



Determinants of South Africa's agri-food export performance: Gravity model approach

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ABSTRACT

The central aim of this study was to investigate the determinants of South Africa's export growth and the challenges associated with agri-food products. To satisfactorily achieve this central aim, two specific objectives were set and addressed differently in this research work. Porter's Diamond framework was followed to identify factors that influence the export performance of South Africa's agri-food products, thereby identifying major challenges and opportunities for sustained growth, and the gravity model was applied to examine the main factors influencing South Africa's agri-food exports to its major trading partners in Africa for the period 1996–2017. The study analyzed and interpreted the results using both primary and secondary data. The study aimed to pinpoint the elements that impact the export performance of South Africa's agri-food products, thereby pinpointing significant obstacles and prospects for long-term expansion. We collected primary data using a structured questionnaire, randomly selecting and interviewing 117 out of 137 respondents. The findings revealed that a scarcity of skilled labor, the expense of skilled labor, the availability of electricity, the cost of raw materials, the cost of advanced technology, transportation expenses, scientific research institutions, pricing, tariffs, language barriers, and crime are the primary barriers to the exportation of agri-food by South African firms. The researcher used 28 countries as export markets to examine factors influencing South Africa's agri-food exports, and the results showed that the size of the economy, geographical proximity, and currency devaluation had a huge effect on exports of agri-food products.

Contribution/Originality: The outcome of this study could contribute to the fundamental body of knowledge and be used as the basis for informed policy formulation to improve agri-food export performance, which will ultimately improve the contribution of the agricultural sector to the gross domestic product (GDP) of the South African economy.

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1. INTRODUCTION

Agri-food is the production of food agriculturally, as opposed to through hunting, fishing, and so forth. The agri-food sector plays a pivotal role in the South African economy at large, considering all necessary contributions like employment, food security, foreign earnings, and so forth. Even though its share in South Africa's gross domestic product (GDP) is relatively small, primary agriculture is a critical sector of the economy. Agriculture seems to continue to provide significant employment, most importantly in rural areas where employment is very scarce and is also a foreign exchange earner for South Africa's economy. In 2013, South Africa recorded a value of agricultural production

of approximately R188 billion, with the sector contributing about R72 billion to the country's GDP. There was an average growth of about 9.9% per annum in the primary agricultural sector between the years 1970 and 2013. However, between the same years in South Africa, the overall annual economic growth of 12.9% resulted in a decrease in the contribution of agriculture to the GDP from 7.1% in 1970 to 2.6% in 2013 (Department of Agriculture Forestry and Fisheries, 2018).

Anand, Roberto, and Zhang (2016) highlighted in a report by the International Monetary Fund (IMF) that South Africa's export performance has disappointed since the last global financial crisis. This clearly indicates the need for corrective actions to bring about improvements. Exports are critical for every country because they are an essential tool for achieving economic growth. In that case, it is of great importance to always make sure that industries have what it takes to compete in the international market. This will necessitate a thorough examination of the factors that influence export performance. Literature shows that quite a few researchers and analysts excessively encourage export promotion.

Reduced trade restrictions should lead to considerable improvement in trade performance in the region, as high levels of trade restrictions have historically been a major barrier to exports (Rodrik, 1998). Since it closes trade deficits with other countries and sets the pace of development, rising export sales volumes are important for national economies (Ayan & Percin, 2005). Ayan and Percin also highlighted that in global marketplaces with heightened rivalry, success necessitates determining the elements influencing exports and implementing remedial measures, which is precisely what this study aims to ascertain.

The Tripartite Free Trade Area (TFTA) is a milestone for Africa's integration progress. It is highly regarded for its potential to unlock the agri-food market and establish new markets in the region. The fact that South Africa is not the sole exporter of agri-food products in Africa underscores the competitiveness of this market, posing a constant challenge for South Africa to enhance its competitiveness and maintain its dominance over the long term. This study, the first of its kind, will examine the main factors influencing South Africa's agri-food exports to its major trading partners in Africa. It is important to study the trade benefits among countries through their regional trade agreements.

2. THEORETICAL FRAMEWORK

The English economist Adam Smith first proposed the theory of absolute advantage in foreign trade activities in his 1776 publication, "Wealth of Nations." He argued that countries should specialize in producing goods over which they have an absolute advantage and engage in trade activities with other countries; as a result, they will all benefit from international trade. The theory, however, does not describe why other countries that do not have an absolute advantage still gain from international trade (Smith & Skinner, 1974).

