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Measuring the economic costs of trade protection in South Africa

Submitted in fulfilment of the requirements of Master of Commerce in Economics for:

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Declaration

I, **Rethabile Molapo** declare that:

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Abstract:

This dissertation investigates the economic cost of trade protection on South Africa's economy through a panel analysis from 2010 to 2022, focusing on South Africa's trade with 127 partner countries.

The Gravity model serves as the main estimation framework for the study as it provides a detailed observation of international trade. The Poisson Pseudo Maximum Likelihood (PPML) and Ordinary Least Squares (OLS) estimation approaches serve as the main methods used to measure the effectiveness of the gravity model in the study. Through comparisons between OLS and PPML the study observes the elasticities of the determinants of trade across the OLS and PPML and affirms the need to focus on the PPML which reveals more reliable estimates which are neither underestimated nor overestimated

The study confirms that trade protection leads to less trade activity, it will result to a reduction in gains from exports which is important in influencing the economic growth of South Africa. The research includes an in-depth analysis of tariffs, both as a standalone measure and as a variable within the gravity model as the main form of protectionism in international trade. The study highlights the evolving role of tariffs in trade protection and concludes that tariffs may have been overstated as a standalone measure of trade protection in studies of international trade. The study shows that tariffs have a more significant influence on trade in the PPML model as opposed to the OLS and the study shows that the PPML explains a larger degree of the effects on trade flows than the OLS does. The findings in the study suggest that the PPML method should be used for South Africa's gravity model simulations due to the reliable elasticities that the model returns.

Keywords: South Africa, International trade, Poisson Pseudo Maximum Likelihood, Exports, Gravity model.

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Chapter One

Background

Accurately measuring the impact of trade protection on the economy is crucial for both international and domestic policy formulation, informing decisions about its implications and for institutional/political effects (Hiscox and Kastner, 2002). Measuring the impact of trade protection encompasses three core elements, namely (i) uncovering the costs and benefits of trade protection, (ii) determining the effects of trade policy on the value of trade, and (iii) analysing the effects of trade on the welfare gained from trade (Plummer and Cheong, 2014).

Trade protection stemming from economic uncertainty is more prevalent today due to the increasingly complex structure of the economy and the changing patterns of trade (Georgiadis and Gräß, 2013). In the year 2020 during the Covid19 pandemic, protectionism across one hundred and thirty-five customs territories in the world increased in the food and medical supplies industries (Evenett et al, 2021). Evenett et al. (2021) show that export protection started to rise in the foods industry from fourteen restrictions in February to seventy-five in October of 2020 and rose from six to one hundred and seven in the medical supplies industry. Import restrictions rose from six to thirty-three in food supplies and medical supplies increased from thirteen to one hundred and forty-nine. Similar patterns of trade during times of economic turmoil are seen in the 2008 Global Financial Crisis which saw a rise in tariffs across the economies of countries worldwide (Datt et al., 2011). According to Datt et al. (2011) there was a total of 1,243 trade measures in late 2008 in response to the crisis. Two to three years after the crisis tariffs were more frequently lowered in efforts to reduce prices.

The ambiguity between raising and reducing protectionism at different points in time calls for a close observation on the various economic results of manipulation of trade policy across countries. Is trade protection optimal for economies? This is the question that arises upon the inception of trade policy. The quest to find out which trade policies work best at different points in time of trade has been unending. Several methods of estimation in efforts to find out how trade policy affects economies have been explored.

The various methods used to measure the impact of trade protection on the economy, include measuring the dynamic (long-run) and static effects (short-run) of trade protection on the welfare of the economy and using empirical analyses such as analysing the incidental consequences of trade protection on trade and analysing the effects of trade protection after protectionism has been observed (Plummer and Cheong, 2014; Hiscox and Kastner, 2002).

Measuring dynamic effects of trade protection on the economy involves using estimation techniques that capture both incidental trade protection and analysing the aftereffects of trade protection, while measuring static effects requires only incidental effects to be observed (Hiscox and Kastner, 2002).

Understanding the economic consequences of increased trade protection is important but properly estimating them can be challenging. To find a good method to measure the effect of trade protection on the economy, firstly, we need to know what a good measure of trade protection is by asking the question: What does a good method of measuring trade protection comprise of ? (Estefania-Flores et al., 2023). According to Silva and Tenreyro (2006) a good method of measuring trade is robust under different variance conditions, it is well grounded in theory, it is easy to implement, and it avoids normalization errors (Estefania-Flores, 2023).

