficiently collect the data for risk assessment. A negative comment or incident related to corporate operations can quickly mobilize a large number of individuals via social media to protest against the company. In response, politicians may transition from being business-friendly advocates to being staunch adversaries of the enterprise. Country risk models must accurately reflect the current risks to ongoing corporate activities.

In an already strained corporate climate, monthly or even quarterly data gathering for sociopolitical risk is likely ineffective. Given that social issues related to environmental concerns are significant for multinational corporations serving a vast consumer base, the creation of a more rapid evaluation methodology becomes warranted. Moreover, additional aspects of country risk, such as the potential for a fluctuating security environment, may increase the necessity for expedited models. A terrorist incident in Germany resulted in an immediate escalation of border security measures. This has led to longer supply periods for commodities traversing borders within the European Union. Allianz Trade reports that these changes resulted in a 1.7% rise in transport and import taxes (Allianz Trade, 2024).

The global security situation is precarious. The activities of drug cartels in Mexico and South America render a heightened response from the USA more probable. Terrorist acts and Russian sabotage actions pose a significant and imminent threat in Europe. In Asia, some conflicts possess the capacity to escalate, including those in Myanmar, Kashmir, and the danger to Taiwan's sovereignty. In Africa, the intensification of persistent crises related to food scarcity, civil unrest, and the effects of climate change is evident. The global interconnectedness of the contemporary world necessitates the acquisition of rapid data for country risk assessment in any given situation. The domain of country risk should focus on optimizing data collection methods for efficiency, while also refining and integrating this

data into various country risk models. This principle applies regardless of the type of country risk model used. A traditional checklist paradigm, despite infrequent practical application, should seek methods to gather more timely data. The neural networks employed in this research can only be effective if trained with precise and timely data that exhibits a consistent upward trend in the model. To develop a model that can be comprehensive and universal, five countries were selected that should cover multiple continents, various cultures, and important ongoing political developments within the country. The countries were selected at the authors' discretion and are not inherent to the model, since its purpose is to be applicable to any country in the world.

Country	Number of websites monitored
Vietnam	110
Germany	164
Mexico	173
Ghana	150
Nigeria	211
Total Countries: 5	Total websites monitored: 808

**Table 2.** Sample selection. Source: Authors elaboration (2025)

Historically, the timeframes for country risk models have been monthly, quarterly, and annually. Regression analyses based on data such as GDP, trade balance, and other statistics typically published by government agencies can only be obtained and evaluated during certain periods. The previously mentioned data is highly pertinent for country risk evaluation. Nonetheless, although a country's GDP can solely be evaluated through the publication of official statistics by government agencies, during the GDP assessment period, news magazines, export reports, and other information sources will already evaluate critical components of the national economy. This data can provide multinational corporations with an image of a host government's economic condition. Future research in country risk assessment should explore innovative methods for the extensive collection of this data and, additionally, how this predominantly qualitative data might be quantified. The methods employed include web scraping of news sites, blogs, government websites, and various other data sources. Open-source intelligence, however, enhances the potential for acquiring more timely and inventive data at new levels. The success of research on country risk modeling will also depend on the financing of further research initiatives. Well-funded research initiatives may incorporate satellite imagery, now accessible to private citizens, for the purpose of data collection. These

categories of data sources are collectively referred to as alternative data sources.

## 2.2 The Variables

The variables represent the different aspects of risk that researchers or practitioners consider important in the context of country risk. Given the variety of country risk, the number of variables throughout the history of country risk research is extensive. Classic variables include a country's GDP and national debt (Kennedy, 1987). Regression models, in particular, focus on selecting independent variables that best interact with dependent variables for explanatory purposes. However, even qualitative models involve the selection of variables that reflect desired outcomes, which can introduce bias from the model's author.

Furthermore, it is crucial to evaluate whether the data basis for the variables includes a sufficient number of data points and whether these points correlate with the data points of other variables within the same model. Occasionally, this can lead to limitations in the data available. An average analysis of the variables used throughout the history of country risk likely reveals a preference for certain variables in country research. Two main factors influence this trend. First, certain variables, such as GDP, are better suited for providing a general overview of a country's stability, particularly regarding economic stability. Second, the early history of country risk is closely associated with institutional models, and the variables employed in those models paved the way for academic research, which often reused these variables to enhance model quality and outcomes (Somerville and Taffler, 2001).

While a regression model seeks to establish a strong relationship between an independent and dependent variable, it is important to note that this model, which aims to address non-linearity issues, does not rely solely on regression between the variables. In qualitative assessments of country risk, the aspects considered are of greater significance, suggesting that the selected variables should encompass as many dimensions of country risk as possible, without necessitating statistical correlation or regression among them. The variables should address key aspects that country risk researchers have identified over the last decade, including political, economic, and security factors. Additionally, the variable related to ecological risk has gained importance in country risk assessments recently. Factors such as renewable energy initiatives and green policies of

multinational corporations are increasingly relevant, as a non-eco-friendly company may encounter challenges with financing or project approvals in a host country.

The variables must maintain a balance, meaning that each variable should be equally represented with data for all assessed countries. However, the sources of data for these variables can be uneven, as many originate from various news outlets, which may cover topics disproportionately, especially in smaller countries. Collecting data from news sources regarding politics, governance, and the economy is generally easier than sourcing information from specialized energy-related websites. Nonetheless, these specialized sources are crucial for specific variables.

The model examining what contributes to a country's stability begins with the first variable (outlined in 2.2.1), which gathers data on political and governmental stability and progress. The second variable (outlined in 2.2.2) focuses on the economy, collecting information about economic advancements within the country, such as national debt levels and foreign direct investment inflow. However, this data is primarily qualitative, as it relies mainly on monitored news sources for input. The third variable (outlined in 2.2.3) addresses societal issues, aiming to reflect problems within the country that could indicate the risk of civil violence or unrest.

The fourth variable (outlined in 2.2.4) is dedicated to environmental assessment. In conjunction with the fifth variable (outlined in 2.2.5), which pertains to energy, this variable considers a country's energy security—an essential factor for both political and civil stability, as well as the country's capacity for domestic production. Variable six evaluates (outlined in 2.2.6) legal stability, examining corruption or the lack thereof within the legal system to assess the reliability of contracts signed in the country and the regulatory stability affecting multinational corporations operating there.

The seventh variable (outlined in 2.2.8) focuses on security, analyzing threats such as terrorism, military conflict, organized crime, cybersecurity, and any other security-related issues that could jeopardize MNC operations. The theoretical framework of this model assigns equal importance to all variables, despite their potential lack of statistical correlation. Given the same amount of input, it cannot be guaranteed that each variable provided consistent data throughout this thesis, as different websites have varying update frequencies.

To identify a model that addresses the linearity problem and employs non-linear machine learning methods offers the additional advantage of covering a diverse range of aspects, similar to the earlier expert checklist methods (Eaton et al., 1986). This implies that the model can later incorporate more variables without requiring an analysis of the relationships between them. This flexibility not only makes the model universally applicable but also scalable to meet the specific needs of a multinational corporation. The variables described in this section are used in this research to reflect a wide array of country risk sources without dividing the data into self-manipulating sizes. Consequently, each variable encompasses multiple dimensions of risk. Kennedy (1987) noted that a component approach is a systematic qualitative model designed to quantify and correlate the fundamental elements of political risk. This methodology identifies the structural sources of political risk and aims to quantify the variables objectively while still requiring some degree of objective-subjective interaction. A component model is not only more objective and theoretically sound than expert-generated opinion approaches, but it also provides the advantage of identifying sources of political risk and allowing for a more precise assessment of their potential influence on the enterprise. Formal-empirical observational models, similar to component approaches, focus on quantifying the structural determinants of political risk; however, they avoid subjective analysis, setting themselves apart from both expert-generated opinions and component methodologies. Only rigorously tested empirical and statistical observational data are employed, producing quantitative scores for international comparison (Kennedy, 1987).

### 2.2.1 Governance (Political)

The governance variable aims to aggregate political and governmental data. The complexity of statecraft at both international and national levels generates extensive input for political risk within country risk models. Robock's (1971) article on political risk focuses solely on this aspect, excluding the later-developed variables of country risk assessment. He noted the global political risks facing corporations and the inadequate management practices for identifying and overseeing such risks. Erb et al. (1996) analyzed the largest country risk assessment institutions. All of them included a variable linked to the government and its influential spheres within a country. Marchetti and Vitale (2014) even aimed to make political risk assessment global by testing „the relevance of a globalization variable for political risk assessment.” Many contemporary managers continue to view their companies' operations as disconnected from the

political landscape in which they operate. In host nations, and often within their organizations, management tends to overlook the political ramifications and the broader political context of their activities. Furthermore, even those tasked with monitoring political risk can be surprised by its manifestations. Management often relies on risk assessment firms and their reports, which depend on expert opinion; however, these reports frequently omit data that is specific to their enterprise and accessible through public sources.

The political transformations, implications, and intricate global political networks of the 21st century have significantly complicated international politics and statecraft. The dissolution of colonial powers and the emergence of new independent states reconfigured the global political landscape, greatly altering the world in the latter part of the previous century. Currently, the world faces the rise of China and other developing nations, which seek greater shares of global political influence. This factor influences many economic aspects of a country's risk assessment. While political conditions differ from one country to another, some political effects on market conditions exhibit international similarities from an economic or legal perspective. Risk assessment should be conducted generally in the data collection process, but the data input for the variables must be tailored to each unique case. For instance, neighboring countries may have strained relations with one another. Therefore, companies must exercise caution regarding their affiliations with governments and gather data that is specific to each situation.

That political risk plays an important role for MNCs is also recognized by the officials who govern countries. Condoleezza Rice and Amy Zegart co-authored *Political Risk* (2018), which is notable since Rice served as the U.S. Secretary of State.

Measuring certain political risks, such as corruption or expropriation, is still difficult. Jessen (2012) attempted this in the context of corruption in the oil and gas industry by breaking down the broader field of corruption in the political risk context into an industry-specific problem. Shotts (2015) developed a model specifically to evaluate the threat of government expropriation of MNCs in host countries.