The question received more attention because it appeared to be critical. The English economist David Ricardo attempted to answer the question by developing a theory. David Ricardo proposed the theory of comparative advantage, which states that a nation benefits from trade by exporting goods that it has a higher comparative advantage in producing and importing goods that it has the least comparative advantage in producing (Ruffin, 2002).

The influential trade theory developed by Swedish economist Ohlin (1933) further expanded the theory of comparative advantage. The Swedish economists enhanced David Ricardo's model by incorporating land and capital, creating the Heckscher-Ohlin Model. The Heckscher-Ohlin model is one of the leading theories about the determinants of countries' trade patterns. The model predicts that a nation will export products that it produces efficiently and abundantly and import those that it produces less efficiently and abundantly.

According to classical trade theory, countries with a lower level of similarity tend to trade more. As a result, it is difficult to characterize the large percentage of intra-industrial trade that drives trade among wealthy nations and between countries with comparable endowments. This provided impetus for the development of new trade theories, which began in the 1980s. By softening the harsh assumptions of classical theory, new theories of trade characterize global trade based on imperfect competition, product differentiation, and economies of scale (Krugman & Obstfeld, 2005). People have recently applied the gravity model to finely define international trade flows that conventional economic theories cannot explain. Here is a representation of the gravity model:

$$F_{ij} = G \frac{M_i M_j}{D_{ij}}$$

Where:

F_{ij} is the gravitational attraction.

$M_i M_j$ are the mass of two objects.

D_{ij} is the distance.

G is the gravitational constant.

The gravity model was initially used to analyse foreign trade flows by a Dutch economist (Tinbergen, 1962). In his study, trade flows between nations were considered a dependent variable. He employed GDP and geographic distance as independent variables. The findings demonstrated that the GDP variable positively impacts international trade. The distance seems to have a detrimental effect. In summary, the findings indicate that countries with larger economies and closer geographical locations typically engage in more trade.

Elshehawy, Shen, and Ahmed (2014) looked at the variables influencing Egypt's export flows to its principal trading partners in bilateral trade. Egypt's exports were estimated using panel data, which included annual data for 42 major trading partners from 2000 to 2013. The study's findings demonstrated that the primary factors influencing Egypt's exports to its major trading partners are the importer's population, GDP, GDP of Egypt, regional trade

agreements (RTAs), and the border between Egypt and its trading partner. Egypt's export flow is positively impacted by several factors.

Binh, Nguyen, and Cuong (2014) examined Vietnam's trading operations with 60 nations on a bilateral basis between 2000 and 2010, using the gravity model. Using information gathered from the World Bank, the Monetary Fund, and the International Trade Centre, panel data on Vietnam's international commerce were examined. The study's findings demonstrated the significant influence that Vietnam's economic size, as well as the economic and market sizes of its foreign partners, culture, and distance, had on bilateral trade between Vietnam and sixty other nations. Vietnam demonstrated trade potential with several new markets, including Western Asia and Africa, by applying the speed of convergence approach to identify potential markets.

Rahman (2003) used cross-section data from 50 countries and augmented gravity models to study Australia's trade potential. The size of the economy, openness, GDP per capita, and shared language all have a beneficial impact on Australia's bilateral trade, according to the study's findings. The study also revealed that distance had an adverse impact on trading partners. Australia has significant trade potential with Argentina, Singapore, Bangladesh, Russia, Greece, Norway, Portugal, Brazil, and Chile, according to the assessed results.

Hatab, Romstad, and Huo (2010) used a gravity model approach to analyze the factors influencing Egypt's agricultural exports to its major trading partners between 1994 and 2008. Their findings revealed that a one percent increase in Egypt's GDP corresponds to an approximately 5.42 percent increase in Egypt's agricultural export flows. However, a rise in GDP per capita in Egypt is associated with a fall in exports; this is because rising economic growth increases the per capita demand for all ordinary products. The findings also revealed a substantial positive coefficient for the exchange rate, meaning that export volumes rise each time the Egyptian pound weakens relative to the currencies of its trading partners. It was discovered that the distance and expense of transportation had an adverse effect on agricultural product exports.

The goal of the Crescimanno, Galati, and Yahiaoui (2013) study, "Determinants of Italian agri-food exports in non-EU Mediterranean partner countries (MPCs)," was to highlight the primary factors influencing Italian agri-food exports in the non-EU MPCs through an empirical investigation using a gravity model approach. The study's findings demonstrated that factors such as the GDP of partner nations, historical and colonial relationships, geographic closeness, and the relative importance of the agriculture sector in particular partner nations all positively affect exports.