Elasticities of the effect of trade frictions have been used as the common ground of determining the effect of trade protection on the economy. Elasticity estimations are useful for two main reasons in trade (i) for explaining the changes in the growth of trade and, (2) for measuring the welfare cost of self-adjusting markets in trade (Simonovska, 2011). According to Devajaran and Go (2023) elasticities are able to explain the impact of frictions against trade based on data aggregation, frequency of information, size and the dimension of the data which explains the need for observing elasticities in trade.

The limitation of observing elasticities in estimations of trade protection is that trade models typically possess larger elasticities as compared to micro-economic- firm-level based models, which calls for a closer observation of the trade models (Devajaran and Go, 2023). Simonovska and Waugh (2011) have attributed this phenomenon of trade models to their limited ability to capture frictions. A study by Simonovska and Waugh (2011) shows that trade models can only make sense of small trade flows with large trade frictions and small elasticities with small frictions in trade and small elasticities which is the reason that a satisfactory method of measurement of trade frictions is required to measure the impact of independent trade frictions of trade flows.

The various frictions observed in trade differ and range starting from financial frictions such as tariffs, which are taxes levied on imported goods and are used as a revenue collection tool by governments and a protective tool to protect domestic producers against foreign producers (Goniwe, Matthew, 2019). Quantity controls such as quotas and antidumping duties which are quantitative restrictions on imported products to limit excessive foreign good imports in

domestic markets. Technical barriers such as labelling requirements, inspection requirements such as fee requirements that go towards inspection and analysis and phytosanitary measures which are health requirements to ensure safety standards of imported products such as testing requirements, treatment of pests, hygienic requirements, storage and transport conditions, restricted use of substances in foods and feeds, microbiological criteria e.g. eggs should not have salmonella, and packing requirements. All these measures are used to protect industries and are used as a punitive measure against trade policies enacted by countries that serve as trading partners.

South Africa has relied on a combination of tariffs and non-tariff measures as tools of trade protection, this is evident in the policymaking strategies that it has enacted. The graph below shows the various degrees of protectionism in the country since 1994/1996.

Non-Tariff Barriers enacted by South Africa

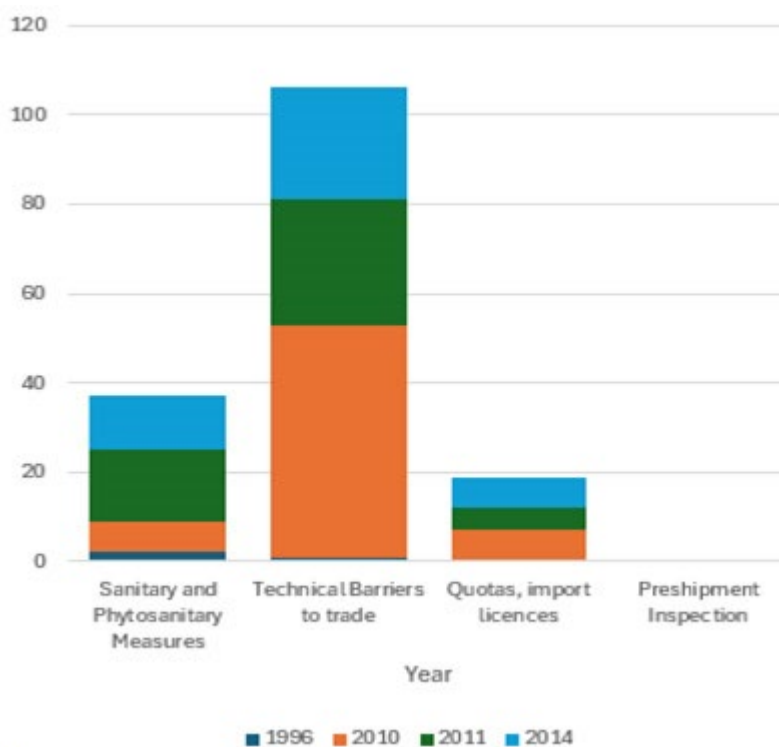


Figure 1

Source: Authors own estimations based on non-tariff data obtained from UNCTAD, TRAINS Database.

Figure 1 shows the amount of non-tariff trade barriers enacted in South Africa from 1996 to 2014. The results show that non-tariff barriers such as technical barriers increased the most

after the 2008 Global Financial Crisis, the technical non-tariff barriers tend to increase more after the 2008 Financial Crisis than other trade barriers followed by Sanitary and Phytosanitary measures. Quotas and import licences contribute much less towards the trade barriers of South Africa followed by preshipment Inspections.

