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Key Risk Factors Influencing Foreign Direct Investment (FDI) in Zimbabwe's Agricultural Sector

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Abstract: This study explores the key risk factors influencing foreign direct investment (FDI) in Zimbabwe's agricultural sector. As a fundamental component of Zimbabwe's economy, agriculture encounters numerous challenges that restrict FDI inflows. The research examines ten critical factors: crop production, climate change, consumer prices, government efficiency, exchange rate fluctuations, fertilizer supply by type and nutrient content, land utilization, GDP deflators, and pesticide use. These elements are analyzed within broader themes, including land ownership and tenure security, political stability, economic volatility and currency issues, infrastructure limitations, legal and regulatory conditions, social and cultural dynamics, and environmental factors. By assessing how these risks either deter or attract FDI, the study offers valuable insights for policymakers, investors, and stakeholders to mitigate challenges and foster a conducive environment for sustainable investment in Zimbabwe's agriculture.

Keywords: FDI in Agriculture, key risk factors, Zimbabwe.

1. Introduction

Zimbabwe lies in the Southern part of Africa, with an economy driven by agriculture, mining, and power generation, having agriculture as the outstanding industry. Mining attracts significant foreign investment, particularly in lithium projects like the $310 million Sandawana mine (Reuters, 2024). Meanwhile, power generation is set to grow by 10.6% in 2025, supported by the Hwange Thermal Power Station and renewable energy projects (Xinhua, 2024). However, agriculture remains the backbone of the economy, contributing to employment, food security, and exports (FAO, 2003). Agriculture's leading role in the economy inspired this research to focus on the risks affecting foreign direct investment in the sector. Agriculture involves the cultivation of soil, crop production, and the raising of livestock for food, fiber, and other essential products that sustain human life (FAO, 2003). It is a fundamental pillar of Zimbabwe's economy, playing a crucial role in employment, food security, and export revenues. Despite its significance, the agricultural sector faces difficulties in attracting foreign direct investment (FDI), which is essential for promoting sustainable growth and modernization. FDI refers to cross-border capital investments made by foreign entities to establish or expand business operations in another country (OECD, 2008). In agriculture, FDI has the potential to introduce technological innovations, enhance infrastructure, and facilitate access to global markets. However, various risk factors continue to discourage investors from engaging in Zimbabwe's agricultural industry. These risks fall into broader categories, including land ownership and tenure security, political stability, economic uncertainty, inadequate infrastructure, legal and regulatory challenges, social and cultural dynamics, and environmental concerns. For example, land ownership remains a contentious issue in Zimbabwe due to past land reforms and ongoing tenure insecurity, which hinder long-term investment prospects (Richardson, 2004). Additionally, political instability and economic challenges, such as exchange rate fluctuations and high inflation, further complicate efforts to establish a stable and attractive investment environment (Makochekanwa, 2020).

The media such as newswire.zw, news papers and magazines recognized risk factors that are placed under the 8 categories as political, environmental, economical, production, institutional, social and technological risks. With the use of these relavant categories, some examples are climate change, drought, floods, pests, and diseases, soil degradation and nutrient depletion, lack of water supply, volatility in currency and prices, GDP deflators and fluctuating exchange-rates, Soil degradation, fertilizer and pesticide inefficiency, lack of technology, dependency on rain-fed systems, poor access to credit and infrastructure, Government policies, land tenure issues, lack of support systems, Labor shortages, migration, gender inequities, population growth, Lack of innovation in R&D outdated/inefficient farming practices limited access to technology. However, the FDI environment in Zimbabwe's agriculture is complex and, various risks that are most relevant according to the aim of the topic were selected to be considered in the research with the help of the theories as well. This study later focuses on selected specific variables/factors based on the data collected from the years 2013-2022.

By examining these factors and their interplay within the context of Zimbabwe, this research aims to identify critical barriers to FDI in agriculture and provide actionable recommendations for addressing them. The findings will contribute to broader discussions on creating an enabling environment for sustainable agricultural investments in developing economies.

2. Literature Review

In many literature searches, more and more researchers that are examining the risk factors affecting foreign companies investing directly and indirectly in the various sectors of host countries. The most comprehensive study to date on the determinants of FDI in various sectors risks is by Neil M. Kellard, Alexandros Kontonikas, Michael J. Lamla, Stefano Maiani and Geoffrey Wood (Risk, Financial Stability and FDI). They emphasize on the fact that all Foreign Direct Investment (FDI) involves risk. They quoted that over the past

decade, Foreign Direct Investment (FDI) stock has grown markedly, rising almost 65% at a global level. This led to an increasing awareness on behalf of policy-makers as to its role as a source of economic growth. For example, they say in 2016, FDI accounted for 35% of global GDP (Carril-Caccia & Pavlova, 2018; Neto & Veiga, 2013). In the aftermath of the Global Financial Crisis (GFC), worries about fiscal sustainability in the EA intensified (Merler and Pisani-Ferry, 2012; Arghyrou & Kontonikas, 2012; Bernoth & Erdogan, 2012; Afonso et al., 2014, 2018) as risks in the banking sector fed back to the sovereign position and vice versa, generating a detrimental cycle (De Bruyckere et al., 2013; Acharya et al., 2014; Delatte et al., 2017). As a result, in the run-up of the sovereign debt crisis, the EA experienced significant capital outflows.