Nguyen (2010) used the gravity model to analyze Vietnam's exporting activities for 20 years. The study used the export value from Vietnam to other countries as a dependent variable, and used GDP, exchange rate, and distance as independent variables, with the Association of Southeast Asian Nations (ASEAN) acting as a dummy variable. The results showed that GDP, exchange rate, and ASEAN partner being in ASEAN positively affect the export value of Vietnam. Distance was found to be negatively affecting the export value of Vietnam to other countries. Vietnam exports more to countries with a closer geographical location.

Thai (2006) describes bilateral trade flows between Vietnam and twenty-three European nations using a gravity model. The analysis covers the period from 1993 to 2004. Vietnam's total trade with other nations was the dependent variable. The population, GDP, exchange rate, geography, and history were all independent variables. The findings revealed that population, GDP, and exchange rates are the primary factors influencing bilateral trade between Vietnam and European countries. The outcomes also demonstrated that distance and history have no bearing at all.

Mathee and Gallego (2017) looked into a variety of market access factors that influence South Africa's export growth along the intensive and extensive margins in their study, "Identifying the determinants of South Africa's extensive and intensive trade margins: A gravity model approach." Using highly disaggregated data, a Heckman selection gravity model was used in this study. The first section presented the variables influencing the likelihood that South Africa will export to a specific country (extensive margins), and the second section presented the variables influencing the volume of exports (intense margins). The study's findings showed that, while South Africa's export product mix is reasonably diverse, there aren't many markets available. Economic factors such as the population and GDP of the importing nation positively influence businesses' decisions to export. Cost, trade laws, and distance were determined to be factors adversely affecting the large margin. The existence of a free trade agreement with the SADC, cultural fit, and the South African embassy's global reach were also shown to be favourably influencing extended margin. It was discovered that there are significant similarities between the extensive and intensive margins in terms of the factors impacting export volumes (intensive margin), with the difference that the time required for exporting has a greater influence than the documentation requirements. The study "Analysing the trade effect of the EU-SA & SADC trading agreements: A panel data approach" was carried out by Jordaan and Kanda (2011). Investigating the trade consequences of the EU-SA and SADC preferential trade agreements, of which South Africa is a part, was the goal of the study. Panel data from 1994 to 2008 was used in the study. Using a gravity model, the study found that trade expansion is significantly impacted by the EU-SA preferential trade deal. The findings also demonstrated that until the agreement is finalized and put into action, no meaningful conclusion regarding the trade effects of the SADC preferential trade can be drawn. It has been suggested that South Africa support attempts for regional trade agreements to further economic stability and growth in the region.

3. MATERIALS AND METHODS

3.1. Study Area

This study focused on the agri-food industry in South Africa. Agri-food firms exporting products to the world were used as respondents to find out from them what they perceive as factors influencing export performance.

3.2. Population of the Study

The population of the study is categorized into two groups, namely export destinations (African markets) and agri-food exporting firms within South Africa. To address the objective of identifying factors that influence the export performance of South Africa's agri-food products, thereby identifying major challenges and opportunities for sustained growth, the population used to draw a sample for data collection was that of exporting firms within South Africa. According to the Ministry of Agriculture, Forestry and Fisheries, the total population, was not known. For that reason, a stratified random sampling method was used to assume the population which amounted to 137 active firms. For this study, the sample size was drawn from a population of 137.

The African market served as the sample population for data collection in order to address the objective of examining the main factors influencing South Africa's agri-food exports to its major trading partners in Africa. The total number of African markets is 54. Due to a lack of data from other countries and a lack of trade activities, the population size was therefore reduced to 45. For this study, the sample size was drawn from a population of 45.

3.3. Sampling Frame

For data about the export destination (African markets), a total of 28 countries were selected from the total population, and the required statistical data were obtained from the World Bank (WB) and the International Trade Centre (ITC) map databases. The primary reason for selecting 28 countries was that some of them didn't have complete data. A total of 28 countries were found to have all the required data. The study randomly selected a total of 117 agri-food exporting firms to serve as respondents.

3.4. Data Collection

3.4.1. Primary Data

Using structured questionnaires, face-to-face interviews were conducted with leaders of the firms selected, and for those who were very far away as well as those who did not have time to meet, questionnaires were e-mailed to them so that they could fill them out in their own free time. Completed questionnaires were later e-mailed back to the researcher. Telephonic interviews were also used as an alternative way of collecting data from some of those who did not have time to meet face-to-face. A total of 112 respondents were able to provide feedback. A five-point Likert scale was used to determine the range in which each determinant is recognized to affect the performance of the firm. SPSS version 27.0 was used as a statistical tool for analysis. Scores ranging between 1 and 5 were allocated to each determinant based on the simple arithmetic means of the answers, with a higher score stipulating a more enhancing factor and a lower score indicating a more challenging factor in terms of performance.