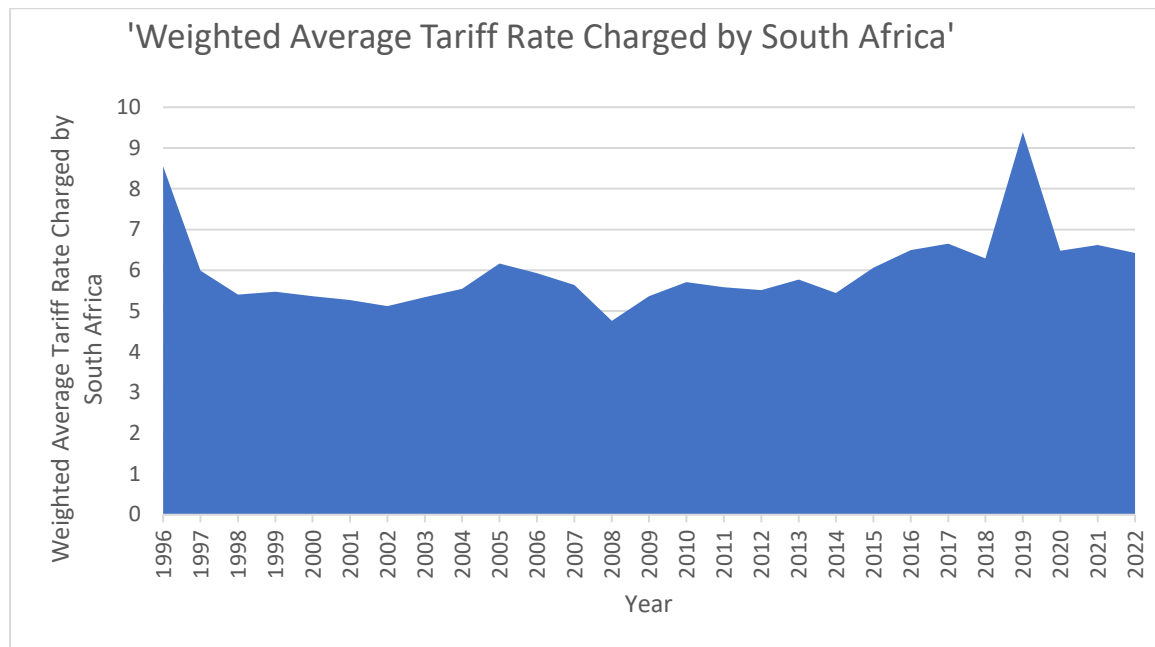


Figure 2

Source: Authors simulations based on Weighted Average Tariff Rates data obtained from UNCTAD, TRAINS Database.

Tariffs in South Africa average around the 5-6 percent mark indicating that tariffs contribute less towards trade barriers in South Africa. In 1996 tariff rates averaged at the 8.5 percent mark which, over the year dropped significantly, especially in 2008 and later increased significantly in 2019 which dropped afterwards and returned to normal averages.

The parameters that build towards elasticities lie in the fluctuations in the economic variables can often be summed into the trade function as trade is directly and positively related to most outcomes of the economy, so – the effect of trade protection on the economy can be estimated from the one variable of trade. Trade in the international scope is demonstrated in three main ways: (i) As exports from country to country, (ii) as imports from one country to another, and (iii) as the terms of trade between the trading countries. Exports are the records of goods and services sold between the residents of one country and the non-residents of another country. These records include the barter of goods and goods exported as gifts and grants (OECD, 2014). Imports refer to the transfer of goods from non-residents to the residents of the trading country.

In terms of trade, the ratio of the value of exports plus imports is divided by the country's gross domestic product (Mputu, 2016).

1.1 Problem Statement

South Africa, being an export led economy relies on trade policy as one of its key policy making strategies. The country has moved towards a more open trade policy over time. However, the effects of protectionism are still unclear as there have been contrasting results on the effects of protectionism on the economy across differing studies. Establishing a trusted model of estimation of the effect of protectionism on the economy is important as it can allow policymakers to make more informed decisions that are reliable across tested models.

By comparing some of the best models used in international trade studies, this study simulates the economic consequences of protectionism on trade.

1.2 Research Questions

This research answers the following questions:

1. To what extent do the determinants of trade protection affect trade?
2. Which econometric approach - PPML or OLS - provides a more accurate framework for estimating the economic costs of protectionism?
3. What lessons can South Africa draw from the findings to improve its trade policies and maximize the benefits of international trade?

1.3 Aim

This research aims to draw an emphasis on the use of the PPML method in South Africa's gravity simulation studies as a reliable method of determining frictions elasticity towards trade.

1.4 Objectives

The objectives of this research are:

1. To explore the evolution of econometric techniques for measuring trade protection, emphasizing the gravity model.
2. To analyze South Africa's elasticity in trade using both OLS and PPML, while identifying the strengths and weaknesses of each method.
3. To assess the significance of explanatory variables, including tariffs, GDP, distance, and trade agreements, within the context of South Africa's trade flows.