### 2.2.2 Economy

The affluence and destitution of nations are closely linked to the global economic system. The global political landscape over the past century has largely been influenced by American hegemony, which has shaped various aspects of the global economy, including the dominance of the US dollar. Currently, scholars are facing a complex situation due to a global shift toward a more multipolar world. The economic landscape is rapidly changing, driven by China's rising geopolitical influence, the emergence of shifting political factions, and the evolving role of BRICS. This environment has led to a recurring return to outdated nationalistic economic perspectives, resulting in a rise in protectionism. Multinational corporations are affected by fluctuations in global economic conditions, and the hyper-interconnectedness of supply networks combined with frequent worldwide demand may expose these corporations to risks tied to their national economies (Bouchet et al., 2018). Most country risk models concentrate on economic or financial components, or at a minimum, incorporate them in their evaluations of country risk. The volume of information has increased significantly due to hyperconnectivity.

Sovereign debt has always played a significant role in determining country risk. The findings of Berganza et al. (2004) include that an increase in debt burden caused by an unexpected real depreciation raises a country's risk premium. The important role of sovereign debt default can be further evaluated under this variable. Gilliard (2020) states that, in terms of country risk ratings, „more than 60% of misratings were caused either by an expropriation or by a sudden control of capital flows.” Since capital flows are the lifeblood of an economy, this indicator highlights the significant role the economy plays in country risk assessments. Gaillard suggests that, regarding capital flows, „the equivocal relationship between economic growth and the liberalization of capital and current accounts should encourage country risk raters to implement analyses of a more qualitative nature when assessing the likelihood that a government will impose restrictions on capital flows.”

Temizsoy and Montes-Rojas (2019) find a positive relationship between risk aversion and the sovereign bond CDS market. With the exception of Greece, they found that „an increase in the ECB refinancing rate or a decrease in money aggregates (M3) increases the risk of government bonds of all countries, except Greece, which has the opposite effect.”

In general, many country risk managers continue to examine a country's balance of payments history to determine its economic situation. Bouchet et al. (2018) notes, „From a country risk perspective, assessing the full amount of a country’s external debt is both crucial and puzzling. The level of external debt, its evolution, and its composition (that is, its structure of maturity, creditors, debtors, currency, interest rate, and securities vs. loans) are important elements in assessing a country’s liquidity and solvency weaknesses, including for cross-country comparisons.” It is evident that countries with a substantial amount of debt typically receive a higher country risk evaluation in nearly every model. While international relief programs from the IMF and World Bank can stimulate economic growth, they also contribute to improved country risk ratings.

Governments often intervene in the economy to enhance their country's overall economic situation. These interventions introduce country risk not only in developing nations but also in developed ones. Bouchet et al. (2018) illustrates this point with quantitative easing programs: „Quantitative easing programs can also be considered a source of country risk if they are not implemented in a careful and cautious manner, including their onset and the wind-down. Such unconventional monetary policies impact not only the countries that undertake them but also the economies of entire regions and potentially the global financial system. There is an argument that they can actually increase the frequency and magnitude of financial events with global impact. Large liquidity injections by central banks can create asset price bubbles in the stock and bond markets, while low-interest rates drive investors to seek higher yields in riskier assets, including those in developing countries with weaker institutional and regulatory frameworks. A second wave of risks can emerge when central banks decide to reduce bond buying and scale back quantitative easing. The withdrawal of monetary stimulus can trigger significant capital outflows from developing countries, while rising rates can harm debtors’ solvency. The ECB initiated the process to unwind five years of unconventional monetary policy at the beginning of 2018 by deciding to halve its bond-buying programs to facilitate a return to normalcy.”

Many of these inventions have country risk aspects. Additionally, actions taken by independent government bodies, such as central banks, can lead to significant problems for a country's economy. The process of globalization was founded on the hegemonic position of the United States, which played a crucial role in the establishment of GATT, the WTO, and other international trade organizations. The development of free liberal

global markets was backed by neoliberal think tanks, such as the Heritage Foundation and the Fraser Institute, which continue to advocate for these principles today. However, country risk managers recognize that the emergence of a multipolar world has altered the economic landscape. China and Russia are forging their own economic partnerships, distancing themselves from Western-dominated collaborations, which now must be reviewed for market access. Furthermore, as trade relations between countries evolve, traditional threats to multinational corporations, such as protectionism, are resurging. Gaillard (2020) identifies these threats as follows: „bailouts; state aid; competitive devaluation; consumption subsidies; export incentives; import bans, quotas, and tariffs; intellectual property protection; expropriation; restrictions on investment; localization requirements; 'national content' preferences; sanitary and phytosanitary rules; technical barriers to trade; funding facilities; trade defense measures; and immigration restrictions.” Recent discussions at the World Economic Forum (2024) have also addressed this development.

### 2.2.3 Societal

Companies are facing an increasingly high level of public scrutiny, both domestically and internationally. The rationale behind this scrutiny is clear, encompassing issues such as inequality, ecological concerns, political affiliations, and various claims of misconduct made by the public or media against corporations in every Western society. Kennedy (1987) pointed out the growing recognition of social risk within country risk models used by banks, emphasizing that sociopolitical factors have taken precedence over macroeconomic considerations. There has been a rise in public awareness regarding protests against a company's business operations. New formats of investigative journalism have emerged, contributing to the increased likelihood of multinational corporations becoming targets of public unrest. Social media has made protest efforts against corporations more successful and visible. These efforts are prompting swift responses from both the media and the general population. Societal perceptions of a corporation are crucial to country risk, as they can lead to significant political and financial risks in the current landscape. In this context, political risk related to social risks refers to how protests may influence lawmakers to modify laws or regulations affecting corporate operations. Boycott pledges can spread through social media, reaching a diverse array of potential consumers.

The most pressing and contentious issue is the perception that companies are linked to unsustainable business practices or political extremes, leading

to political pressure through public protests and resulting in financial institutions withdrawing their support. This scenario has historically been depicted in the oil and gas sector. Currently, any corporation that generates emissions during its operations may become a target, as shown by Google and Amazon. In the USA, people view both companies as politically progressive entities that advocate for environmental protection, but they also face criticism for their emissions and employment practices. Additionally, a classic issue is the political affiliation of multinational corporations. In the Western context, firms often face challenges in supporting or aligning with political parties. In the recent American election, Elon Musk explicitly endorsed Donald Trump. His most recognized company, Tesla, has been associated with the progressive left in the USA, as electric vehicle production is considered a progressive issue in environmental conservation. His new connection to Trump's right-wing Make America Great Again movement led to public calls for boycotts of the company's products. Another recent example is Budweiser, which illustrates social protest within the U.S. market. An unlicensed advertisement featuring a transgender woman sparked outrage among American conservatives, significantly affecting Budweiser's consumer base. Consumers publicly committed to boycotting the company's products. In both cases, the social media protests were significant, raising concerns among analysts about the potential detrimental impact on the companies. In these examples, it did not matter whether the protests originated from the political right or left.

#### 2.2.4 Environmental

One risk element that varies significantly in nature is ecological threats. Currently, the risks are interwoven across social, economic, legal, and political dimensions. However, since the impending global battle will revolve around commodities, with significant environmental repercussions stemming from mining, agriculture, and other commodity production activities, the risk will increase. For multinational corporations engaged in commodity exploration or associated with it, the present situation signifies an increasing danger of expropriation, adverse legislation, and political opposition.

Environmental organizations are scrutinizing all facets of multinational corporations' supply chains, indicating that manufacturing in the home country may also be influenced by activist initiatives. Multinational corporations that heavily rely on foreign commodities and are perceived to

have a negative public attitude regarding exploration activities in other nations are likely to become targets of protest. Moreover, political groups may leverage ecological effects to publicly denigrate enterprises they deem antagonistic to environmental protection. The complexity of the subject, despite the clarity of the scientific consensus, was once again highlighted at the World Climate Conference in Baku in November 2024. The meeting concluded with minimal progress, and the outcome given was condemned for its inadequacy. The inability of countries to reach an agreement stems from various significant country risk issues, encompassing both financial and economic factors. OPEC nations, especially Saudi Arabia, continue to depend on fossil fuels to meet their national development goals, with the intention of completing large urbanization projects and creating a sustainable economy before they transition away from oil and gas exploration and production activities. Moreover, developing nations anticipate financial assistance from the industrialized world to achieve climate objectives. Prolonged fossil fuel consumption and unrestricted carbon emissions yield subsequent benefits. Developing countries and their economies thus require financial support from the global community. Gaillard (2020) concludes that climate change represents the most significant risk, noting that securing financial support for developing countries is challenging due to geopolitical tensions among world powers. His assertion that country risk managers should view climate risk—as part of the broader environmental variable—as a „matrix of all other risks” is compelling. However, his appeal for world policymakers to „coordinate their efforts” should be regarded as a moral request from a country risk manager rather than a feasible expectation for future developments. The frequently cited issue of resource scarcity, alongside the geopolitical ambitions of nations, is likely to create a more complex environment for multinational corporations.

### 2.2.5 Energy

The model regards energy as a distinct variable, separate from economic or governmental variables, despite their strong correlation. This trend is attributable to the significant role energy will have in the future of nations and corporations. While the Western political sphere endeavors to transition to renewable energy, developing nations are seeking to secure additional oil and gas resources. Energy issues are impacting other factors inside the model, including governance and economics, and perhaps leading to societal unrest, thereby affecting the social variable. As the model does not constitute a standard regression analysis, multicollinearity

is not a significant factor in this context. Websites related to energy can provide significant insights into a country's economic and political conditions by disseminating news about the energy landscape of nations.

The impact of energy on a nation was recently evident in Germany at the onset of the Ukraine–Russian conflict. Germany augmented the procurement of Russian gas during the past decade to ensure economical energy for its domestic sector. Following the onset of the war, the European Union initiated sanctions against Russia to exert pressure on the nation. Germany managed to enforce the sanctions; yet, it faced challenges in securing adequate energy for its industry. Germany sought a new energy provider and looked to Qatar for the provision of LNG gas. A contract was criticized due to the human rights situation in Qatar and for regressive negotiations aimed at securing fossil fuels, which many perceive as a betrayal of Germany's ecological initiatives. The evolution of the global energy sector will be crucial and unpredictable in the imminent future. As OPEC exerts greater influence over the oil and gas sector and Western financial institutions seek to diminish funding for fossil fuel operations, the supply dynamics of the energy markets will undergo a transformation. Augmenting investment in nuclear energy and other developments will generate political risk on a worldwide scale. Consequently, energy is likely to assume an increasingly significant role in country risk assessment. Recent research by Li et al. (2021) confirms the role of geopolitics in energy trade, which is part of the energy variable.