Some researchers have identified factors that may influence a farming field's decision to invest in one country over another. Generally, the risk factors for investment in the farming sector can be divided into the following principal categories: geological, political, regulatory, marketing, fiscal, monetary, environmental and social, operational, and profit (Ruicheng Yanga, Weize Xinga, Shuxia Houb,). Some researchers, such as Kasatuka and Minnitt (2006), add another category. They divide the risk factors into commercial and non-commercial and provide a detailed list of non-commercial risks, which includes government instability, poor socio-economic conditions, conflict, corruption, political terrorism, civil war, quality of bureaucracy, racial and nationality tensions, and religious tensions. In recent years, some researchers consider the policy makers of a host country as a risk factor for that particular country's farming sector. (Andre Jungmittag1,2 | Robert Marschinski1, Nov 2022) For policy-makers FDI is desirable as an additional source of capital and by means of knowledge transfers and spill-overs also for productivity gains. Some say that the capacity to attract foreign direct investment (FDI) is generally seen as one dimension of a country's economic competitiveness and in addition to consider typical financial, operational, and geological factors. //(Farok J. Contractor, N. Nuruzzaman b, Ramesh Dangol c, S. Raghunath d, 2021) also give an explanatory to how country regulatory factors are influencing FDI Inflows to emerging market meaning that there are many risks found in the process of FDI inflows. They further discuss whether and how country-level regulations and institutions influence the choice made by multinational corporations (MNCs) in choosing between countries as investment destinations, and which regulatory changes (statistically) have the strongest effect on incoming FDI. (Farok J. Contractora,*, Ramesh Dangolb, N. Nuruzzamana, S. Raghunathc) goes on to try to answer why some countries receive more Foreign Direct Investment, or FDI, than others, making it a crucial question.

However, on another note literature focusing only on the risk factors of FDI in the Zimbabwean farming sector is scarce. As far as I know, there are a few researchers that have close to a bit in line about FDI inflows risks and regulations, industry development and related problems over various sectors in various countries. These risk factors include political risk, the country's farming policies, corruption, professional workers, and the equipment management system, and so forth. There are no studies or comprehensive studies directly evaluating the importance of the investment risks that tried to analyse the risk factors that affect FDI in the farming sector of Zimbabwe. Therefore, using the complex network approach, this paper assesses and ranks each risk factor for foreign investment in Zimbabwe's farming sector. Hopefully, the results will help the Zimbabwean authorities in coming up with comprehensive measures to minimise the adversity of these risks and ultimately attract foreign direct investment.

3. Methodology

3.1. Research approach and design

This study explores the key risk factors influencing foreign direct investment (FDI) in Zimbabwe's agricultural sector for future investors. To enhance the research, a detailed quantitative method will be used, incorporating a complex network approach to assess risk factors even with a limited sample size. By analyzing this development, this method can effectively identify intrinsic relationships between risks and determine their significance. A complex network approach will be apploied to calculate and classify the importance of each risk factor.

3.2. Building a complex network

Analytical framework using the mathematical formulas

Step 1: Designing the complex network.

We denote a complex network as where $G = (V, E, W, A)$

- $V = \{v1, v2, \ldots vn\}$...rep risk factors
- $E = \{(v_i, v_j)\} \subseteq V \otimes V$ rep set of edges between risk factors

A $= (a_{ij})$ denotes the adjacency matrix, rep if edge exists between risk factors v_i and v_j .

a_{ij} = 1 represents an edge whereas a_{ij} = 0 represents no edge, which is decided by

$$a_{ij} = \begin{cases} 1 \text{ if } \rho_{ij} \ 0.50 \\ 0 \text{ if otherwise} \end{cases} \quad (1)$$

W = (w_{ij} denotes the weight matrix, rep the edge weight that represents the interactive distance between
risk factors v_i and v_j which is decided by

$$w_{ij} = \begin{cases} 1/|\rho_{ij}| \text{ if node } v_i \text{ and } v_j \text{ are connected,} \\ 0 \text{ if otherwise} \end{cases} \quad (2)$$

where ρij is the correlation coefficient between nodes v_i and v_j which can be calculated from evolution data of all of the risk factors. The smaller $w_{ij}$is (i.e., the larger the $\rho_{ij}$is), the more significant the interaction between nodes v_i and v_j

To design the complex network is to define the system and in this case will make it into a Venn graph represented by *G={V,E,A,W}* to make it more clear and easy to understand.

Where *V*: In this step key variables are risk factors such as climate change, crops etc.

E: This step it represents the edge between the risk factors.

A: This represent an adjacency matrix which denotes if an edge exist between the nodes, in which if two risk factors relationship is 0 it means there is no edge existing between them and if 1 then otherwise.

W: This denotes the weight matrix which rep the interactive distance between the nodes, by calculating the coefficient correlation between the nodes then calculate the weight of each node to define the strength of each node in a period of time.

Step 2: Calculating node efficiency

The efficiency I_i of node v_i is defined as $\boldsymbol{I_i = \frac{1}{n-1} \sum_{j=1, j\neq 1}^{n} \frac{1}{d_{ij}}}$, (3)

where n is the number of nodes in the network, and dij is the distance from node v_i to node v_j.