4. To recommend the best method of measuring trade protection on the economy of South Africa to researchers and policymakers.

1.5 Research Gap

While much of South Africa's studies incorporate the gravity model, a limited number of studies have used this model using the robust PPML estimation approach to study the effects of protectionism on the economy. This research addresses this geographical gap as it emphasizes using the Poisson Pseudo Maximum Likelihood estimation approach for future studies in international trade.

1.6. Limitations of the Study

This study observes trade over 13 years, from 2010 to 2022. This limit is set on the availability of data captured by the South African Revenue Service, which has trade data from 2010. This study is limited in that the trade flows over thirteen years may not reliably capture the effect of the variables included in the model on South Africa's exports, which would have otherwise provided more value over a more significant period.

1.7. Outline of the Research

Chapter one of the study provides the background of the research. It outlines the research problem, the aims, the objectives, and the limitations of the study. It also outlines the structure of the research.

Chapter two of the study provides the literature review of the study. This is an extensive review of the classical theories of trade and the evolution of the measures of trade protection.

Chapter three highlights the sources of data in the study, provides insight into variable selection, it provides the logic of the estimation techniques of the paper, it provides the descriptive statistics of the paper, it provides the logic of the diagnostic tests used in the study.

Chapter four presents the empirical findings of the models chosen in the study. It explains the significance of the variables and the models for the study, and it quantifies the impact of protectionism.

Chapter five provides the conclusion based on the entirety of the study and makes recommendations to researchers and policymakers based on the findings on the research.

Chapter Two

Introduction

Trade Theories

2.1 Absolute Advantage

Various functions of thought exist on the reasoning behind the concept of trade, all of these functions are embedded in greater schools of thought that provide a clear underpinning behind trade. One of the famous theoretic underpinnings behind international trade is from Adam Smith. Adam Smith (1876) introduced the theory of absolute advantage which is the idea that countries should put an emphasis on increasing the welfare balance of the economy through trade, the theory hypothesises that if a country can specialise in the production of goods and services in which it has an absolute cost advantage in over other countries it will gain from trade.

Adam Smith's theory was an advance from Aristotle whose theoretic background has been widely accepted as the initial basis for protectionism in trade. Aristotle advocated for authorities to decide on necessary imports and exports and added that to ensure fairness in trade, there should be commercial laws (Dorobăț, 2015, p. 108). Aristotle advocated for protectionism in countries in sectors in which the country has an abundant factor and should import more in those sectors in which it derives a benefit, that would be imports.

While the countries practice a level of protectionism by using Aristotle's theories, trade is still open as limited amounts of imports are still allowed to the elasticity of the benefit of the importing country. It is easy for critics to mistake the theory of Absolute Advantage by Adam Smith's and Aristotle as allowing for absolutely no imports due to the rigidity on the emphasis to focus of specialisation. A misinterpretation of these theories would imply that a country that has an absolute advantage in the production of all goods and services would not be able to import. This would imply that the country with absolute advantage would not be able to draw gains from trade as consumption and production are only constrained to the country's capacity. The gains from trade would have been obtained from increased revenue from exports which would then aid the purchases of imported goods (Krugman, 1995 as seen on Smit, 2010). The emphasis of the two theories is to ensure efficient capacity making it easy to have an advantage in trade and obtain gains.

2.2 Scholastic and Christian School of Thought

It was against Aristotle's theory that the scholastic and Christian schools of thought arose in the 13th and 15th centuries. These schools held that people and regions of the world were not well

endowed with nature in the face of life's necessities, and foreign trade was imminent (Dorobăț, 2015). The varying needs of countries and the scarcity that is faced by the world necessitates trade. Faced with this realization, these schools faced concerns that increased interaction with foreigners had its own moral consequences (Dorobăț, 2015, p. 108). As countries interact, it is not without consequences that as the countries interact with each other, there will be cultural and language exchanges, and cultural changes may pose threats to existing cultures.

Plato (1930) reaffirmed the need for open economies as trade would expand opportunities. “Trading in gold and silver shifts focus from the city towards greater opportunities and problems of the world”, this statement by Plato (1930) aligns with the inherent ability of trade to widen the access of domestic markets towards larger markets, while also acknowledging that the world will now be interdependent implying that a negative effect in one country’s economy could potentially affect other economies connected to it. Plato also acknowledged trade as a natural phenomenon – occurring naturally between traders due to the lack and surplus between trading partners. This shows that due the natural scarcity phenomenon countries would be interdependent anyway and emphasises trade as a naturally beneficial phenomenon

Against the theories of Aristotle and Plato, it became the consensus of the study of international trade amongst economists that trade is overall beneficial as it is beneficial for whole societies (Grotius 1916, Suarez 1934, as seen on Dorobăț, 2015, p. 108). It was against this view that Mercantilism emerged.