### 2.2.6 Legal

Management must assess the legal climate of its host country before making any investment decisions. Both micro and macro considerations related to legal issues must be addressed. Legislation can become a focal point in international politics and economics. Management must know how enforceable contracts are in the host nation and the duration of court procedures in that country. Multinational corporations must also evaluate the stability provided by international trade organizations, such as the World Trade Organization, within the country. The World Trade Organization is often criticized by global political activists for being a Western institution that aims to maintain the economic supremacy of Western nations, particularly the United States. Consequently, the effectiveness of its guidelines varies, especially in the developing world. Many multinational corporations, therefore, seek to protect their investments through private arbitration courts. The existence of private

arbitration courts, which operate independently of any national legal system, raises concerns about their authority to terminate a company's operations and, thus, introduces additional political risk.

Governance can be employed to safeguard multinational corporations from hostile actions taken by foreign governments. Gaillard (2020) provides several examples in which the U.S. government utilizes specific domestic laws concerning aid, foreign investments, and trade to apply pressure on foreign governments that act aggressively toward their MNCs. However, for a nation to effectively use these laws as a defense mechanism, it must possess substantial economic and geopolitical power. Over the past century, with the exception of the United States, few countries have been able to defend their MNCs in this way.

### 2.2.7 Security

Assessing the security situation within a host country has become increasingly complicated over the years. While the business sector in which a multinational corporation operates is certainly relevant to the level of risk, any MNC can be adversely affected by security developments that deteriorate the overall security landscape in a host country. Terrorist activities, organized crime, and cybersecurity threats are becoming more complex and global in nature. Coupled with instability in many developing countries and shifting global power dynamics, security assessments must be more sophisticated and treated with greater significance.

Civil unrest and terrorism pose direct threats to MNCs by physically damaging their properties. Additionally, MNCs face risks to their supply chains due to disruptions in logistics routes. A frequently cited in-country risk is the Iranian Revolution, which unexpectedly impacted U.S.-based MNCs. In traditional risk models, this risk is often categorized under variables such as revolution or expropriation. However, it is important to note that a full-blown revolution is not necessary for an MNC to be affected by security incidents. Even minor conflicts and terrorist acts can influence financial and commodity markets, as well as government policies. These developments can also be represented in a model addressing socio-political changes (Kennedy, 1987).

Recently, the escalation between Israel and Iran, which began on Friday the 13th, June 2025, has once again subjected the oil market to potential price increases (Kern, 2025). For energy-intensive industries, these price

spikes have significant effects on production and distribution. Such fluctuations in energy markets have unsettled investors and resulted in rapid and intense capital movements. Moreover, Iran has the capability to block a critical route for oil trade through the Strait of Hormuz, which could lead to yet another surge in oil prices, as twenty percent of global oil exports transit through this narrow passage. The broader implications of this conflict remain to be fully understood, especially following the U.S.'s direct intervention on June 21, 2025. Developments in security within the Middle East serve as a prime example, particularly since October 7, 2023, when a series of events triggered a rapid escalation of multiple conflicts in the region. Alyatama (2016) studied the political risk perceptions of managers in Kuwait during the Arab Spring, providing insights into political risk perceptions within the country and, by extension, the broader region.

Terrorist incidents and armed conflicts have impacted the insurance industry. As previously mentioned, the exposure of multinational corporations to political developments in host countries has created a demand for political insurance, as standard insurance contracts typically do not cover wars and terrorist incidents. According to the Intelligent Insurer (2025), the market for credit and political risk is projected to be worth \$49 billion in 2025. Hamdani et al. (2005) from the Federal Reserve Bank of New York analyzed the Political Risk Insurance market from 2003 onward, defining PRI as „protection against losses that result from acts of currency transfer restrictions, expropriation, and political violence.” Offered by national, multilateral, and private insurers, PRI is utilized by investors to mitigate country risks associated with emerging market debt, equity investments, and lending. For insurers, PRI represents a high-cost but profitable business. They characterized PRI contracts as generally ranging from 3 to 20 years in duration, with most contracts skewed towards the shorter end of that range. The report highlights the PRI market as a lucrative opportunity for insurance providers. Research has shown that the influence of domestic institutions on multinational corporations' risk premiums for PRI depends on the host country's economic situation; during periods of stable economic performance, political and democratic constraints help protect foreign investors, but in times of financial crisis these protections weaken and the incentives for governments to exploit MNCs increase (Jensen, 2005).

Additionally, the report analyzes cost factors: „The cost of PRI reflects several factors. One important consideration is the unpredictability of losses. The infrequency and uniqueness of political events lead to a lack of

reliable data and readily available statistical models for actuarial estimations of future losses.” This criticism underscores the deficiencies in country risk methodologies and the skepticism of risk insurance providers regarding their efficacy, despite ongoing efforts to enhance risk models. The report also identifies the high cost of data analysis in the underwriting process as another factor influencing expenses for insurers. This suggests that even multimillion-dollar insurance companies struggle with the costly data collection necessary for assessing country or political risk, which presents a challenge for multinational corporations attempting to evaluate risk independently without significant resources. Nevertheless, the report indicates that only a small fraction of investments in host countries—specifically in developing or emerging markets—are covered by PRI. Energy projects in these regions may surpass the coverage limits provided by PRI.

Another challenge with Political Risk Insurance is the difficulty in drafting contracts that describe covered events with enough specificity for clear identification while maintaining sufficient generality to avoid overly narrow or cumbersome agreements. A frequent source of litigation in insurance arises from disputes over whether a covered event has actually occurred, as determining the occurrence is inherently subjective. These disputes can create investor concerns regarding insurers' willingness to pay and may frustrate insurers, who feel that investors do not fully grasp the coverage provided. This situation contributes to a pessimistic outlook for PRI. There will always be a certain level of uncertainty and risk of litigation; it is fundamentally impossible to anticipate and describe all potential manifestations of country risk without crafting overly specific contracts and unwieldy. Furthermore, many market participants express skepticism that the existing gaps in PRI coverage can be filled with comprehensive policies that are priced appropriately for buyers who already view PRI as expensive. Consequently, PRI alone cannot be relied upon to replace the essential economic, political, and legal reforms needed to attract foreign direct investment in emerging markets. Nonetheless, the current size of the PRI and credit insurance market underscores the necessity for PRI contracts. Additionally, insurance companies not directly involved in political insurance can also be affected by security incidents. For instance, following the events of September 11, 2001, the stock values of US-based insurance companies plummeted, and this correlation has been observed repeatedly since then. Political risk protection typically focuses on specific, sudden hazards, such as nationalization, capital controls, confiscation, kidnapping, and terrorism (Bouchet et al., 2018). Coface, for

instants, offers insurance policies that are tailored for complex, long-term projects and cover non-payment risks stemming from political events (Coface, 2025). This feature highlights the importance of country risk assessment as a key business aspect for specialized insurance companies.

A more modern threat is cybercrime, which multinational corporations face when their systems are compromised by various forms of hacking, extortion, espionage, data manipulation, and deletion. MNCs must maintain high connectivity between facilities, resulting in numerous potential points of attack. Even the most robust cybersecurity defenses can be undermined by human error. Assessing cyberthreats in the context of country risk is challenging. While some countries, such as China, Russia, and North Korea, are known for targeted attacks on MNCs, the overall threat remains opaque and difficult to incorporate into a country risk model. For instance, a US-based company's operations in Ghana could be targeted by a Russian hacker group using servers located elsewhere in the Americas, making it impossible to link the threat directly to Ghana. The only viable quantitative and qualitative assessment of cyberattack risks for MNCs in Ghana is to retrospectively analyze past cyber incidents within the country. Another cybersecurity threat involves artificially manipulated news and videos; AI tools are increasingly adept at creating propaganda and false narratives that can incite violence and unrest.

The security situation globally over the next decade will also be influenced by resource depletion, as mentioned in the introduction. While oil is the most recognized strategic commodity considered by nations, modern societies depend on a wide range of commodities to maintain stability. Terrorist groups and religious extremists may exploit scarcity, particularly in nations rich in natural resources, to disseminate propaganda and incite uprisings and violence worldwide. Currently, the United States views China's dominant position in the rare earth elements sector as a national security concern, given that these elements play a crucial role in both economic and military applications (Shepherd and Li, 2025). In the future, developing countries will need to recognize more basic commodities, such as water and grains, as national security issues. In African nations, where hunger already contributes to civil unrest, these resources will become increasingly critical for national stability.

When global orders change, such as the increasingly nationalistic behavior of the United States, the dynamics of intervention in conflicts involving developing countries also shift. Bouchet et al. (2018) referred to this change

as the „end of US-dominated multilaterals,” a framework that has prevailed since World War II. Additionally, the United Nations, which has recently struggled to act effectively in significant conflicts, will likely be unable to determine a clear course of action. Particularly in Africa, China's expanding global influence is likely to manifest in emerging conflicts. By implementing strategic policies aimed at African nations, China has already established a significant presence on the continent, utilizing these relationships to bolster its military footprint, as seen at the port of Djibouti. Moreover, China is actively working to secure various commodities in Africa through exploration contracts with local governments. The country is also exploring resources in Asia, including in unstable nations like Afghanistan and Iraq, where it now operates the largest oil field. While the global scramble for commodities raises concerns for many governments, it is crucial to recognize that demand for these resources is expected to surge as developing countries strive to narrow the gap with the developed world. Consequently, multinational corporations should consistently consider potential shifts in nationalization policies regarding resources within host countries.

According to Bouchet et al. (2018), investors often perceive developing countries as a single asset class and are concerned about spillover effects, which can lead to simultaneous withdrawals of investment from multiple nations. This means that security incidents can negatively impact adjacent countries, affecting the financial stability of host countries for multinational corporations. As a result, MNCs may struggle to secure financing for their operations in a host country.

MNCs experience varying levels of exposure to the security situation in a host nation. While financial institutions typically hold liquid investments that can be quickly relocated, industrial MNCs have established production facilities and consumer markets within the host country. Such MNCs risk expropriation during military coups and can also suffer direct damage from violent attacks against their facilities by non-state actors. These non-state actors include not only terrorist groups but also private military companies, which are increasingly expanding their influence and creating heightened threats within host countries (Office of the Director of National Intelligence, 2024a).

MNCs are not merely collateral damage; they often become targets for these non-state actors. Particularly, U.S. companies are considered representatives of the U.S. government and, by extension, become targets

for hostile non-state entities. For a long time, MNCs have been viewed as symbols of Western hegemony and, in some instances, as instruments of modern colonization. This perception is especially pronounced when MNCs capture significant market shares in domestic markets, thereby undermining local companies' ability to compete.

Additionally, hostilities from citizens and domestic economic entities can be exploited for political unrest, which can lead to physical attacks against MNCs, making it even more challenging to secure financing for future investments in host countries. Furthermore, companies in certain industries, such as oil, are often associated with environmental damage, exposing them to increased risks.