3.4.2. Secondary Data

Secondary data were obtained from the World Bank (WB) and International Trade Center (ITC) databases. The WB data set includes GDP, GDP per capita, population, and exchange rate, whereas the ITC data set includes export values.

3.5. Limitations of the Study

- For primary data collection, some respondents did not provide feedback, and that led to a reduced sample size.
- For secondary data, the plan was to use all African countries' statistics, but some countries' information was not available.

3.6. Results and Discussion

3.6.1. Results Based on Porter's Diamond Methodology

Table 1 displays agri-food companies' perceptions of labor factors. The table indicates that many companies struggle to find skilled labor, with 59% strongly agreeing that it is difficult to obtain skilled labor. The reason could be that most skilled laborers demand high wages because they are skilled enough and have what it takes to make a considerable contribution to the company. 31% of companies agree that skilled labor is too costly.

Table 1. Perception of agri-food companies on labour factors.

Labour factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Labour factors
Skilled labour is difficult to obtain	59%	22%	8%	7%	5%	Skilled labour is easy to obtain
Skilled labour is too costly	10%	31%	32%	20%	7%	Skilled labour is very affordable

The cost of doing business, infrastructure, and technology are the most crucial factors within the organization. Table 2 provides results based on what agri-food companies perceive as constraining and non-constraining factors in that regard. 59% of the population strongly agreed that the most constraining factor for them is the electricity supply. The cost of raw materials is also a big problem. Many companies find raw materials very expensive because the results show that 34% strongly agree that the cost is extremely high and 45% agree that the cost is high. According to the results in Table 2, the cost of better infrastructure is not too high, with 43% of the population feeling neutral about the cost and 34% agreeing that the cost is affordable. The cost of quality technology is another factor that agri-food

companies find to be very expensive. A total of 28% strongly agree that the cost of quality technology is extremely high, and 46% of the companies concur that it is too costly.

Table 2. Perception of agri-food companies on business cost, infrastructure and technology.

Business cost, infrastructure, and technology factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Business cost, infrastructure, and technology factors
Electricity supply is a constraint	59%	22%	20%	0%	0%	Electricity supply is not a constraint
Telecommunication is a constraint	5%	5%	31%	25%	34%	Telecommunication is not a constraint
The cost of better infrastructure is extremely high	0%	0%	43%	34%	23%	The cost of better infrastructure is very affordable
The cost of raw materials is extremely high	34%	45%	15%	6%	0%	The cost of raw materials is very affordable
The quality of technology for the company generally lags behind most others	5%	13%	43%	26%	14%	The quality of technology for the company is among the world leaders
The cost of quality technology is extremely high	28%	46%	20%	6%	1%	The cost of quality technology is very affordable

Moving goods from one place to another always requires an available and reliable transportation system. Table 3 below presents agri-food companies' perceptions about transportation. It can be concluded that transportation due to infrastructure and the availability of transport are not a challenge to companies, with a total of 69% feeling neutral about it and 49% feeling the same about the availability of transport. However, the major constraint is the cost of transporting goods from one place to another. 66% strongly agree that it is too expensive.

Table 3. Perception of agri-food companies on transportation.

Transport factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Transport factors
Transportation due to infrastructure is a constraint	1%	9%	69%	14%	7%	Transportation due to infrastructure is not a constraint
Transportation costs are very high	66%	23%	10%	1%	0%	Transportation costs are affordable
Transport is rarely available	5%	34%	49%	7%	5%	Transportation is always readily available

Table 4 presents the perceptions of respondents about research and development. A majority of respondents believe that scientific research institutions do not exist, with 66% of the population strongly agreeing with that statement. This means that what is available is not enough to help with research and development within the industry. A total of 74% of the respondents felt neutral about the collaboration with scientific institutions in their research and development activities.

Table 4. Perception of agri-food companies on research and development.