Step 3: Calculating the degree of a node

The degree of node v_i represents its ability to affect adjacent nodes and reflects its local importance.The degree of node v_i is the sum of the weights of the edges that connect with it, that is $\boldsymbol{D_i \sum_{j=1,\ j\neq i}^{n} w_{ij}}$ (4)

Step 4: Calculating node importance value

The node importance value shows the importance of each risk factor. C_i denotes the importance value of node v_i, and it can be calculated by

$$\boldsymbol{C_i = I_i \times \sum_{j=1, j\neq 1}^{n} \frac{w_{ij} D_j I_j}{\bar{D}^2}}, \quad \text{where } \boldsymbol{\bar{D} = \frac{1}{n} \sum_{i=1}^{n} D_i} \quad (5)$$

Step 5: Ranking and classifying the risk factors

If the importance value is over 0.50, shows much risk and if below 0.50 is otherwise. Inorder to get these results we classify the risk factors into N different risk levels according to the following rules:

The interval of the first risk level: $(C^{max}\text{-d}, C^{max}]$ **(6)**

The interval of the second risk level: $(C^{max}\text{-2d}, C^{max}\text{- d}]$ **(7)**

The interval of the N risk level: $(C^{min}, C^{min}\text{+ d}]$ **(8)**

where $C^{min}=\min\{C_1, C_2 \ldots, C_n\}$, $C^{max}=\min\{C_1, C_2 \ldots, C_n\}$, $d = \frac{C^{max}-C^{min}}{N}$

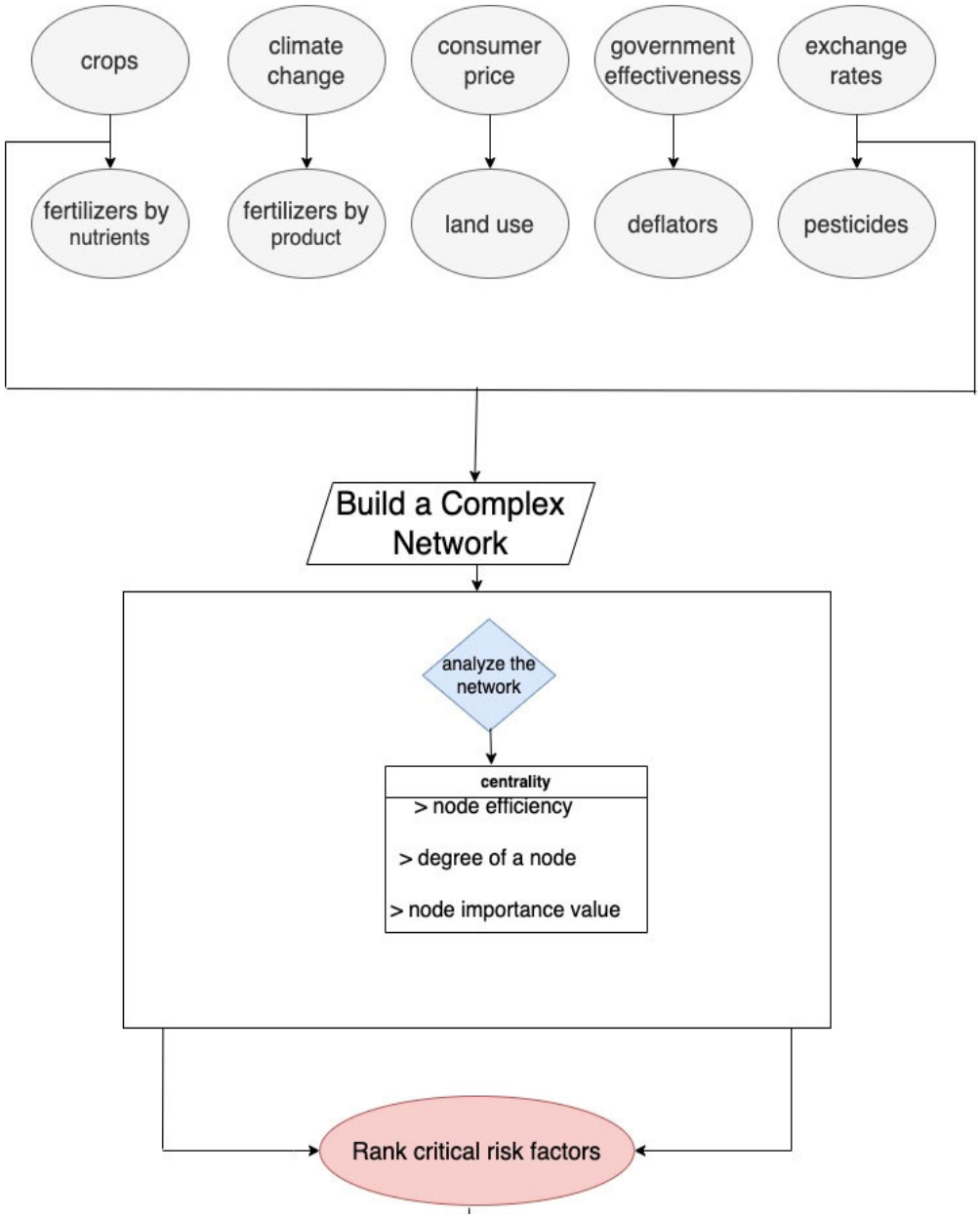

Figure 1. Illustration of the research design

3.3. Data Collection of the risk factors

The research utilizes an authoritative source for agricultural data collection, the Food and Agriculture Organization (FAO) of the United Nations. This study will focuses on the period from 2013 to 2022, as data for most of the variables is available up until 2022. Firstly, about 27 identified risks from media such as news papers and magazines are placed under the 6 categories, and theories later help identify the most relevant risk factor examples. These identified risks are summarized in the table below. Below is a diagram with the details.