## 3. EMPIRICAL ANALYSIS AND DISCUSSION

### 3.1 Sentiment Analysis

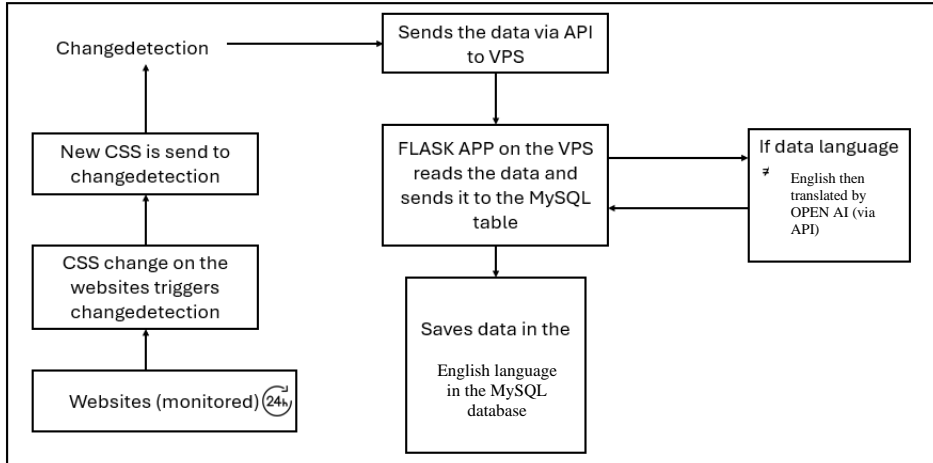
Sentiment analysis is the initial step in analyzing the collected data. The sentiments are categorized into three labels: positive, negative, and objective. To perform sentiment analysis, the text input must undergo tokenization. Tokenization is the process of converting words into unique numerical identifiers. Python libraries assist in converting the text inputs stored in the MySQL table into these unique identifiers. Since the sentiment dictionary is in English, the input data is pre-assessed for language. Any non-English input is translated prior to analysis by sending it via an API call to OpenAI for translation. This procedure ensures that the data is compatible with the appropriate sentiment packages. Before tokenization occurs, the data is cleansed of punctuation, HTML code, and other unwanted elements that could distort the sentiment analysis. Each input text is assigned a unique ID for identification purposes. In the subsequent 3D scatterplot, each input text can be identified by its corresponding ID number. The dictionary utilized is SentiWordNet, which is available on GitHub for conducting text analysis. As described on GitHub, SentiWordNet is a lexical resource for opinion mining, assigning three sentiment scores—positivity, negativity, and objectivity—to each synset of WordNet. Consequently, it serves as a lexicon-based method for sentiment analysis, providing sentiment scores for individual words.

### 3.2 The Neural Network for the Country Risk Model

The concept of employing neural networks in country risk assessment is to manage the extensive volume of available open-source intelligence data, which exceeds the capacity of any single individual if a daily assessment is required, as well as to process daily data quantities that even management teams cannot effectively handle. As machine learning and artificial intelligence research advances, it is essential to include these developments in country risk assessment modeling. This approach is also predicated on the incorporation of new methodologies for gathering data pertinent to country risk assessment. A substantial quantity of pertinent data resides on news websites, in blog posts, within insider columns, in background stories, and in governmental declarations. A comprehensive and continuously monitored database must be established for country risk assessment.

Supervised and unsupervised neural networks can assist in the evaluation. The model design depends on the achievements the neural network aims for, as well as the structure of the data the model is receiving as an input (Gale, 2024). The news data on the World Wide Web is frequently accessible without barriers; at times, data is even provided pre-sorted with API access (see ALEG). Additional input, classified as open-source intelligence data, can be provided by paid subscription. This, however, was excluded from this research due to its limitations in regard to financing. Nonetheless, as it is classified as open-source intelligence, any additional input would significantly expand the database. This thesis involved the daily scraping of several hundred websites for data via Changedetection. Evaluating the data input is a critical consideration for every country risk model, regardless of whether it involves questionnaire data, regression variable model data, or the data used in this neural network. The objective of the neural network is to analyze the data input, which is the result of the sentiment analysis. The neural network analyzes the data and generates a positive or negative trend forecast regarding country risk (as outlined in 8.3 (Code Appendix)). The sentiment analysis and neural network allow for the selection and individual analysis of factors and countries.

The research aimed to produce a model by establishing an individual database that was unattainable during Robock's day. Any substantial output from a model necessitates the collection and storage of requisite data in adequate quantities for analysis. An external service is utilized for collection reasons, which hosts the open-source software Changedetection. Changedetection is a fundamental component of the infrastructure, facilitating data collection and transmission to the server via an API POST statement. Changedetection observes third-party websites for modifications by utilizing the CSS framework of a site and transmits the altered data to a designated address. This research required a private server, which then stored the transmitted data in a MySQL database (as outlined in Figure 2 below)



**Figure 2.** Changedetection *Source:* Author

At the outset of every model, the issue of data refinement arises. When Changedetection monitors a website, the visual filter tool assists in selecting the precise CSS portions of the site. Nevertheless, the websites are frequently constructed in a manner that prevents the program from extracting individual words or numbers. This indicates that the data cannot be refined prior to its utilization in the neural network study. In contrast to the stringent refinement required for quantitative methods such as regression analysis, the qualitative data approach utilizing a neural network is presumed to be more adaptable, provided the data input is sufficiently extensive. Datasets capable of substantial scaling should maintain minimal volatility due to extensive data input.

ID	INSERT_TIME	WEBPAGE	COUNTRY_VARIABLE	NEW_DATA_TRANSLATED	NEW_DATA
19676	20.02.2025 00:13	https://citinewsroom.com/tag/strike/	GHA	soc	* About Us * Contact Us * Photo
19677	20.02.2025 00:13	https://www.pulse.com.gh/search-results?keywords=	GHA	soc	Loading
19678	20.02.2025 00:16	https://www.gbcghanaonline.com/?s=strike	GHA	soc	Government questions legal basis of CLOGSAG's plc
19679	20.02.2025 00:18	https://www.gbcghanaonline.com/?s=protest	GHA	soc	Obuoho youth protest unlawful burning of excavato
19680	20.02.2025 00:25	https://animalpolitico.com/sociedad	MEX	soc	Read later Banxico cuts its growth forecast for Mexic Leer después Banxico recorta a 0.6 % su pronó
19681	20.02.2025 00:26	https://www.milenio.com/temas/manifestaciones	MEX	soc	* 18.02.2025 March in the center of Monterrey for ma * 18.02.2025 Marchan en el centro de Monterrey pr
19682	20.02.2025 00:28	https://edition.cnn.com/world/americas/mexico	MEX	soc	â€ Live Updates Live Updates Jim Watson
19683	20.02.2025 00:32	https://blueprint.ng/?s=energy	NGA	ene	Business NIES 2025: Omgliafo to deliver keynote :
19684	20.02.2025 00:34	https://www.environewsng.com/category/energy/	NGA	ene	Renewable Energy Ethiopia signs MoU with A
19685	20.02.2025 00:35	https://www.premiumtimesng.com/search_gcse?q=N	NGA	ene	Custom Search
19686	20.02.2025 00:39	https://www.vanguardngr.com/search/energy	NGA	ene	Experts demand urgent action on Nigeria's energy c
19687	20.02.2025 00:40	https://mexiconewsdaily.com/category/news/	MEX	soc	2025 Future of Mexico Forum: MND interviews Valeri
19688	20.02.2025 00:40	https://www.vanguardngr.com/search/oil	NGA	ene	Nigeria's oil output excluding condensate rises by4
19689	20.02.2025 00:42	https://punchng.com/tags/NMDPRA/	NGA	ene	Latest News * 17th February 2025 NMDI
19690	20.02.2025 00:44	https://thenationonlineng.net/tag/NMDPRA/	NGA	ene	NMDPRA NMDPRA bans over 60,000ml petrol truc
19691	20.02.2025 00:44	https://businessday.ng/category/energy/	NGA	ene	* Home * > * Energy Energy Petrol import pr
19692	20.02.2025 00:45	https://politica.expansion.mx/sociedad?utm_source=	MEX	soc	Society What courses does the CECART training cent Sociedad * Sociedad ¿Qué cursos ofrec
19693	20.02.2025 00:51	https://leadership.ng/tag/renewable-energy/	NGA	ene	Tag: Renewable Energy Reps To Hold Summi
19694	20.02.2025 00:53	https://www.ripplesnigeria.com/tag/dangote/	NGA	ene	* Business 2 days ago Dangote on \$23bn refine
19695	20.02.2025 01:00	https://www.promexicoindustry.com/en/news	MEX	soc	San Luis Potosi February 2025 San Lu
19696	20.02.2025 01:01	https://www.csis.org/	GLO	sec	Image Mining for Defense: Unlocking the Poten
19697	20.02.2025 01:02	https://intelnews.org/	GLO	sec	Review of "Chinese Espionage Operations and Tacti
19698	20.02.2025 01:05	https://thenationonlineng.net/business/	NGA	eco	Business Academy launches initiative to end Nig
19699	20.02.2025 01:05	https://punchng.com/topics/business/	NGA	eco	Latest News * 20th February 2025 Vehic
19700	20.02.2025 01:06	https://www.premiumtimesng.com/category/business/	NGA	eco	More News FG plans to ban overloaded petr
19701	20.02.2025 01:07	https://tradingeconomics.com/nigeria/news	NGA	eco	* Nigeria Inflation Rate Falls to 24.48% After Data
19702	20.02.2025 01:09	https://businessday.ng/tag/bdlead/	NGA	eco	BDlead Health workers unemployment soars to 26
19703	20.02.2025 01:09	https://www.vanguardngr.com/category/business/	NGA	eco	Austriacard to partner banks, fintechs, others boost
19704	20.02.2025 01:12	https://businessday.ng/category/business-economy/	NGA	eco	Economy CBN to boost remittances from Nigerian
19705	20.02.2025 01:13	https://businessday.ng/category/companies/	NGA	eco	Companies Dangote to double its Ethiopia cemen
19706	20.02.2025 01:13	https://businessday.ng/category/markets/	NGA	eco	Markets Here're analysts views on stocks ahead o