2.3 Mercantilism

Mercantilism proposes that in the presence of trade, it should be in the country's interest to increase welfare. According to this theory, to achieve welfare, a country first has to accumulate gold and silver in its treasury. Secondly, governments should provide aid to producers. Thirdly, governments should only promote exports of manufacturing goods and imports of raw materials. While this view is protectionist in its nature due to its proposition of the aid of exports and imports that are limited to natural resources, like the other schools of thought, it agrees that countries should trade to some extent – thus contributing to the consensus of economists in international trade.

2.4 Adam Smith

The main critique against Mercantilism emerged from the famous scholar Adam Smith based on three accusations. Adam Smith's central proposition was that nations could all benefit from free trade by virtue of the "Absolute Advantage." The absolute advantage arises when a nation

produces a good or service more efficiently than the other, allowing it to induce lower prices for its trading partners due to lower costs of production, thereby benefitting itself as a country with an absolute advantage to its trading partner who produces at a higher cost what it would instead produce at a lower cost. Adam Smith also argued that gold and silver were not a nation's only sources of wealth, and that this notion limited the potential for real wealth. Instead, he advocated for a nation whose wealth depended on agricultural cultivation, trading in manufactured goods, and specialized labour (Constitutional Rights Foundation, 2007). Secondly, Adam Smith advocated for free trade as it would further stimulate the production of traded goods and increase labour, as the production of goods requires labour as an input (Dorobăț, 2015). The increase in production would also correspond with an increase in exports due to surplus goods in the economy.

Finally, Adam Smith advocated for a limited role of government intervention in the economy, as economies could operate on natural forces, leading to a fair resource distribution (Constitutional Rights Foundation, 2007). Adam Smith's theory is practical: if the desires of a nation are to increase the nation's welfare, the trading countries should leverage all opportunities available to increase the welfare, which includes encouraging imports that are leveraged in production processes.

2.5 Comparative Advantage

2.5.1 David Ricardo

From the logic of the theory of Absolute Advantage arose the theory of Comparative Advantage from David Ricardo. The theory of comparative advantage subsumes that all nations can trade, and benefit based on production efficiency despite not having an absolute advantage in resources. If a nation is efficient in producing one good, it should trade in this good as a speciality and import those goods with higher production costs. For example, if it is cheap to import goods from one country then reproducing and reselling products from the imports would still benefit the importing country leading to gains in the economy due to that particular product that is relatively efficient to benefit from. This theory is different from the theory of absolute advantage in that the country will always import. This theory subsumes that labour is the only factor of production in the production of all products and it is the cost of labour which is cheap that allows countries to benefit from comparative advantage.

To illustrate the theory of comparative advantage, Ricardo explained, "To produce the wine in Portugal might require only the labour of 80 men for one year, and to produce the cloth in the

same might require the labour of 90 men for the same time. It would, therefore, be advantageous for her to export wine in exchange for cloth. This exchange might even occur even though the commodity imported by Portugal could be produced there with less labour than in England. Though she could make cloth with the labour of 90 men, she would import it from a country where it required the labour of 100 men to produce it because it would be advantageous to her rather than employ her capital in the production of wine, for which she would obtain more cloth from England, than she could produce by diverting a portion of her capital from the cultivation of vines to the manufacture of cloth" as cited by (Irwin, 1996, p. 21).

The assumption that labour is the only factor of production in comparative advantage led to much of the critique from Ricardo's assumption of trade as other factors such as technologies grew to have an impact on production.

2.5.2 Heckscher-Ohlin

Heckscher-Ohlin expanded the theory of Comparative Advantage by showing that countries will trade based on the intensity such as both labour and technologies in the process of production of goods and services. The main reason that the H-O theory falls under the theory of comparative advantage is that this theory ignores the implications of having an abundance of resources in trade, implying that gains from trade can still be achieved as long as labour and capital are at the correct amount.

2.6 Leontif Paradox

Leontif (1953) found it paradoxical that the United States economy exported goods which it had less of an abundance of factors of that is that, while the United States is a capital abundant country, it exported more of its labour-intensive products. Guo (2015) explained that this process occurs as a result of localised factor intensity reversals such as in skills which result to factor price reversals.

2.7 New Trade Theory

Increased intra-industry trade resulted to a paradox which could not be explained by the theory of comparative advantage which has perfect competition and constant returns to scale as its assumptions (Smit, 2015). Companies that are in perfect competition would trade with each other on the basis of yielding greater profits depending on its existing market position. For example, suppose that two shipping companies are in perfect competition, due to the inability of one company to contain the overflow of goods it has to book services with its competitor.