Risk factors Categories

Risk Factor Category	Examples of risk factors	Explanation
Environmental Risks	Climate change, drought, floods, pests, and diseases, soil degradation and nutrient depletion, lak of water supply	Directly affect crop yields and livestock health. Most agricultural output heavily depends on favorable climate.
Economical Risks	Fluctuations in commodity prices, exchange rates volatility, or demand, Limited access to credit, high input costs, inflation	Affect profitability and predictability of income. In most cases volatility in currency and prices is a major concern. GDP deflators and fluctuating exchangerates significantly increase agricultural costs.
Production Risks	Soil degradation, fertilizer and pesticide inefficiency, lack of technology, dependancy on rainfed systems, poor acess to credit and infractructure	Directly influence productivity. The availability of key inputs like potash, phosphate, and nutrients plays a role.
Institutional Risks	Government policies, land tenure issues, lack of support systems	Challenges like government effectiveness and land-use policy heavily impact the agriculture sector.
Social Risks	Labor shortages, migration, gender inequities, population growth	Influence the workforce and decision-making processes in agricultural systems.
Technological Risks	Lack of innovation in R&D outdated/inefficient farming practices limited access to technology	Results in inefficiency and lower yields. Nutrient and fertilizer mismanagement compounds this risk.

Theories in support of relevant risk factors

Later on, relevant risks to agriculture FDI in Zimbabwe are later selected according to 7 theories such as institutional theory, Risk-Return Tradeoff Theory, Macroeconomic Stability Theory, Resource-Based View (RBV), Land Tenure Theory, Sustainability and FDI Theory and Currency Risk Theory.

Theory	risk factors	Source & Explanation
Institutional	Government effectiveness, land reforms, unclear land tenure, lack of institutional support	Source: World Bank (2022). Foreign Investment in Sub-Saharan Agriculture: Barriers and Opportunities. -Weak governance and inconsistent land policies deter investors.
Risk-Return Tradeoff	Climate variability, inflation, exchange rate volatility.	source: FAO (2023). Climate Change and Agriculture in Zimbabwe. High risks from climate and economic instability reduce expected returns, discouraging investment.
Macroeconomic Stability	GDP deflators, inflation, exchange rate volatility, Limited access to credit, high input costs	Source: IMF (2022). Macroeconomic Stability and Investment in Emerging Economies. -Unpredictable returns directly impact investment decisions negatively.
Resource-Based View (RBV)	Fertilizer availability, pesticide efficiency, nutrient deficiencies (e.g., potash, phosphate).	Source: World Bank (2022). Foreign Investment in Sub-Saharan Agriculture: Barriers and Opportunities. Lack of key resources to improving agricultural output degrades productivity, adding more production risks and reduces attraction of potential investors.
Land Tenure	Land reforms, unclear ownership rights.	Source: UNDP (2023). Land Tenure and Agricultural Productivity in Zimbabwe. Land reforms and unclear ownership create uncertainty for

		FDI in agriculture
Sustainability and FDI	Soil degradation, climate change resilience, dependency on traditional practices.	Source: World Bank (2022). Foreign Investment in Sub-Saharan Agriculture: Barriers and Opportunities. unsustainable practices and unenvironmentally ensure short-term productivity conscious investors.
Currency Risk	Fluctuations in commodity prices, exchange rates volatility, or demand, Limited access to credit, high input costs, inflation	Source: RBZ (2023). Exchange Rate Dynamics and Their Impact on FDI in Zimbabwe. Currency instability discourages international investors from committing to long-term projects.

4. Results and Discussion

Table 1. Descriptive statistics for the risk factors

Descriptive Statistics

Risk factors	Minimum	Maximum	Mean	Std. Deviation
R1D	99.396	122.465	107.08920	7.612762
R2Cr1	5460.2	5491.7	5471.910	10.0741
R2Cr2	272.1	794.1	516.860	159.7820
R2Cr3	2308.1	2412.6	2366.490	26.8721
R2Cr4	124.4	466.7	288.090	115.7801
R2Cr5	440.5	1534.4	1043.490	399.1593
R2Cr6	190.7	697.2	435.530	183.9216
R2Cr7	695.4	1868.0	1347.880	368.1993
R3ER	51.329	374.954	284.18622	125.186168
R4P	2185.07	2550.07	2221.5700	115.42313
R5C	-.319	1.271	.51530	.522069
R6L	287.00	356.92	317.9720	24.70874
R7GE	-1.342	-1.250	-1.28690	.029145
R8CP	96.761	7500.209	1242.95766	2459.476243
R9N1	39300	65000	48560.00	8636.898
R9N2	23000	47900	40570.00	8404.503
R9N3	13000	40000	24690.00	10712.241
R10FP1	19882.72	125585.16	58175.9350	33923.73040
R10FP2	2159.27	24866.23	9380.3090	8375.58479
R10FP3	1770.70	83916.27	17764.7320	24586.81807
R10FP4	4051.52	48211.96	20008.7920	14892.40054
R10FP5	.00	4549.51	1309.5740	1628.31056
R10FP6	15067.33	99669.77	36063.2840	25226.88920
R10FP7	.00	36.64	8.4140	13.97681
R10FP8	4148.74	27993.38	13590.6350	7685.21296