**Figure 3.** Illustration of the MySQL table *Source*: Author

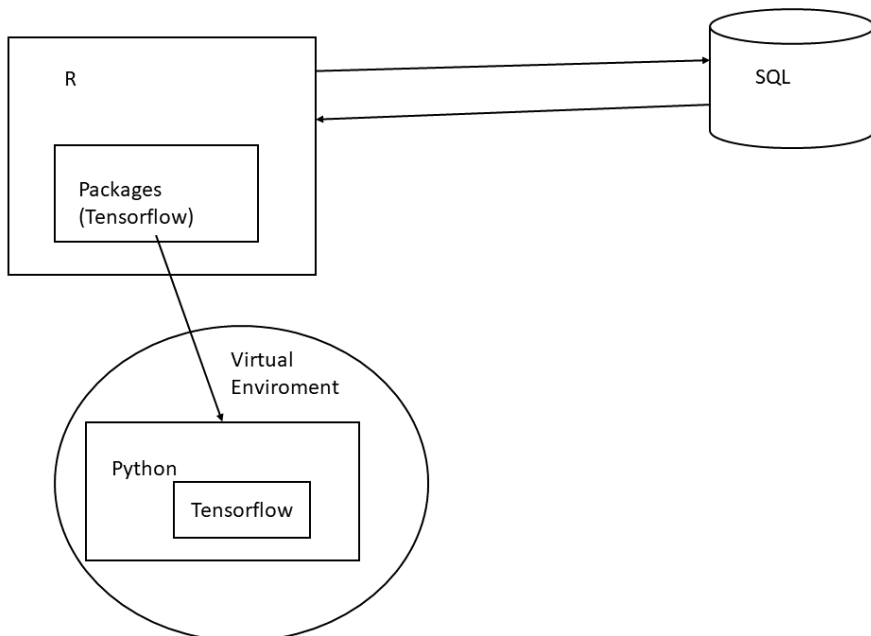
The private server is equipped with a Python *listener* script that facilitates API access. The foundational FLASK library is capable of executing the necessary actions (API connection) to gather data from specific websites and transmit it to a private server.

When the *listener* script processes a POST command, it reads the transmitted data and converts it for storage in a MySQL table. The *listener* has been manually initiated on the server for the first time and is secured with an auto-run command. It utilizes FLASK application technology for its functionality. The data is contained within a JSON string, and the *listener* script can categorize this data by specified country and variable using a group tag for labeling (for example, 'GHA\_sec' would be categorized as Ghana and security).

Moreover, the *listener* script can determine the language of the transmitted data through the Python library langdetect. If it's not detected as English, it is sent for translation to OpenAI via API. It channels the input data into specific MySQL columns: ID, TIMESTAMP, OLD DATA, COUNTRY, VARIABLE, and LANGUAGE. The private server supports a MySQL database with columns that include ID, TIMESTAMP, WEBSITE, OLD DATA, NEW DATA, NEW DATA TRANSLATED, VARIABLE,

LANGUAGE, and COUNTRY. The MySQL Workbench tool is used to access stored data and create appropriately labeled tables for retrieval by R Studio (as outlined in Figure 3 above).

Changedetection allows for the integration of an API within the notification section, which facilitates the sending of data to the *listener* script on the server. The API connection comprises the server's IP address and directives for which website updates should be transmitted to the *listener*. The *listener* is invoked using the POST command of the protocol language employed for the API of Changedetection. MySQL stores the data, which can be accessed by R Studio for subsequent analysis (as outlined in Figure 4 below). RStudio is an environment for the statistical programming language R. It includes a package-based environment for different statistical and mathematical analyses. The package encompasses methods employed for country risk assessment. Moreover, virtual environments can utilize Python language packages. The packages TensorFlow and Keras are required here. These packages include the possibility of neural network analysis, along with the element of unsupervised learning.



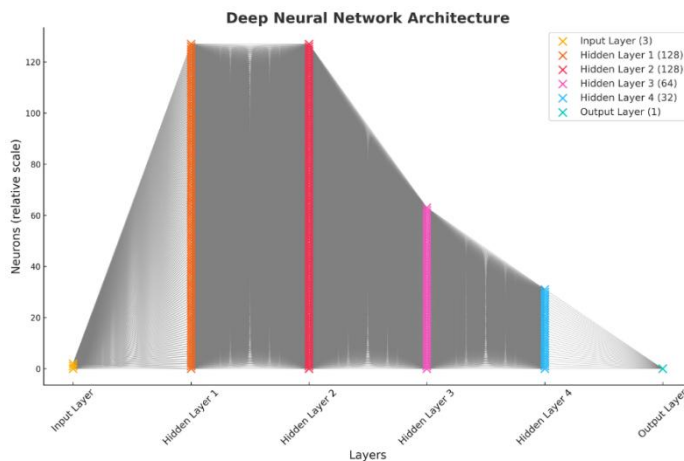
**Figure 4.** Tensorflow in a virtual environment *Source:* Author

To create the neural network model planned for this research, the application TensorFlow utilizes multiple related machine learning packages. (Carter, 2024) TensorFlow, developed by a team of Google engineers, is a sophisticated program for building neural networks. It incorporates the program Keira, which serves as a standard tool in machine learning and neural network applications. Because TensorFlow is a Python-based program, it is necessary, in addition to installing Python, to create a virtual environment for use in RStudio. One must install TensorFlow again within this virtual environment. Subsequently, additional packages are installed in R Studio to link it to the Python virtual environment, enabling the design and execution of the neural network within R Studio (as outlined in Figure Appendix 8.3). R as a language and RStudio as the Integrated Developer Environment (IDE) are suitable to handle neural networks. (Ciaburro and Venkateswaran, 2017) The deep neural network operates with non-linear data, allowing for the inclusion of variables in the same model that might not exhibit significant regression in a linear regression model.

The input consists of vectors constructed from positive, negative, and objective classifications. The deep neural network is capable of learning from clusters and uncovering hidden relationships within the data using these classifications, indicating its self-learning capability. Moreover, the network is designed to handle complex and large datasets efficiently. At present, the input size includes data from 808 websites, which undergo daily monitoring. While not every website provides daily updates, the majority do, allowing for rapid scaling of the dataset. This dataset is highly scalable, with entry rows potentially exceeding several hundred to a few thousand data entries. Additionally, the complexity of the data arises from its text-based nature. Managing this complexity requires careful monitoring of computational resources and ensuring their availability. R Studio can perform intricate calculations on standard computers, but as the model evolves, there will be a need to extend computational power.

The deep neural network has the advantage of analyzing non-linear relationships that are inherently present in country risk data. It can process sentiment analysis data along with the constructed vectors to conduct trend analysis. The sigmoid activation function in the last layer neuron allows for a binary output, indicating either a positive or negative trend. Additionally, the deep neural network can be expanded by adding more layers and neurons. (Aggarwal, 2018). The input data vectors will first pass through the initial layer, which contains 128 neurons. A ReLU activation function

determines whether the data will proceed to the subsequent layers. The second, third, and fourth layers also utilize the ReLU function for activation. The second layer contains 128 neurons, the third layer has 64 neurons, and the fourth layer comprises 32 neurons. The final layer employs the sigmoid activation function, which uses z-scores for activation, calculated as the sum of the assigned weights. These weights are determined for each input row, underscoring the need for substantial computing power (as outlined in Appendix 8.3).



**Figure 5.** AI created theoretical representation of a 4-layer ANN *Source:* OpenAI

Weight calculation for layer 1-4

$$z = w_1x_1 + w_2x_2 + \dots + w_nx_n + b$$

Weight calculation for the last layer

$$z = w_1h_1 + w_2h_2 + \dots + w_nh_n + b$$

ReLU activation in layer 1-4

$$\text{ReLU}(x) = \max(0, x)$$

$$\text{For } x > 0: \text{ReLU}(x) = x$$

$$\text{For } x \leq 0: \text{ReLU}(x) = 0$$

Sigmoid activation in the last neuron

$$\sigma(z) = \frac{1}{1 + e^{-z}}$$

### 3.3 K-means Cluster Analysis

After the sentiment analysis, the k-means algorithm examines the data to build clusters. K-means clustering calculates the centroids in the network. The clusters can be calculated for every variable and country individually. The cluster analysis is not necessarily a requirement for the country risk assessment with a neural network, but it can help to identify abnormalities in the network's output. Within this research, the cluster analysis plays a marginalized role and serves mainly for error monitoring (as outlined in Appendix 8.3).

### 3.4 3D Scatterplot, Timeline and Interface Program

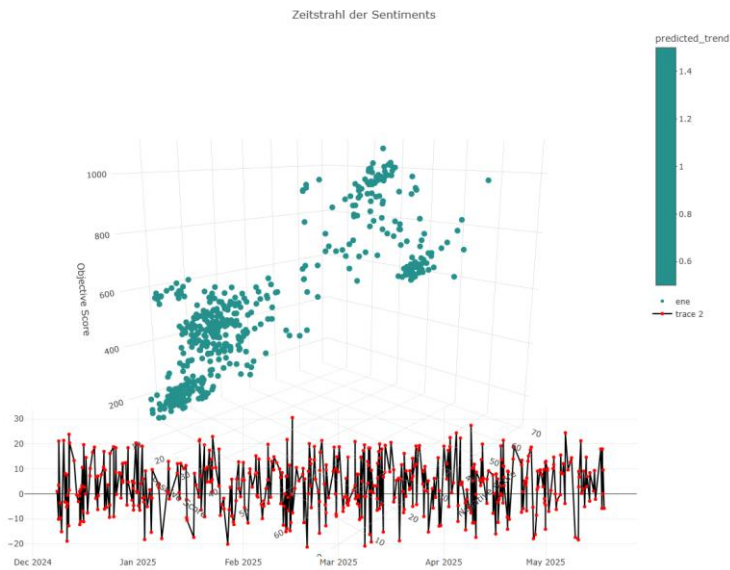
The three-dimensional scatterplot serves as an effective illustration of the concept. It seeks to demonstrate sentiment analysis, cluster formation, and a timeline of net sentiment. This feature provides an overview of the input data and the neural network's results. The model requires a substantial quantity of data to function effectively. The scatterplot hence possesses numerous data entry points and can be overwhelming. Therefore, within the 3D scatterplot, the points have the individual ID entry for identification, as well as the negative, positive, and objective values. Each point additionally illustrates the net-sentiment value and the anticipated neural network trend (as outlined in Appendix 8.3).

### 3.5 The Results of the Neural Network

**H1:** A neural network analytical framework can be developed for country risk assessment utilizing individually collected daily open-source intelligence data.