Research and development factor	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Research and development factor
Scientific research institutions do not exist	66%	14%	21%	0%	0%	Scientific institutions are the best in their field
Your collaboration with scientific research institutions in their R&D activities does not exist	1%	13%	74%	9%	3%	Your collaboration with scientific research institutions in their R&D activities is intensive and ongoing

The table (Table 5) presents the strategic factors affecting export performance. The results show the effect that these factors have on exports. According to the table (Table 5), product design, packaging, pricing, and promotion are the most crucial factors that help in improving the export performance of agri-food products, with 74%, 46%, 69%, and 86%, respectively, agreeing strongly that these factors improve export performance. The results, however, indicate that tariffs and language are major barriers to exports. A total of 74% of the respondents strongly agree that tariffs

have a negative effect on exports, and 70% of the respondents also agree that language is a major constraint. This implies that South African agri-food enterprises encounter difficulties when engaging in trade with nations that utilize distinct official languages from their own, particularly in terms of paperwork and comprehending product labels. It is easier to do business with those countries that use English as compared to those that use other languages. Researchers have also discovered that the individual in charge of export activities within the organization must possess the essential qualities and mindset that enhance export performance. A total of 47% of respondents strongly agree that a manager's willingness to export is very important and improves export volumes; 48% strongly agree that a manager's educational and training level is also crucial; 78% agree that the manager's period of experience in the company has a positive effect on export performance; and 68% strongly agree that a manager's overall experience has a positive effect on export performance.

Table 5. Perception of agri-food companies on export factor conditions.

Export factors	Strongly agree	Agree	Neutral	Agree	Strongly agree	Export factors
Product design improves exports	74%	14%	11%	1%	0%	Product design does not improve exports
Packaging improves exports	46%	26%	16%	9%	2%	Packaging does not improve exports
Labelling has a positive effect on exports	69%	22%	9%	0%	0%	Labelling has no effect on exports
Pricing has a positive effect on exports	46%	41%	13%	0%	0%	Pricing has no effect on exports
Promotion improves exports	86%	10%	3%	0%	0%	Promotion does not improve exports
Tariffs are a major barrier to exports	74%	20%	7%	0%	0%	Tariffs are not a major barrier to exports
Managers' willingness to export improves exports	47%	36%	17%	0%	0%	Managers' willingness to export does not improve exports
Managers' educational and training levels improve exports	48%	45%	6%	1%	0%	Managers' educational and training levels do not improve exports
Period of the manager in the company improves exports	13%	78%	9%	0%	0%	Period of the manager in the company does not improve exports
Managers' experience improves exports	68%	26%	6%	0%	0%	Managers' experience does not improve exports
Language is a constraint	70%	21%	9%	0%	0%	Language is not a constraint

Table 6 presents the African market and its growth. South African agri-food companies see the African market as one with great potential. A total of 53% of the respondents agree strongly, and 33% agree that the market size is large enough. On the other hand, a great number (76% of the respondents) agree strongly that the growth in the market is fast enough. Therefore, we can conclude that the African market is highly competitive, and the South African agri-food industry must address its challenges to achieve market dominance.

Table 6. Perception of agri-food companies on demand factors.

Demand factors	Strongly agree	Agree	Neutral	Agree	Strongly agree	Demand factors
The market size is too small	2%	6%	6%	33%	53%	The market size is large enough
Growth in the market is too slow	0%	0%	6%	18%	76%	Growth in the market is fast enough

Agri-food companies rely on other companies, farmers, institutions, and so forth to help them achieve their goals. These are regarded as related and supportive industries. **Table 7** displays respondents' perceptions based on related and supporting industries. According to the table of results (**Table 7**), the availability of local suppliers of primary inputs is not a constraint at all, with 64% of respondents agreeing that there are numerous suppliers of primary inputs. The agri-food companies are also satisfied with the quality of the inputs supplied. A total of 63% of the respondents agree that the primary inputs they receive from local suppliers are of high quality and are therefore internationally competitive. Sustainability is also not a problem at all, with a majority of respondents (63%) agreeing that the suppliers of primary inputs to their companies are sustainable enough.

Table 7. Perception of agri-food companies on related and support industries.

Related and support industries factors	Strongly agree	Agree	Neutral	Agree	Strongly agree	Related and support industries factors
The availability of local suppliers of primary inputs does not exist	0%	1%	8%	64%	26%	The availability of local suppliers of primary inputs is numerous
The quality of suppliers of the company's primary inputs is inefficient	1%	3%	23%	63%	9%	The quality of suppliers of the company's primary inputs is internationally competitive
The sustainability of local suppliers of the company's primary inputs is a huge problem	0%	2%	14%	63%	21%	The sustainability of local suppliers of the company's primary inputs is not a problem at all

The **Table 8** provides the perceptions of the respondents on firm strategy, structure, and rivalry. Research is very important in any industry, however, it appears that the respondents feel that the agri-food industry is not given enough attention in the area of research and development. A total of 47% of respondents agree, and 48% strongly agree, that industry's expenditure on research and development is very low. On the other hand, 61% of the respondents agree that competition in the market is very intense. This clearly indicates the need for corrective actions in research and development to handle the intense market competition. A staggering 74% of respondents agree that the entry of new competitors occurs more often, which means that the African market in general is becoming more and more competitive.