This implies that the companies at this point are less focused on competition and more focused on efficiency, which show that trade is driven by economies of scale. For these two companies, trade becomes a positive sum game. Since trade in this case is ruled by imperfect competition it is safe to rule that in some cases countries trade as a result of economies of scale.

2.8 Strategic Trade Theory

This theory holds that the government should only participate in trade policies minimally, as Adam Smith recommended, so that partial equilibrium assumptions of trade can still be met. While participating minimally, this theory poses that the government spots winners in trade before firms can and foreign firms can only agree with the government rule of the domestic firms. There is no consensus on the operations of this method in trade and no gains in welfare have been detected on this form of trade (Smit, 2015).

2.9 Porters Diamond Theory

Having studied the existing trade theories trade Porter (1990, 1997, 1998, 2000) put forth that the scope of factors of production went above capital and labour, he established a new demand structure that allows countries to trade and focused on the structure of the firm, rivalry as the main basis for trade.

Factor Structures:

Porter draws emphasis on human resources, physical resources, knowledge resources, capital resources, and infrastructure. These resources are different from the traditional theories which focused on mainly labour, capital and technologies as the main factors of production. Porter posits that unskilled labour, raw materials, climatic conditions, and water are inherited resources which require minimal investment for use in production processes. Porter then posits that advanced factors such as skilled labour, can be upgraded and innovated into special factors forming sustainable competitive advantage for a country.

Demand structures

Porter shows that the scope of demand goes above the size of the home to the tastes and preferences of the home. The tastes and preferences of homes determine the perception of firms which respond to family needs. Firms of the home country compete in the domestic market encouraging innovation within the domestic market leading to the domestic country's advantage in the international market.

Firm structure, strategy and rivalry. According to Porter, rivalry in domestic firms forces the firms to be competitive and innovative against foreign firms. Finally, Porter (1998) it is the local support industries such as industry clusters which provide networks and institutions dominance over markets allowing. Clusters provide fertile environments for learning, innovation and operation.

Porters' theory was criticised on the basis of having no mathematical underpinnings which could not prove causality which prompted a for further review of theories with clear hypotheses, theorems and conjectures (Smit, 2010).

2.10 The Gravity Theory

A model of trade that has strong theoretic foundations is the gravity model of international trade. It explains and predicts trade flows based on distance and gross domestic product. The gravity model provides the reduced-form equation of the general equilibrium of demand and supply (Karemera et al. ,1999). This model hypothesises that the gross domestic products of an exporting country will represent the country's production and supply capacity, and that the importing country's income shows the purchasing power and absorption of that country (Karemera et al., 1999). The gravity model models the demand of trade that is derived from maximising the utility function of the constant elasticity of substitution (CES) given the income constraints of importing countries (Karemera et al., 1999). The gravity model also models the supply side which is derived from the firms processes of profit maximisation of the exporting country. The gravity model is then obtained where the supply side meets the demand side.

Karemera et al. (1999) show this process as:

$$X_{ij} = \beta^0 Y_i^{\beta1} Y_j^{\beta2} C_{ij}^{\beta3} T_{ij}^{\beta4} P_i^{\beta5} P_j^{\beta6} E_{ij}^{\beta7} I_i^{\beta8} I_j^{\beta9} e_{ij} \quad (2.1.1)$$

where $i= 1 \dots, N_1$ and $j=1 \dots, N_2$

The dependent variable in this method are the trade flows (X_{ij}). The trade flows represented as either imports or exports are expected to flow positively in relation to the incomes from both sides of importer and importer flow. In the equation X_{ij} is the trade volume between country i and j represented in the currency denomination which is affected by β which represents the parameters of the model, Y_i , Y_j which are the domestic incomes of countries i and j , C_{ij} represents the transport costs incurred in trade between countries i and j , T_{ij} are other factors which can either aid or restrict trade, P_i and P_j are the unit value of exports, E_{ij} is the spot

exchange rate between country i and j at the time of trading, I_i and I_j are the inflation rates of countries i and j and e_{ij} is the error term.

The gravity model captures a variety of effects towards the outcome as shown by Karemera et al. (1999). The model can also capture the elasticity of variables such as sharing a common language, preferential trade agreements between countries, adjacency between the trading countries, colonial history, and indications of being in a landlocked country, distance, and income (Piermartini and Teh, 2005). Economic justifications of the additions of the different variables are required for the legitimacy of the model.