4.1. Correlation analysis

This table below shows correlation coefficient $/\rho_{ij/}$ is a measure of the linear relationship between two nodes. After calculating the correlation for all pairs of nodes ie. risk factors, the result is organized into a symmetric matrix where each element represents correlation between risk factors i and j.

Table 2. below shows correlation coefficient $/\rho_{ij/}$ matrix of the risk factors.

correlation

	R1D	R2Cr1	R2Cr2	R2Cr3	R2Cr4	R2Cr5	R2Cr6	R2Cr7	R3ER	R4P	R5C	R6L	R7GE	R8CP	R9N1	R9N2	R9N3
R1D	1	0.2027	0.347	-0.0228	0.4903	0.7213	0.6227	0.2737	-0.4168	-0.3435	-0.454	0.8882	-0.0118	0.4592	-0.5583	0.7816	-0.1284
R2Cr1	0.2027	1	-0.2377	-0.1824	-0.2746	-0.0585	-0.0211	-0.2202	-0.0301	0.6902	-0.3802	0.4366	-0.034	0.1442	-0.4911	-0.0858	-0.7417
R2Cr2	0.347	-0.2377	1	-0.3317	0.6744	0.764	0.8015	0.9419	-0.3107	-0.1699	-0.4198	0.5075	-0.2977	0.4161	-0.2371	0.4495	-0.018
R2Cr3	-0.0228	-0.1824	-0.3317	1	-0.0839	-0.1027	-0.2815	-0.5234	0.2897	-0.1777	0.4949	-0.1241	0.3456	-0.2841	0.2888	-0.0631	0.5361
R2Cr4	0.4903	-0.2746	0.6744	-0.0839	1	0.8992	0.6584	0.6199	-0.3152	-0.3107	-0.6	0.4864	-0.1571	0.5206	0.0036	0.5673	0.1845
R2Cr5	0.7213	-0.0585	0.764	-0.1027	0.8992	1	0.7871	0.6668	-0.311	-0.2628	-0.681	0.7362	-0.1533	0.4562	-0.2688	0.6656	0.0183
R2Cr6	0.6227	-0.0211	0.8015	-0.2815	0.6584	0.7871	1	0.6894	-0.605	-0.2463	-0.455	0.7215	-0.4312	0.6436	-0.6005	0.633	-0.2045
R2Cr7	0.2737	-0.2202	0.9419	-0.5234	0.6199	0.6668	0.6894	1	-0.281	-0.0321	-0.4752	0.4496	-0.3607	0.3721	-0.0922	0.4863	0.0072
R3ER	-0.4168	-0.0301	-0.3107	0.2897	-0.3152	-0.311	-0.605	-0.281	1	0.2182	-0.0243	-0.4616	0.7024	-0.8323	0.5124	-0.5575	0.1685
R4P	-0.3435	0.6902	-0.1699	-0.1777	-0.3107	-0.2628	-0.2463	-0.0321	0.2182	1	-0.221	0.0226	-0.2544	-0.1623	0.1318	-0.212	-0.3113
R5C	-0.454	-0.3802	-0.4198	0.4949	-0.6	-0.681	-0.455	-0.4752	-0.0243	-0.221	1	-0.5418	0.0098	-0.2238	0.2274	-0.2935	0.4049
R6L	0.8882	0.4366	0.5075	-0.1241	0.4864	0.7362	0.7215	0.4496	-0.4616	0.0226	-0.5418	1	-0.1867	0.5832	-0.6115	0.7393	-0.3031
R7GE	-0.0118	-0.034	-0.2977	0.3456	-0.1571	-0.1533	-0.4312	-0.3607	0.7024	-0.2544	0.0098	-0.1867	1	-0.3629	0.1167	-0.4433	-0.0447
R8CP	0.4592	0.1442	0.4161	-0.2841	0.5206	0.4562	0.6436	0.3721	-0.8323	-0.1623	-0.2238	0.5832	-0.3629	1	-0.5289	0.4449	-0.3484
R9N1	-0.5583	-0.4911	-0.2371	0.2888	0.0036	-0.2688	-0.6005	-0.0922	0.5124	0.1318	0.2274	-0.6115	0.1167	-0.5289	1	-0.1739	0.7529
R9N2	0.7816	-0.0858	0.4495	-0.0631	0.5673	0.6656	0.633	0.4863	-0.5575	-0.212	-0.2935	0.7393	-0.4433	0.4449	-0.1739	1	0.2874
R9N3	-0.1284	-0.7417	-0.018	0.5361	0.1845	0.0183	-0.2045	0.0072	0.1685	-0.3113	0.4049	-0.3031	-0.0447	-0.3484	0.7529	0.2874	1