In addition to being fully functional, the code that was written for this thesis is capable of producing significant results for any nation that was chosen to serve as an example for this research. Based on the following data entry, the model makes a prediction regarding whether or not the sentiment

associated with a particular variable would increase. Once it has been trained using sequential data, it will produce a binary signal that indicates whether an upward or downward shift in sentiment is anticipated. Due to the fact that the input data was developed to represent a comprehensive country risk model, this change is revealing the country risk that multinational firms face. The model accurately depicts the direction of short-term sentiment progression based on document order, and it does so without being dependent on a predetermined level of time horizon. As a result, H1 indicates a positive outcome.



**Figure 6.** Positive trend prediction Germany May 5<sup>th</sup> *Source:* Author

The model was tested with a time stop. On the 5<sup>th</sup> of May 2025, the model made an accurate prediction that Germany will have a positive trend within the government variable. On May 6<sup>th</sup> 2025, Germany formed its new government, which was an event that was regarded favorably on the international stage. This conclusion was due to the fact that it was regarded as a symbol of stability in Europe and a continuation of Germany's position in terms of its foreign policy. The anticipated strong election results for the far-right party in Germany posed a threat to this stability.

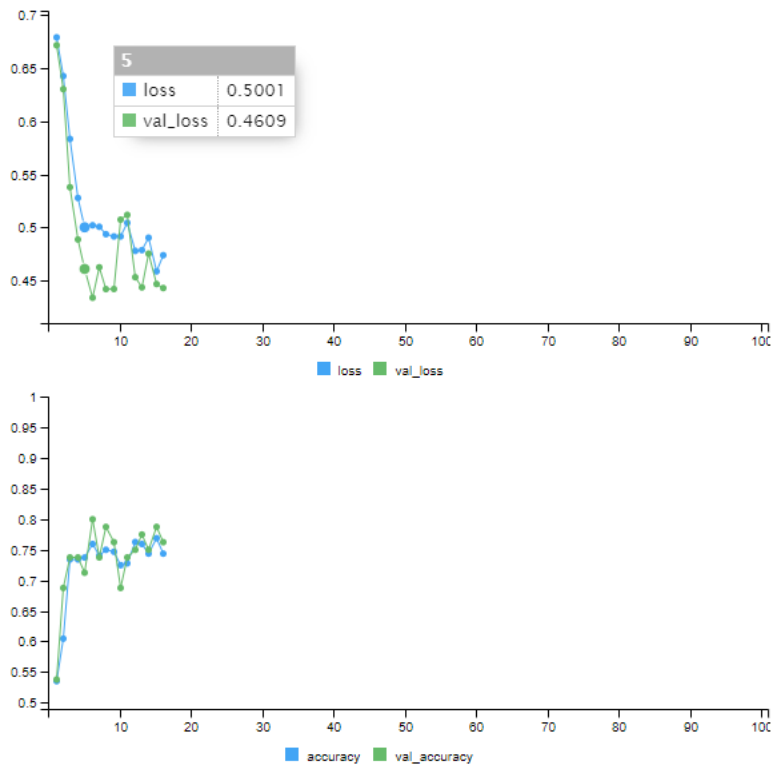
```
> summary(nn_model)
Model: "sequential"
```

Layer (type)	Output Shape	Param #
dense_4 (Dense)	(None, 128)	512
dropout_3 (Dropout)	(None, 128)	0
dense_3 (Dense)	(None, 128)	16512
dropout_2 (Dropout)	(None, 128)	0
dense_2 (Dense)	(None, 64)	8256
dropout_1 (Dropout)	(None, 64)	0
dense_1 (Dense)	(None, 32)	2080
dropout (Dropout)	(None, 32)	0
dense (Dense)	(None, 1)	33

Total params: 27393 (107.00 KB)  
 Trainable params: 27393 (107.00 KB)  
 Non-trainable params: 0 (0.00 byte)

**Figure 7.** Neural Network layout – Nigeria May 11<sup>th</sup> *Source:* Author

Furthermore, the model also predicted a positive trend for Nigeria in the economy variable on May 11th. On May 12th, the World Bank gave a positive outlook statement for Nigeria's economy.



**Figure 8.** Validation accuracy and validation loss for Mexico March 17<sup>th</sup> *Source:* Author

In addition, the model performed accurately when it predicted that the government variable for Mexico would have a favorable outlook on March 17th. Claudia Sheinbaum introduced an important legislative act March 18<sup>th</sup> that reformed Mexico’s energy sector.

**H1.1:** The proposed neural network demonstrates statistically significant predictive performance, as evidence by model interpretability techniques such as LIME (Local Interpretable Model Agnostic Explanations), SHAP (Shapley Additive Explanations) and the results of a K-fold analysis.

The results of the LIME and SHAP analysis were mixed. While the actual predictions, with the exception of Mexico, were significant, the explanation fit was low. In the case of SHAP, this is also true for the average prediction. The results, however, don't make the model insignificant (as outlined in Table 3 below). The success of the one-day prediction highlights the actual predictions from Germany and Nigeria.

country	LIME	SHAP
Germany	Explanation Fit: 0.54	Actual Prediction: 0.91 Average Prediction: 0.57
Mexico	Explanation Fit: 0.4	Actual Prediction: 0.06 Average Prediction: 0.48
Nigeria	Explanation Fit: 0.43	Actual Prediction: 0.87 Average Prediction: 0.50

**Table 3.** LIME and SHAP results for the three events examined *Source:* Author

The K-fold analysis shows significant mean accuracy values for a binary prediction. The mean-prediction values are also significant. Overall, the K-fold values show the model as statistically significant (as outlined in Table 4 below). Since the K-fold test results are seen here as superior to the LIME and SHAP results, the H1.1 is seen as positive, and the model gives significant results with the exemplary tests.

country	date (one day prior to event)	event	mean- accuracy	mean- precision	mean- recall	mean- f1- score	mean- auc
Germany	05.05.25	Gov.	0.703	0.711	0.689	0.695	0.780
Mexico	17.03.25	Gov.	0.762	0.794	0.738	0.758	0.859
Nigeria	11.05.25	Eco.	0.7	0.752	0.598	0.656	0.797

**Table 4.** K-fold analysis of one day ahead event prediction *Source:* Author

**H1.2:** The model effectively addresses and overcomes the limitations of linear assumptions inherent in traditional quantitative country risk assessment methodologies.

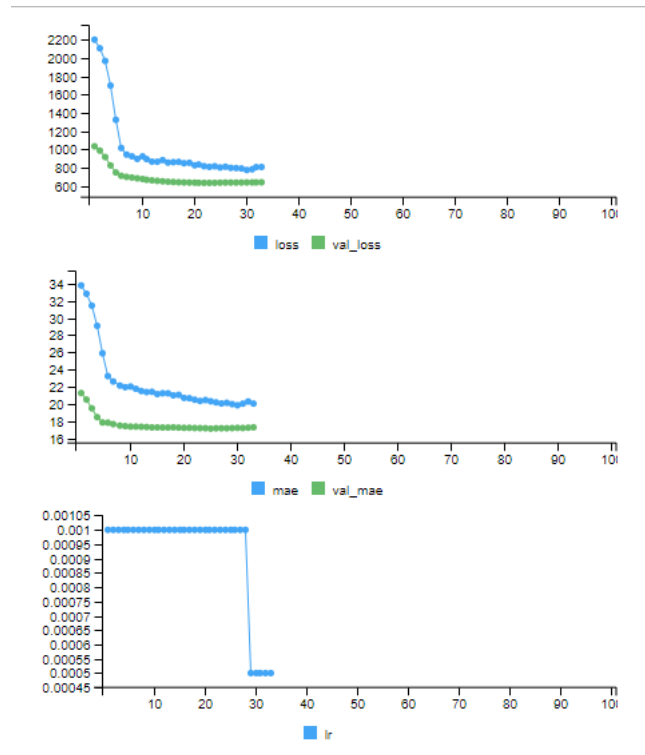
The variables within the databank are for all countries the same. The data is collected over a time span of over half a year, which leads to positive and negative data input in unequal amounts and in irregular time periods. Since the model overcomes the obstacles of H1 and H1.1 and produces a significant working model with the non-linearity problem in hand, H1.2 must be answered positively. A neural network analysis framework based on open-source intelligence data can overcome the non-linearity problem. The one-day-ahead model results show that the model performs stably; however, there remains potential for further fine-tuning. Possible improvements include increasing or decreasing the number of layers within the deep neural network. Furthermore, the learning rate could be increased if necessary, as could the batch size of the input matrices during training. The latter two adjustments, however, would only be advisable if the dataset were to increase considerably in size.

### 3.6 The Results of the Neural Network -Weekly/Monthly Predictions

Both the weekly and the monthly prediction models used a linear activation function in the final layer, thereby changing the final activation from a sigmoid function to a linear regression. The code used for the weekly and monthly predictions was based on the original code developed for the one-day-ahead prediction but required further adjustments, as shown in Appendices 8.5 and 8.6. These models were trained and evaluated using the same dataset as the one-day-ahead model.

Due to issues related to data density, the most suitable data stream for the model was the country-level data for Mexico, using variables derived from the collected government data. Within this data stream, limitations in data

collection became apparent through an increased level of noise, as well as the appearance of warning signs typically associated with a risk of overfitting during training. However, despite these issues, the results indicate that while the mean AUC values are low and require further training, they are sufficiently high to suggest that additional training is promising.



**Figure 9.** Validation accuracy and validation loss for Mexico (weekly prediction) *Source:* Author

In the weekly prediction using the Mexican government variable, with a start date of December 1st, 2025, the model also exhibited insufficient mean AUC performance. As stated above, Mexico was selected because it provided the densest data collection among all monitored countries. However, the mean absolute error and the loss decreased sharply within the first ten epochs and then remained nearly unchanged, without further convergence. This behavior caused the learning rate to decrease around the 30th epoch to a value below the already low learning rate of 0.001.

The remaining K-fold analysis indicates additional potential issues with the data. Although the OSINT collection component of the model is capable of collecting near-infinite amounts of data within the technical limits of the system, the dataset collected within the constraints of this research was likely insufficient for robust model training.

country	LIME	SHAP
Mexico	Explanation Fit: 0.13	Actual Prediction: 23.03 Average Prediction: 27.11

**Table 5.** LIME and SHAP results for the weekly prediction *Source:* Author

The SHAP actual prediction values are low, particularly when compared to the results of the one-day-ahead model, whereas the LIME model provides an explanation framework similar to that used for the one-day-ahead prediction. For the weekly and monthly models, K-fold analysis is also employed as the primary method for performance assessment.