Table 8. Perception of agri-food companies on firm strategy, structure and rivalry.

Firm strategy, structure, and rivalry factors	Strongly agree	Agree	Neutral	Agree	Strongly agree	Firm strategy, structure, and rivalry factors
The industry's expenditure on research and development is very low	48%	47%	5%	0%	0%	The industry's expenditure on research and development is massive
Competition in the market is very limited	15%	3%	21%	61%	0%	Competition in the market is very intense
Entry of new competitors rarely occurs	0%	1%	14%	74%	11%	Entry of new competitors occurs more often

Every country aspires to implement the most effective policies and systems that can assist industries and governments in achieving their goals, thereby contributing to the nation's development or success. **Table 9** presents the perceptions of respondents on government support and policies. South Africa seems to have good policies in place, as the results show that 66% of the respondents strongly agree and 25% agree that South Africa's trade policy is not a constraint on companies' performance. This notion of trade policy is the same as that of South African labor policy and macroeconomic policy. A total of 45% express indifference towards the labor policy's role as a constraint or an enhancement to performance, while 35% concur that the labor policy in South Africa enhances the performance of companies. A total of 36% of the respondents agree that macroeconomic policy is an enhancement to performance, yet 55% felt indifferent between macroeconomic policy being a constraint and an enhancement. Lastly, respondents seem to be fine with the South African tax system that is in place. A total of 30% of the respondents agree that the tax system is not a constraint at all; on the other hand, 66% felt indifferent about the tax system being a constraint or not a constraint at all.

Table 9. Perception of agri-food companies on government support and policies.

Government support and policy factors	Strongly agree	Agree	Neutral	Agree	Strongly agree	Government support and policy factors
South Africa's trade policy is a constraint on the company's performance	0%	1%	8%	66%	25%	South Africa's trade policy is not a constraint on the company's performance
South Africa's labour policy is a constraint on the company's performance	0%	2%	45%	38%	15%	South Africa's labour policy is an enhancement to the company's performance
South Africa's macroeconomic policy is a constraint	0%	1%	55%	36%	8%	South Africa's macroeconomic policy is an enhancement
The tax system is a constraint	0%	0%	66%	30%	5%	The tax system is not a constraint

Table 10 summarizes respondents' perceptions based on chance factors. Many companies feel that crime is still a major problem in South Africa. A total of 54% of the respondents agree strongly, and 29% agree that crime is a constraint on performance.

Economic stability is not a significant issue, as indicated by the majority of respondents (60%), who recorded a neutral response. This indicates that most respondents perceive South African economic stability as neither a constraint nor a source of increased opportunities for performance improvement, making it a moderate issue. According to the respondents, the exchange rate is excellent, with 55% agreeing that it improves performance.

Table 10. Perception of agri-food companies on chance factors.

Chance factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Chance factors
Crime is a constraint	54%	29%	9%	6%	2%	Crime is not a constraint
Economic stability in South Africa is a constraint	9%	29%	60%	2%	0%	Economic stability in South Africa creates opportunity to improve performance
Exchange rate is a constraint on performance	0%	0%	14%	55%	31%	Exchange rate enhances performance

3.7.1. Results Based on the Gravity Model

3.7.1.1. Analytical Technique and Variables

In the case of South Africa, a variation of gravity models given by Krugman and Obstfeld (2005) was applied. According to the original model, only two independent variables are introduced, which include GDP and distances. In this article, the model was therefore further enhanced by putting in other variables, namely, population, exchange rate, and GDP per capita. The gravity model was estimated in logarithmic form as follows:

$$\text{LogTijt} = \alpha_0 + \alpha_1 \text{logYit} + \alpha_2 \text{logGjt} + \alpha_3 \text{logGit} + \alpha_4 \text{logYjt} + \alpha_5 \text{logPit} + \alpha_6 \text{logEXijt} + \alpha_7 \text{logPjt} + \alpha_8 \text{logDij} + eijt$$

Where:

i = 1 (South Africa).

j = 2, 3, 4, (partner countries).

t = 2007, 2008, 2009... 2016.

Tijt: South Africa's trade with country j in year t.

Log1: Yit: South Africa's GDP in year t.

Log2: Gjt: GDP per capita of country j in year t.

Log3: Git: South Africa's GDP per capita in year t.

Log4: Yjt: GDP of country j in year t.

Log5: Pit: South Africa's population in year t.

Log6: EXijt: Exchange rate between South Africa and country j in year t.

Log7: Pjt: Population of country j in year t.