The main drive behind the use of the gravity model lies in its high explanatory power in explaining trade flows and its plausibility in explaining the role of variables in affecting trade (Piermartini and Teh, 2005). Due to the high explanatory power of the variables used in the model which add significant variables into the model establishes the importance of these variables in explaining trade (Piermartini and Teh, 2005). The goodness of fit of the gravity model alone cannot be used as a justification for using the gravity model. To curb this problem, Piermartini and Teh (2005) state that a theoretical basis is required as a justification for the use of the gravity model.

Isard (1954) initiated the study of the gravity model by attributing the same to income and distance. The study by Isard (1954) holds that the income potential of a trading country is inversely related to the distance between two trading countries, *ceteris paribus*. If trade is between countries with similar resources, industrial structures, and institutions then the country closest to the exporting country would have the closest trading relationship with it.

Tinbergen (1963) expanded on Isard (1954) when he made the concept of the use of gravity and distance famous by attempting to provide a theoretic foundation for trade by making the occurrence of trade as one that is governed by the physical laws of attraction. The original physical Newton's Law of Gravity holds that every particle attracts every other particle in the presence of the force of gravity F_g , which is directly proportional to the masses of particles one and two, denoted M_1 and M_2 below and is inversely proportional to the square of the distance "D" between the masses of particles, where distance is measured between the centres of the two particles (Piermartini and Teh, 2005). This physical law is denoted as:

$$F_g = G \frac{M_1 \text{ and } M_2}{D^2} \quad (\text{Bobkova, 2011}) \quad (2.1..2)$$

The G in this equation is representative of the universal gravitational constant.

To simplify this equation:

$$F_g \propto M_1, M_2 \text{ when distance remains constant.} \quad (2.1.3)$$

$$\text{and } F_g \propto \frac{1}{D_{21,2}^2} \text{ when } M_1, M_2 \text{ remain unchanged.} \quad (2.1.4)$$

Now Tinbergen's (1963) significance of Newton's Law of Gravity model in the determination of international trade stems from the basis that trade between countries will have an attractive force between countries of similar economic sizes and the distance between the two countries will have an inversely proportional relationship with trade, that is, trade will decline when the distance between trading countries rises and trade will increase the more similar the incomes of the trading countries are. Tinbergen's (1963) theory supersedes Isard (1954) concept as it provides a proven calculation of the effect of income and distance on resulting trade as opposed to the definite relationship that is only between distance and income.

In international trade, the gravity model of international trade is denoted as follows:

$$F_{ij} = C \frac{GDP_i * GDP_j}{D_{ij}} \quad (2.1.5)$$

Where F_{ij} is representative of the value of trade between two countries i and j , C is representative of a constant, GDP_i is representative of the economy size of country i and GDP_j is the economy size of country j . D_{ij} represents the distance between the trading countries i and j .

When unscrambling this formula, the international gravity model can be explained by the following:

The value of trade depends on the GDP/economic size of a country. This implies that the value of trade is directly proportional to economic size of the countries this will be denoted as:

$$F_{ij} \propto GDP_i, GDP_j \quad (2.1.6)$$

when $D_{i,j}$ remains constant

The distance between the two trading countries reduces the gains from trade. This supports the assumption of the inverse relationship between two countries mathematically depicted as $F_{ij} \propto$

$$\frac{1}{D_{2ij}^2} \quad (2.1.7)$$

Isard's (1954) contribution to international studies comprises of a transformation of (2.1.1) which views gravity as income potential. This model is denoted as:

$$iV = \sum_{j=1}^n iV_j = k \frac{Y_j}{d_{ij}^\alpha} \quad (2.1.8)$$

Where Y_j is the income of country (region) j , d_{ij} is the average effective distance (that is distance adjusted for level of transport rates) between countries i and j , α is a constant power to which d_{ij} is raised, k is a constant similar to the gravitational constant, iV_j is the income potential produced by nation j upon nation i , and iV is the income potential produced by all nations upon nation i . In Isard (1954) model the income potential by country i has an inverse relationship with distance.

Tinbergen's contribution to studies of international trade is amongst the most popular models of trade by using the gravity model. This model is more inclined towards an econometric estimation of bilateral trade flows and is the first model of gravity that without deviating from Newton's Law of Gravity added additional variables to the gravity model. Tinbergen's study was also the first study of the gravity model to include dummy variables such as colonial, religion, cultural and social parameters into the gravity model.

While Tinbergen's (1963) study has attempted to provide a justification for the gravity model, this justification is not enough in the field of international trade as the economic basis of the gravity model cannot simply be justified by the laws of physics. Therefore, at this point, the gravity model was critiqued for lacking an economic theoretical underpinning as it was difficult to deduce that countries trade simply because of having similar economic size as in the case of the particles of nature. This critique stirred an intensive study of the gravity model to find a plausible basis of analysing international trade flows. Linders (1961), Ricardo (1817/1951), Samuelson (1949), and Anderson (1979) are amongst the popular studies which have aided the theoretic basis of the gravity model of international trade in economics.