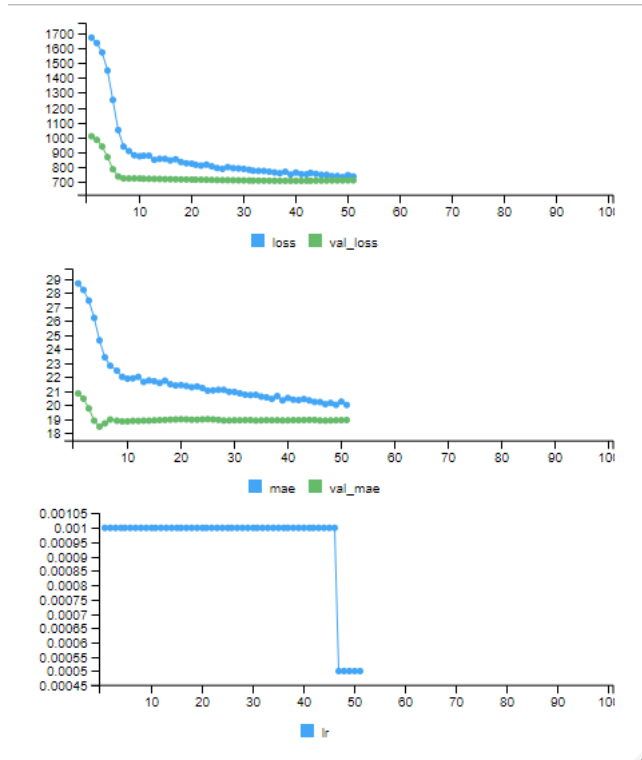
The K-fold analysis for the Mexican government variable with a start date of December 1st shows high levels of mean accuracy, mean precision, mean recall, and mean F1-score. However, the previously discussed mean AUC indicates that the model requires further improvement before it can be applied in practice. The rolling mean window was evaluated at lags 3 and 7.

country	stop date	event	mean-accuracy	mean-precision	mean-recall	mean-f1-score	mean-auc
Mexico	01.12.25	Gov.	0.831	0.844	0.982	0.907	0.582

**Table 6.** K-fold analysis for the weekly prediction *Source:* Author

The monthly prediction also uses December 1st, 2025, as the start date. The monthly prediction applies a 30-day window, thereby representing sentiment predictions for December 2025. Within this period, Mexico exhibited some positive signals, including a reduction in the fiscal deficit in 2025 and the achievement of a water delivery agreement with the United States.

In this case, the rolling mean window was set to 15 and 30.



**Figure 10.** Validation accuracy and validation loss for Mexico (monthly prediction) *Source:* Author

The figure above shows the mean absolute error and the validation loss, as well as the training loss and validation loss, using a learning rate of 0.001. These results indicate that the model is capable of functioning; however, its capacity is likely greater than what the available data can support. Around the 50th epoch, both the loss and the mean absolute error fall below their corresponding validation metrics. In addition, the learning rate decreases around the 45th epoch, which provides a further indication of overfitting when considered alongside the observed behavior of the validation mean absolute error and validation loss.

country	LIME	SHAP	
Mexico	Explanation Fit: 0.11	Actual 18.43	Prediction:
		Average 26.36	Prediction:

**Table 7.** LIME and SHAP results for the monthly prediction *Source:* Author

The monthly prediction values for LIME and SHAP exhibit behavior similar to that observed in the weekly predictions. Again, these results are not considered as important as the K-fold analysis; however, the SHAP values remain extremely low.

country	stop date	event	mean-accuracy	mean-precision	mean-recall	mean-f1-score	mean-auc
Mexico	01.12.25	Gov.	0.836	0.837	1	0.910	0.612

**Table 8.** K-fold analysis for the monthly prediction *Source:* Author

In addition to the LIME and SHAP values, the K-fold analysis performance presents results indicating that the model exhibits insufficient mean AUC. Mean recall again gives the impression of an overfitting model, likely due to missing data. The monthly-ahead prediction requires a 30-day linear regression and therefore incorporates more data than the weekly prediction. Even though the Mexican government variables provided the best data coverage, the dataset still appears to be too small.

Furthermore, the weekly and monthly prediction capabilities require additional optimization. With a wider database, the model could likely perform more stably. Although the model has collected nearly one hundred thousand data points to date, the predictions remain noisy when using a linear activation function in the final layer. One underlying issue is that certain variables and countries are better covered by news outlets and expert reports than others.

While the LIME and SHAP values were problematic in both the one-day-ahead and the monthly prediction models, the K-fold analysis would most likely improve with more extensive data. In the case of the monthly prediction, the model frequently suffered from too many missing data

points to meet the forecasting objective. For such long forecasting horizons, the data collection process must be significantly more extensive.

In general, as with other neural network applications, the model developed in this thesis requires a higher volume of input data to effectively support a linear activation function in the final layer. The model itself cannot influence how frequently news outlets report on specific topics. Therefore, future research must increase the volume of input data in order to enable reliable monthly predictions for all model variables at any point in time. If data inflow remains low, expanding the number of monitored websites could mitigate this limitation and generate sufficient data for analysis and prediction.

**H2:** The model will perform better in one-day-ahead predictions than in weekly and monthly predictions.

The one-day-ahead model performed better than both the weekly and the monthly prediction models. The mean AUC values obtained from the K-fold analysis showed unsatisfactory results for the weekly and monthly forecasts, indicating that these results must be examined with respect to potential overfitting. Furthermore, the recall and F1-score values are excessively high, and the high prediction accuracy is likely influenced by noisy and missing data points.

The sigmoid activation function performed better with the data collected through the model's OSINT collection process than the linear activation function used in the weekly and monthly prediction models. The one-day-ahead prediction model appears to be more capable of mitigating data noise. Overall, the K-fold analysis also demonstrates more conclusive performance for the one-day-ahead prediction.

Although the mean AUC and prediction results are not optimal, they provide sufficient positive feedback to justify using the model in its current form while monitoring future results to identify potential areas for fine-tuning. In contrast, the weekly and monthly prediction models clearly indicate a need for increased data availability. Therefore, Hypothesis H2 is confirmed.

### 3.7 Comparison of Country Risk Rating

There are challenges in comparing the results of this thesis model with other country risk models. The models used by institutional country risk assessment firms are proprietary, and even academic attempts to replicate them never yield results that are exactly the same as those produced by the institutions. A primary issue in this research is the varying time horizons across different studies. The data collected for this thesis is primarily daily, whereas established models typically utilize longer time frames. Additionally, the time horizon of the model developed in this research is not fixed to a specific period. Although it has been tested for one-day-ahead predictions, it has not been specifically trained for this purpose. The goal of this approach is to improve the model's adaptability, enabling it to undergo training at a later date for specific time periods.

Nonetheless, one can compare the overall trend predictions of country risk from this model to the most recent institutional risk assessments. The following section presents a comparison of their ratings for the five countries analyzed. For Mexico, Vietnam, and Germany, the trend predictions align closely with institutional rankings (as outlined in Table 9 below). Ghana also fits within the institutional framework, although not as clearly as the other countries. The positive trend prediction for Nigeria stands out, as it sharply contrasts with institutional assessments. This discrepancy is likely due to the recent collection of positive sentiment data that influenced the model, which may not yet have been incorporated into the assessments of other models.

Model	Mexico	Vietnam	Germany	Nigeria	Ghana
Coface	B	A4	A3	C	C
OECD	3	5	1	6	6
CRC					
Fitch Solutions	72	71	81	46.6	53.1
Economist Intelligence Unit (EIU)	70-75	71	83-85	50-60	54-60
Thesis model	0 (negative)	1 (positive)	1 (positive)	1 (positive)	0 (negative)

**Table 9.** Comparison to other Country Risk Ratings *Source:* Author

### 3.8 Individual Variable prediction

The variables represent distinct facets of country risk, and each must be capable of producing a valid result independently. This step is especially important if a multinational corporation identifies a particular variable that poses a greater risk to its operations. While the overall country risk trend requires that the variables be equally weighted in terms of the websites monitored, an MNC might later focus on just one variable and increase the data input for that specific area. This decision would largely depend on the nature of the MNC's business. For example, a production company with limited political exposure might be more concerned with energy stability, prompting it to enhance the data input for that variable.

In this research, it is ensured that the variables were equally weighted regarding the websites monitored to maintain universality. The model successfully generated a trend for each variable. However, some variables accumulated more data over time than others, as news coverage varies by topic. The most effective data collection occurred for the variables related to government and economy. The utilized events from these variables assess the significance of the results and to evaluate the significance of the trend predictions.

Variable	Mexico	Vietnam	Nigeria	Ghana	Germany
Energy	1 (positive)	0 (negative)	1 (positive)	1 (positive)	1 (positive)
Environment	0 (negative)	1 (positive)	1 (positive)	1 (positive)	1 (positive)
Economic	0 (negative)	0 (negative)	0 (negative)	0 (negative)	1 (positive)
Government	0 (negative)	1 (positive)	1 (positive)	0 (negative)	0 (negative)
Security	0 (negative)	0 (negative)	1 (positive)	0 (negative)	1 (positive)
Legal	0 (negative)	1 (positive)	1 (positive)	0 (negative)	0 (negative)
Social	0 (negative)	1 (positive)	1 (positive)	0 (negative)	1 (positive)

**Table 10.** Individual results of the thesis model variables *Source:* Author

### 3.9 Discussion

The thesis model can be optimized and requires ongoing monitoring of data input throughout its lifespan; nevertheless, it also presents opportunities for further research. The initial study objectives should focus on advancing the model for every country acknowledged by the United Nations, assessing if the infrastructure can accommodate the data volume and generate significant results. The second potential area of ongoing research may be the dimensions of the concealed relationship that the model does not show. The issues addressed with constraints within the model indicated that, despite the fact a deep neural network may discern concealed patterns, it lacks the capacity of a political strategist to perceive the political nuances that affect certain political processes, irrespective of sentiment.

Additionally, with further study opportunities, the model input must be scrutinized for another emerging issue: artificial news websites. A substantial amount of website content is currently generated by machine learning algorithms utilizing natural language processing techniques. A portion of those websites are established as news platforms. At a certain juncture, the model may face the issue of machine learning from another machine.

One potential advancement is the ability to compute the DNN with a quantum computer and quantum algorithms. Companies such as D-Wave Quantum provide commercially available quantum computers. This might elevate the model's potential to new heights.