Matrix based-network analysis

Table 3. shows Adjacency matrix A= (a_{ij}) of the complex network.

adjacency

	R1D	R2Cr1	R2Cr2	R2Cr3	R2Cr4	R2Cr5	R2Cr6	R2Cr7	R3ER	R4P	R5C	R6L	R7GE	R8CP	R9N1	R9N2	R9N3
R1D	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
R2Cr1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R2Cr2	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
R2Cr3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R2Cr4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
R2Cr5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
R2Cr6	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R2Cr7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R3ER	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
R4P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R5C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R6L	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R7GE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R8CP	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
R9N1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R9N2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R9N3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Weighted network analysis

Table 4. shows weight matrix W=(w_{ij}) of the complex network edges.

weight matrix

	R1D	R2Cr1	R2Cr2	R2Cr3	R2Cr4	R2Cr5	R2Cr6	R2Cr7	R3ER	R4P	R5C	R6L	R7GE	R8CP	R9N1	R9N2	R9N3
R1D	0	0.6013	0.6735	0.4886	0.7452	0.8606	0.8113	0.6369	0.2916	0.3283	0.273	0.9441	0.4941	0.7296	0.2209	0.8908	0.4358
R2Cr1	0.6013	0	0.3812	0.4088	0.3627	0.4707	0.4895	0.3899	0.4849	0.8451	0.3099	0.7183	0.483	0.5721	0.2545	0.4571	0.1291
R2Cr2	0.6735	0.3812	0	0.3342	0.8372	0.882	0.9007	0.9709	0.3446	0.4151	0.2901	0.7538	0.3512	0.7081	0.3814	0.7248	0.491
R2Cr3	0.4886	0.4088	0.3342	0	0.4581	0.4486	0.3593	0.2383	0.6448	0.4112	0.7474	0.4379	0.6728	0.3579	0.6444	0.4685	0.7681
R2Cr4	0.7452	0.3627	0.8372	0.4581	0	0.9496	0.8292	0.8099	0.3424	0.3446	0.2	0.7432	0.4215	0.7603	0.5018	0.7836	0.5922
R2Cr5	0.8606	0.4707	0.882	0.4486	0.9496	0	0.8935	0.8334	0.3445	0.3686	0.1595	0.8681	0.4233	0.7281	0.3656	0.8328	0.5091
R2Cr6	0.8113	0.4895	0.9007	0.3593	0.8292	0.8935	0	0.8447	0.1975	0.3768	0.2725	0.8608	0.2844	0.8218	0.1998	0.8165	0.3978
R2Cr7	0.6369	0.3899	0.9709	0.2383	0.8099	0.8334	0.8447	0	0.3595	0.4839	0.2624	0.7248	0.3197	0.686	0.4539	0.7431	0.5036
R3ER	0.2916	0.4849	0.3446	0.6448	0.3424	0.3445	0.1975	0.3595	0	0.6091	0.4879	0.2692	0.8512	0.0839	0.7562	0.2212	0.5842
R4P	0.3283	0.8451	0.4151	0.4112	0.3446	0.3686	0.3768	0.4839	0.6091	0	0.3895	0.5113	0.3728	0.4188	0.5659	0.394	0.3444
R5C	0.273	0.3099	0.2901	0.7474	0.2	0.1595	0.2725	0.2624	0.4879	0.3895	0	0.2291	0.5049	0.3881	0.6137	0.3533	0.7024
R6L	0.9441	0.7183	0.7538	0.4379	0.7432	0.8681	0.8608	0.7248	0.2692	0.5113	0.2291	0	0.4066	0.7916	0.1943	0.8696	0.3485
R7GE	0.4941	0.483	0.3512	0.6728	0.4215	0.4233	0.2844	0.3197	0.8512	0.3728	0.5049	0.4066	0	0.3186	0.5584	0.2783	0.4777
R8CP	0.7296	0.5721	0.7081	0.3579	0.7603	0.7281	0.8218	0.686	0.0839	0.4188	0.3881	0.7916	0.3186	0	0.2356	0.7224	0.3258
R9N1	0.2209	0.2545	0.3814	0.6444	0.5018	0.3656	0.1998	0.4539	0.7562	0.5659	0.6137	0.1943	0.5584	0.2356	0	0.413	0.8764
R9N2	0.8908	0.4571	0.7248	0.4685	0.7836	0.8328	0.8165	0.7431	0.2212	0.394	0.3533	0.8696	0.2783	0.7224	0.413	0	0.6437
R9N3	0.4358	0.1291	0.491	0.7681	0.5922	0.5091	0.3978	0.5036	0.5842	0.3444	0.7024	0.3485	0.4777	0.3258	0.8764	0.6437	0