Log8: Dij: Distance in kilometres between South Africa and country j.

eijt: Error term.

3.7.1.2. Results Based on the Size of the Agri-Food Industry

The figure (Figure 1) shows the structure of agri-food companies in terms of size. Based on the figure, the size is categorized into small, medium, and large companies. The manner in which the size was categorized was based on number of employees within the company. It was therefore concluded that a company with 5 to 49 employees was regarded as a small-sized company, one with 50 to 99 employees was regarded as a medium company, and lastly, one with 100 or more employees was regarded as a large company. The figure (Figure 1), indicates that small-sized companies dominate with 51%, followed by medium-sized companies with a share of 19%, and, lastly, large-sized companies being the least with a share of 17% of the overall sample.

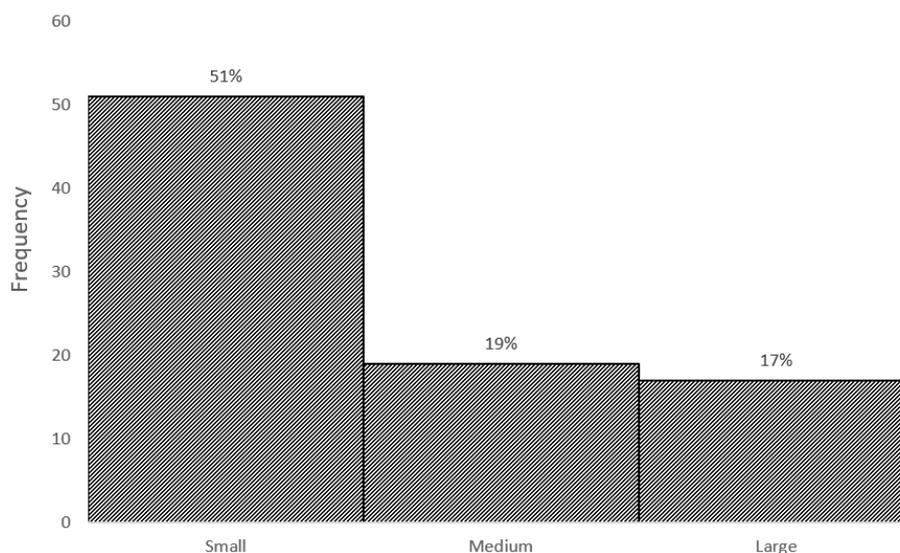


Figure 1. Sample size of agri-food companies.

Table 11 presents the results of the gravity model carried out using R statistical software. The results show that importers' GDP, exchange rate, and distance are the variables that influence South Africa's export performance with a high level of significance. On the other hand, importers' GDP per capita and importers' population influence South Africa's exports with a moderate level of significance. The results also indicate that South Africa's exports are not influenced by exporters' GDP, exporters' population, or exporters' GDP per capita.

The findings indicate that an increase in the importing nation's GDP per capita causes an increase in the nation's import of agri-food goods. The findings also show that a rise in the importing nation's GDP corresponds to a rise in the country's agri-food imports. This is consistent with macroeconomic theory, which holds that rising national incomes will result in rising import volumes. The importer's population is also found to be positively significant, indicating that an increase in the population of the importing country leads to an increase in imports. This is linked to an increase in market size, as an increase in population necessitates the feeding of a larger number of people, which in turn demands a higher volume of imports. The results also demonstrate the positive significance of exchange rate and distance variables. The results indicate that a devaluation in the South African currency leads to an increase in exports of agri-food products. This could be due to the growing interest among agri-food exporters to increase their product exports, as a devaluation increases their potential earnings. This distance shows that South Africa's agri-food exporters target countries that are a bit closer to South Africa. Before expanding further, exporters take advantage of the proximity. This may be due to transportation costs.

Table 11. Gravity model regression results.

Coefficients:				
Variables	Estimate	Std. error	t value	Pr(> t)
(Intercept)	-421.935	5569.035	-0.076	0.940
log ₁	63.781	805.407	0.079	0.937
log ₂	0.214	0.068	3.145	0.002**
log ₃	63.442	805.657	0.079	0.937
log ₄	0.401	0.077	3.343	0.000182***
log ₅	-63.571	805.196	-0.079	0.937
log ₆	-0.239	0.039	-6.137	2.97e-09***
log ₇	0.209	0.064	3.279	0.00118**
log ₈	-0.850	0.074	-11.551	<2e-16***

Significant codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Null deviance: 72920714 on 279 degrees of freedom Multiple R: 0.847
Residual deviance: 21442866 On 271 degrees of freedom R square: 0.7800
Number of fisher scoring iterations: 6 Adjusted R square: 0.745

Note: E means exponent multiplied by the preceding number ***, **, and * means statistically significant at 1%, 5% and 10% respectively.