Finally, institutional country risk assessment providers and their models have the advantage of using proprietary data within a much more established framework. This applies to both quantitative and qualitative models, as institutional country risk providers protect not only their quantitative datasets but also the experts who contribute qualitative assessments. The institutions mentioned in Section 4.2 have long-established data collection methodologies, as evidenced by their extensive history of published assessments.

However, this thesis elevates the collection of OSINT data into a databank capable of performing country risk assessments without the need for institutional support. Furthermore, the proposed model enables the data to be assessed in multiple ways, while the use of a neural network remains a promising approach for overcoming the linearity limitations inherent in purely quantitative data

## 4 CONCLUSION, RECOMMENDATIONS, POLICY IMPLICATION, AND LIMITATION

### 4.1 Conclusion and Recommendations

The results show that daily data input into a neural network for assessing country risk can provide a predicted trend analysis for country risk assessment. Multinational corporations (MNCs) seeking a more individualized approach to country risk assessment are provided with a foundation on which the model developed in this thesis can be further extended. By applying the one-day-ahead prediction model in combination with a sufficiently robust database, MNCs could assess risks related to their business operations for each country for which data are collected. However, the model competes with long-established institutional providers. MNCs with sufficient financial resources that can afford the services of providers such as Coface, Fitch Solutions, and other established institutions require a longer period of real-world application before adopting the thesis model.

Contemporary developments, however, increase the likelihood that MNCs will once again internalize country risk assessment capabilities. Following an already turbulent decade, the second term of Donald Trump as President of the United States has reiterated the relevance of the BANI model, illustrated by developments such as the forced extradition of Venezuela's illegitimate president Maduro, the announcement of incorporating Greenland into the United States as part of U.S. security strategy considerations, and the threat of extraordinary taxation of U.S. allies should they fail to comply with demands or actions by the U.S. administration.

The process of internalizing country risk assessment has occurred previously, notably after the Iranian Revolution, and was later dismantled primarily due to cost considerations and a period of relative geopolitical stability for MNCs. The global expansion of MNCs and their international business operations was closely linked to increasing market globalization and the predominance of liberal economic principles. As geopolitical conflicts increasingly reflect traditional hegemonic strategies aimed at securing influence, resources, and national prosperity, MNCs now have renewed incentives to reincorporate country risk assessment models in-house.

For these developments, the model proposed in this thesis provides a strong foundation for further advancement, particularly due to its novel approach

to collecting OSINT data within a framework of variables that have proven effective in country risk models over the past century. Multinational corporations (MNCs) have the option to collect OSINT data individually and according to their specific requirements, while still benefiting from the underlying model framework. Furthermore, the use of a deep neural network in this thesis to address the linearity limitations of traditional country risk models aligns closely with another contemporary development.

The rise of large language models and the growing importance for many companies of deploying agents to gain business advantages have led many MNCs to consider internalizing such agents in order to protect customer data. As a result, MNCs are likely to possess greater GPU capacity and computational resources overall. These resources are essential prerequisites for scaling the application of neural networks for country risk assessment within the proposed model, particularly when combined with expanded data collection. Consequently, the recommendations of this thesis must include a call for funding further research in order to gain access to larger datasets. This requirement does not stand in contrast to the proposed OSINT collection approach, as discussed in Chapter 2.8.

From an academic perspective, the field of country risk assessment is likely to experience increased research activity as a result of the developments outlined above. While neural networks have previously been applied in related research, these methods continue to offer substantial potential for further investigation, particularly when models are fine-tuned using individually collected data rather than focusing solely on comparative performance analyses against institutional assessments or rankings. Given the heterogeneous nature of neural network architectures, the scope for developing models specifically tailored to country risk assessment remains broad. For researchers pursuing this direction, a likely next step in the evolution of neural network applications for country risk assessment is the use of world models. Such models would not only analyze data and improve performance through training but could also learn underlying „rules of the world.” In the context of country risk assessment, this capability could enable models to evaluate outcomes that are currently monitored by political experts, potentially reducing the need for such expert intervention.

With respect to the role of OSINT data in country risk assessment, the field also presents significant opportunities for further research, particularly in

the large-scale application of OSINT data collection. This thesis seeks to contribute novelty to this aspect of country risk assessment. The volume and value of OSINT data, as discussed in Chapter 2.8, indicate its importance for MNCs not only in supporting traditional business operations but also in protecting those operations through informed country risk assessment. Scaling the thesis model, or any comparable model that seeks to aggregate country risk data using OSINT sources, would likely require collaboration with a corporate research partner, as data refinement at larger scales becomes increasingly complex to manage.

## 4.2 Policy Implication

The results should inform the company about the risks associated with the environment in which it operates, enabling management to evaluate the potential effects on business operations. The company's environment includes not only the host countries of the multinational corporation and its home country but also third-party countries, as risks in those regions can impact the MNC, as illustrated by Bouchet et al. (2003). A comprehensive country risk model should encompass a global environmental assessment, placing greater emphasis on factors that significantly expose business operations to the global environment. The results are organized by variable, necessitating the synthesis of each individual result to create a complete picture for the MNCs. This assessment should empower management to decide whether to proceed with an investment or to halt it, as well as to determine strategies for protecting business operations.

After conducting a country risk assessment, management must decide whether to take mediation actions or to cease investments and business operations. While this research primarily focuses on assessing country risk, it is essential to briefly explore who is responsible for risk mitigation. This exploration can offer explanations for the outcomes of the country risk assessment and any potential delays in reporting information. Mediation actions may involve engaging stakeholders through corporate diplomacy initiatives or reducing operations in host countries.

## 4.3 Limitation

Recognizing the constraints and therefore the limitation of the model is essential. While the deep neural network can reveal hidden relationships within the input sentiment, it does not possess the insight of a political strategist. For instance, if negative sentiment arises from current political

developments—a situation a political strategist might interpret as a temporary trend—the deep neural network requires additional time to adjust the weight of that input. This limitation highlights the necessity for expert input to provide context for some of the results. Since political experts already provide a portion of the model’s input data through published reports and news updates, the country risk assessment ecosystem should include expert commentary on the model’s results.

To address computing constraints, one can enhance the infrastructure capabilities. Upgrading the MySQL database server from a limited private virtual server to a cloud server would offer virtually limitless scalability. Considering that the model will receive data inputs from thousands of websites daily, the MySQL storage must be sufficient. A notable limitation of this research has been funding; external financial support would enable the expansion of data input and enhance data quality. This was most directly observed in the evaluation of the weekly and monthly country risk assessments, which did not perform to their full potential, most likely due to missing data points. An increase in the availability of financial data could enhance data input across all variables in the model for each country uniformly. Future research into open-source intelligence data gathering for country risk assessments should take this funding issue into consideration.

Although change detection is open source and can also be deployed on a cloud server, a custom-programmed web scraper may provide more precise and efficient data collection. Change detection can monitor an unlimited number of websites, but the selection of the CSS data scraped relies on the integrated Playwright application. Playwright’s visual filter isolates CSS elements on the websites, improving the accuracy of the scraping process. Nevertheless, a tailored solution could further refine this process, thereby enhancing the quality of the input data for the deep neural network. Since the quality and volume of input data are defining factors in the training of a neural network, a tailored data collection solution could directly improve the performance of the country risk assessment model.

## 5. NEW AND NOVEL SCIENTIFIC FINDINGS

The thesis explored the potential of open-source intelligence data gathering, the application of neural networks, and the feasibility of creating a universally applicable country risk model for multinational corporations. The findings are novel, given that the collected data, the timeframe for collection, and the countries examined are unique. Additionally, the results indicate promising avenues for further research in the realm of open-source intelligence analysis and the future utilization of artificial intelligence. Expanding the databases developed for this research, especially with additional funding, could enable a more significant data collection effort.

1. This research demonstrates that average manual efforts cannot achieve the automated collection of open-source data to the same extent. The use of website monitoring software, such as Changedetection, in conjunction with external servers equipped with MySQL databases, allows for the collection of data from hundreds to thousands of websites daily, aided by the Python script developed for this research. The database established in the thesis contains over 44,000 data entries for just five countries. Through API calls, non-English data was sent to OpenAI for translation, and the translated data was subsequently uploaded automatically via API to the MySQL database. Establishing a truly universal open-source intelligence process serves as a foundation for future data collection in country research.
2. Moreover, given the extensive prior research in the field of country risk, this study demonstrated that by augmenting variables and consolidating them into seven comprehensive categories, the future of country risk analysis and artificial intelligence can shift from seeking perfect correlations and regressions between variables to focusing on the most effective analysis of the data derived from these variables.
3. Neural networks can evaluate OSINT data in relation to country risk. By employing sentiment analysis based on tokenization through the TensorFlow library, the neural network can predict positive or negative trends for the country risk data. The neural network has the capability to analyze either the entire country or specific variables pertinent to that country. The predictions generated by the neural network are statistically significant.

## 6. LIST OF PUBLICATIONS

Marquering, A., & Gál, V. (2025). A diplomatic incident: The political risk of corporate diplomacy and the implementation of corporate diplomacy strategy concepts within scrutinized industries. *Regional and Business Studies*, 17(1), 55–69.

Marquering, A., & Gál, V. (2024). The writing on the wall: Implementing daily wheat prices into a country risk model. In C. J. Kovács, P. Földi, & P. Viktor (Eds.), *X. Winter Conference of Economics PhD Students and Researchers: Book of Abstracts* (p. 19). Association of Hungarian PhD and DLA Students.

Marquering, A., & Gál, V. (2024). The writing on the wall: Implementing daily wheat prices into a country risk model. In P. Földi, C. J. Kovács, A. Szeberényi, & P. Viktor (Eds.), *X. Winter Conference of Economics PhD Students and Researchers: Conference proceedings* (pp. 135–145). Association of Hungarian PhD and DLA Candidates.

Marquering, A., & Gál, V. (2024). The moral dimension: The global political risks for small international oil companies. *International Research Journal of Modernization in Engineering Technology and Science*, 6(8), 449–459. DOI: <https://doi.org/10.56726/IRJMETS60831>

Marquering, A. (2024). The key: Timing as the key to successfully applied corporate diplomacy. *International Research Journal of Modernization in Engineering Technology and Science*, 6(6), 4583–4588. DOI: <https://www.doi.org/10.56726/IRJMETS59784>

Marquering, A. (2021). The United Nations new international economic order and the connected risks for multinational corporations in emerging markets. In B. Nagy et al. (Eds.), *15th International Conference on Economics and Business: Challenges in the Carpathian Basin: Global challenges – local answers: Interdependencies or globalisation?* (pp. 934–948). Editura Risoprint. ISBN: 978-973-53-2752-1