Importance value and risk-level ranking and classification

Table 5. shows the importance value and risk-level ranking and classification

Rank	Risk factor	Importance value	Risk level
1	R2Cr5	0.9742	High
2	R2Cr4	0.9565	High
3	R2Cr1	0.9441	High
4	R2Cr2	0.9380	High
5	R2Cr3	0.9195	Medium
6	R4P	0.9104	Medium
7	R7GE	0.8919	Medium
8	R8CP	0.8832	Medium
9	R9N3	0.8681	Medium
10	R9N2	0.8577	Medium
11	R9N1	0.8446	Medium
12	R1D	0.8193	Low
13	R2Cr6	0.8104	Low
14	R2Cr7	0.8030	Low
15	R5C	0.7816	Low
16	R6L	0.7612	Low
17	R3ER	0.7352	Low

The node importance value is an indicator of each risk factors' importance in the network. From Formula 3.2, we derive the importance values of the risk factors and rank them according to their respective values as follows:

Table 5 shows the rank, importance value, and risk-level classification of each risk factor, in which the risk factors are divided into three levels according to Formula ((6))–(8). Here, N = 3, d=0.0797, and the three levels are divided as follows: the interval of the Highest level is (0.915,0.9742), the interval of the medium level is (0.8446.0.0.9195), and the interval of the low level is (0.7352,0.8446). The results are also presented in Table 5 and below is a more detailed discussion.

4.2. Quantitative Risk assessment results analysis

First (High) risk-level

In table5, we can see that the risk factors of FDI of Zimbabwe's agriculture are divided into three levels according to importance values. Illustration 3 shows a complex network diagram, the red dotted highlevel risks are connected not only to the eight second-level nodes but also to some third-level nodes. Their oscillation will cause changes

in many other nodes in the network making them most critical risks. The first-level risks are titled High, which are:

R2C5(Crop5-Maize corn)

Maize corn's importance value is 0.9742 giving it also top priority among the risks making it a critical risk as maize is Zimbabwe's staple crop, forming the basis of the national diet. However, recurrent droughts, like those during the El Niño phenomenon, severely affect maize yields. In 2019, Zimbabwe faced a maize deficit of nearly 800,000 tons, leading to increased imports and skyrocketing prices. Foreign investors must focus on climate-resilient maize varieties and irrigation systems to mitigate risks and secure returns.

R2C4(Crop4-millet)

Importance value is 0.9565 still making it as a top priority among the risks making it a critical risks. Millet is a climate-resilient crop that thrives in semi-arid regions of Zimbabwe, making it crucial for drought-prone areas. It also plays a role in food security for low-income households. For instance some NGOs such as FAO have promoted millet farming as a sustainable food security solution. Investors targeting millet cultivation should contribute more to climate-smart agriculture, so as to reducing risks of crop failure as millet is past of the most critical risk factors.

R2C1(Crop1-barley)

The importance value is 0.9441.The fact that it's value still range in the same as the first three while in the high risk level makes it part of the most critical risks factor that investors should pay attention to. Barley is primarily grown for brewing and serves as a cash crop. Its profitability makes it a key interest for foreign agribusiness investors. However, water shortages can hinder barley production. Delta Beverages, Zimbabwe's largest beverage company, sources barley locally for beer production. Any disruptions in barley supply directly affect production costs and profits. FDI in barley farming requires investments in irrigation infrastructure to ensure consistent yields so investors should pay more details in this crop incase of investment.

R21C2(Crop2-beans dry)

Importance value is 0.9380, making the value still in the same range as the first four while in the high risk level makes it part of the most critical risks. Beans are a critical protein source in Zimbabwe and serve both domestic and export markets. In missions and boarding schools and hospitals, beans is the most eaten food as it is rich in protein and easily accessible. However, pest infestations like bean weevils have threatened yields. Farmers in the eastern highlands have reported significant post-harvest losses due to poor storage facilities. Investors must consider pest management technologies and storage solutions to secure their returns while investing in Zimbawe's agriculture.

Second (Medium) risk level

The second-level risks are titled medium. These factors are located in the center of the network and are connected to most of the other nodes. This indicates that the second-level risk factors have an important influence on overall investment risk because they have most of the high important values posing huge threat. These include:

R2C3(Crop3-greencorn)

It's importance value is 0.9195. Being the first in the medium risk level makes is more critical as it is linked to the high risks too. Green corn is consumed fresh and exported to regional markets. However, its production is limited to irrigated areas, making it vulnerable to water scarcity. The Tokwe-Mukosi dam irrigation project increased green corn production in the Masvingo region. Expanding irrigation infrastructure offers opportunities for investors in high-value crops.

R4(Pesticides)

Themportance value is 0.9104, Pesticides are critical for controlling pests like fall armyworms, which devastate maize and other crops and this makes them more critical as they are linked to the high risks too. The fall armyworm outbreak in 2017 led to crop losses worth millions, emphasizing the importance of pesticide availability. More FDI in pesticide production or distribution can stabilize the agricultural sector.

R7(Government effectiveness)

Importance value is 0.8919. Although the value is decreasing, It is still recorded as a medium risk at the center of other making it even more influential. Zimbabwe's agricultural policies, including subsidies and land reforms, influence investor confidence. Corruption and red tape reduce efficiency. The Command Agriculture program improved maize production but faced allegations of mismanagement. The project plan of foreign investors would be inconsistent with the regulatory framework if government policies and regulations changed suddenly. This might lead to the failure of ongoing projects and bring huge losses to the investors. In the last 10 years, Zimbabwe has revised its laws related to agriculture development more than 10 times. For example, in 2012, Zimbabwe introduced laws to define the agriculture industry as an important strategic area, raising the entry threshold for foreign investment and strengthening supervision of it. The relevant provisions were incorporated into the new investment law. This aggravates the investment risk for foreign companies in Zimbabwe's agriculture. Transparent policies and efficient governance are essential for sustaining FDI.