3.8. Hypotheses Testing Results

For this study, three hypotheses were proposed, which are highlighted in Chapter One of this study. The following table presents the results of hypothesis test number one, which states that:

H₀: The size of the economy does not influence South Africa's exports of agri-food products to Africa.

H₁: The size of the economy has a positive influence on South Africa's exports of agri-food products to Africa.

According to the results in the table (Table 12), the null hypothesis has been disproven. In that scenario, we accept the alternative hypothesis over the null hypothesis. The test statistics, which show a value greater than the critical

value ($t = 7.256 > 1.650$), inform the decision to reject the null hypothesis. value was also taken into consideration when deciding whether to reject the null hypothesis or not. The p-value rule states that we should reject the null hypothesis if the p-value is less than alpha. The test results show that the p-value is less than an alpha; therefore, this tells us to reject the null hypothesis.

Table 12. Hypothesis test results on the size of the economy.

Test	Results	Data
Mean	140856,3	42780,79
Variance	4,87E+10	2,24E+09
Observations	279	279
Hypothesized mean	0	
df	304	
t-statistic	7,256	
P(T<=t) one-tail	1,67E-12	
t critical one-tail	1,650	
P(T<=t) two-tail	3,35E-12	
t critical two-tail	1,968	

Note: E means exponent multiplied by the preceding number.

Table 13 provides results about the second hypothesis, stated as follows:

H₀: There is no relationship between geographical distance and trade.

H₁: Geographical distance is a barrier to trade.

The test statistics are greater than the critical value ($t=10.333 > 1.650$), and the p-value is less than alpha. Based on the test results, the null hypothesis is rejected, and the alternative hypothesis is accepted.

Table 13. Hypothesis test results on the geographical distance.

Test	Results	Data
Mean	140856,287	4271,319
Variance	4,874E+10	8931799
Observations	279	279
Hypothesized mean	0	
df	278	
t-statistic	10,333	
P(T<=t) one-tail	1,074E-21	
t critical one-tail	1,650	
P(T<=t) two-tail	2,148E-21	
t critical two-tail	1,969	

Note: E means exponent multiplied by the preceding number.

The table (**Table 14**) shows the results of the last hypothesis, which states that:

H₀: Devaluation of South Africa's currency has no effect on agri-food exports variations.

H₁: Devaluation of South Africa's currency has a positive effect on agri-food exports variations.

The table's results support the acceptance of the alternative hypothesis over the null hypothesis. The reason being that the test statistics were found to be greater than the critical value ($t = 7.085 > 1.650$), and the p-value was less than alpha.

Table 14. Hypothesis test results on the exchange rate.

Test	Results	Data
Mean	140856,3	43003,2
Variance	4,87E+10	4,48E+09
Observations	279	279
Hypothesized mean	0	
df	329	
t-statistic	7,085	
P(T<=t) one-tail	4,24E-12	
t critical one-tail	1,649	
P(T<=t) two-tail	8,48E-12	
t critical two-tail	1,967	

Note: E means exponent multiplied by the preceding number.

4. CONCLUSION

The main focus of this study was to investigate factors that influence the export performance of South Africa's agri-food products, thereby identifying major challenges and opportunities for sustained growth as well as examining the main factors that influence South Africa's agri-food exports to its major trading partners in Africa for the period

1996 to 2017. The study used both primary and secondary data to address the two main objectives. The gravity model was applied to examine the benefits of trade between South Africa and the African market at large. To identify the major challenges, Porter's framework was followed, and the results showed that quite a number of factors are indeed a huge challenge to agri-food exporting firms in South Africa. The factors include shortage of skilled labour, the cost of skilled labour, electricity supply, cost of raw materials, cost of high-level technology, transportation costs, scientific research institutions, pricing, tariffs, language, and crime. To examine factors influencing South Africa's agri-food exports, the gravity model was employed, and the results of the study support the hypotheses that predicted that South Africa's agri-food exports are positively affected by the size of the economy, geographical proximity, and currency devaluation.

Abbreviations

ASEAN: Association of Southeast Asian Nations; DALRRD: Department of Agriculture, Land Reform, and Rural Development; GDP: Gross Domestic Product; ICT: International Trade Centre; IMF: International Monetary Fund; RTA: Regional Trade Agreements; SADC: Southern African Development Community; TFTA: Tripartite Free Trade Area; WB: World Bank.

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Transparency: The author states that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

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