R8(Consumer Price)

The importance value is 0.8832. Although the value is decreasing, It is still recorded as a medium risk at the center of others making it even more influential. Consumer price inflation in Zimbabwe directly affects the affordability of agricultural products, impacting both domestic and export markets. High inflation erodes purchasing power, which can lead to reduced demand for high-value crops and inputs. In 2022, Zimbabwe recorded one of the highest inflation rates in the world, making basic agricultural inputs unaffordable for most smallholder farmers. This, in turn, reduced crop productivity and hurt both local and foreign investors. For FDI, consumer price instability poses a risk to demand predictability and profit margins. Investors should monitor inflation trends and consider investing in subsidies or credit schemes for farmers to stabilize production and demand.

R9N3(Nutrient3-Potash K20 total)

The importance value is 0.8681. It is recorded as a medium risk at the center of others making it even more risk influential. Potash (K_2O) is an essential nutrient for crop growth, particularly for improving yields in crops like maize and soybeans. However, Zimbabwe relies heavily on imported potash, making it vulnerable to global supply chain disruptions. During the 2022 global fertilizer crisis, Zimbabwe faced a severe shortage of potash, leading to decreased yields and increased costs for farmers. FDI in potash production, whether through local mining or alternative sources like ash-derived potash, would enhance agricultural productivity and reduce reliance on imports.

R9N2(Nutrient 2-Phosphate P205 total)

The importance value being 0.8577 but recorded as a

medium risk at the center of others makes it even more crucial as it connects and influence the first and third risks. Phosphate (P_2O_5) is critical for root development and early plant growth. Zimbabwe's phosphate needs are met through imports, exposing the sector to price volatility and availability risks. Dorowa Mine in Zimbabwe produces phosphate rock but has limited capacity to meet national demand, leading to high dependence on imports.

Implication: For investors, expanding local phosphate production or introducing advanced technologies for better nutrient use efficiency can help stabilize agricultural input supply chains.

R9N1(Nutrient1-Nitrogen N total)

The first nutrients importance value is 0.8446. Nitrogen is the most essential nutrient for plant growth, and urea-based fertilizers dominate the market. However, production and import challenges often lead to shortages, reducing crop yields. In 2021, nitrogen fertilizer yields shortages caused a decline in maize productivity, pushing Zimbabwe to import more maize to meet domestic demand.FDI in nitrogen fertilizer production plants or alternative nitrogen delivery systems (e.g., controlled-release fertilizers) can reduce the country's dependency on imports and ensure sustainable agricultural productivity.

Third level risk factors (Low)

Compared with High-level and Medium -level risk factors, Low-level risk factors are less important, so we do not interpret them in detail. In a nutshell, to avoid or reduce the investment loss in Zimbabwe's Agriculture, foreign companies should emphasize High- and Medium-level risk factors, while paying attention to the Low-level risk factorsas well.

5. Conclusion

5.1. Summary of conclusion

This study serves as a foundation for my graduation thesis, where I will develop, refine these findings and I will further explore and expand the critical risk factors affecting FDI in Zimbabwe's agriculture. This paper investigates the risk factors that affect FDI inZimbabwe's agriculture. These risk factors can be grouped into broader categories, such as land ownership and tenure issues, political stability, economic instability, infrastructure deficits, legal and regulatory frameworks, social and cultural factors, and environmental concerns. The main contributions of this study lie in ranking these risk factors and dividing them into three levels. The high-level risk factors include R2C5 (Crop5-Maize corn), R2C4(Crop4-millet), R2C1(Crop1-barley), R21C2(Crop2-beans dry), The medium-level risk factors include R2C3(Crop3-green corn), R4(Pesticides), R7(Government effectiveness), R8(Consumer Price), R9N3(Nutrient3-Potash K20 total), R9N2(Nutrient 2-Phosphate P205 total) and R9N1(Nutrient1-Nitrogen N total). The low-level risk factors include R1D(GDP Deflators), R2C6(Crop6-sorghum), R2C7(Crop7-soyabeans), R10FP2 (Ammonium sulphate), R5(Climate change), R6(Land use), R3(Exchange rates). The quantitative risk assessment results analysis shows that when investing in Zimbabwe's agriculture, foreign companies should pay most attention to first(High)- and second-level(Medium) risk factors, while also giving due consideration to third-level(Low) risk factors. More broadly, the results remind foreign companies investing in Zimbabwe's agriculture to monitor risks according to their respective importance to avoid or mitigate investment loss. The complex network approach is an important feature of this paper. The risk factors examined in this research are dynamic, and the complex network approach captures the evolutionary relations of the factors and ranks them well. This study provides an overall view of the risk factors associated with FDI Zimbabwe's agriculture. The results will not only help foreign companies to reduce their investment losses but also help Zimbabwe's government to improve its policies to attract foreign investment in the agriculture.

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