Linder's (1961) support of the gravity model and basis for trade is based on the limitation of domestic markets which calls for countries to trade with each other so that demand expands through the reach of different markets. In Linder's (1961) theory, the more similar the demand structure of two countries is, the more intensively these countries will trade amongst each other. This theory is in line with the income aspect of the gravity model as demand is based on the limited budget structure of an economy of the willingness and ability to buy Eastin and Arbogast (2011).

Initially Anderson (1979) acknowledged the popular use of the gravity model in international trade, citing that the gravity model usually produces a good fit for estimating trade relations. Despite its varied use, Anderson (1979) critiques the gravity model for having no theoretical basis for its use policy instruments as these instruments have “no identified” properties into the model. There is no theoretical basis for adding border taxes into the gravity model, in a similar sense, inference on the effect of taxes using the gravity model carried no validity through the models use overtime (Anderson, 1979).

Anderson (1979) denotes the gravity model by the following specification:

$$M_{ij} = \alpha_K Y_i Y_j N_i N_j D_{ij} U_{ij} \quad (2.1.9)$$

The model is considered to be traditional and is multiplicative in its form, where M_{ij} represents exports from country i to country j , measured in thousands of U.S dollars, Y_j and Y_i are the incomes of country I and J , D_{ij} is the distance between country i and j , N are importer and exporter fixed effects and U_{ij} is the equations measurement error.

Anderson and van Wincoop (2003) adjusted this model to

$$T_{ij} = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} N_i^{\alpha_1} N_j^{\alpha_2} D_{ij}^{\alpha_3} e^{\theta_i d_i + \theta_j d_j} \quad (2.1.10)$$

Which considers multilateral resistance terms $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \theta$ which are the estimated parameters and d_i and d_j are the dummy variables associated with to the two trading countries. Fixed effects of this model include country specific effects into the model which in trade can include information on the country’s membership to trade agreements, the sharing of borders between countries, having common spoken languages in bilateral trade, union membership, common currencies, etc. (Anderson and van Wincoop, 2003). This method allows for easier computation while addressing the multi-resistance terms in the model.

This model will be represented by the form

$$E(T_{ij} | Y_i Y_j N_i N_j^{\alpha_2} D_{ij}^{\alpha_3} d_i d_j \alpha_0 Y_i Y_j N_i N_j D_{ij} e^{\theta_i d_i + \theta_j d_j}), \quad (2.1.11)$$

which infers that the conditional expectation of T_{ij} depends on given explanatory variables.

Alternatively, through simplification of (2) the multiplicative gravity model can be denoted:

$$F_{ij} = C M_1 M_2 D_{ij} U \quad (2.1.12)$$

Where U represents the random error of measurement.

The use of the multiplicative model declined with time as it was considered to have limited computational power and was difficult to measure (Silverstovs and Schumacher, 2009). Studies instead focused on the log-linear approach estimation of the gravity model. The log-linear model of gravity will be a transformation of

$$\ln(F_{ij}) = \ln C + \alpha \ln(M_1) + \beta \ln(M_2) + \gamma \ln(D) + \ln(U) \quad (2.1.13)$$

into

$$\ln(X_{ij}) = b_0 + b_1 \ln Y_i + b_2 \ln Y_j + b_3 \ln(D_{ij}) + \ln(e) \quad (2.1.14)$$

b_0 is representative of the parameters of the model, e represents the random error term when trade flows between countries i and j , under the assumption that $N(0, \sigma)$, that is, normal distribution with standard deviation σ and mean 0, X_{ij} is the value of trade flow between country i and country j . D_{ij} is the distance between countries i and j . Y_i and Y_j are the economy sizes of countries i and j .

2.11 Partial Equilibrium Models

Initially, trade was measured by looking at small factors such as tariff rates and the magnitude to which the tariff rates would affect gains from trade (Estefania-Flores, 2022). The focus on tariff measurement involved calculating the effect of a tariff on restricting the trade of a country and the effect of thereof (of tariffs) on welfare and output. To measure this effect initially, the simple average tariff measure was employed.

Under the simple average tariff, all tariff lines are given the same weight, such that agricultural goods are subject to the same tariff charges as those of the automotive industry (Bach and Martin, 2001). This defining method of the simple average tariff is also the model's limitation. The simple average tariff does not consider the respective importance of the weight of each good in forming the tariff (Bach and Martin, 2001). Disregarding the weight of a product in forming the average tariff distorts this weight measure as policy formulation will be skewed upwards or downwards as it does not display the importance of each traded good on the economy (Bach and Martin, 2001). In a case where the tariff rate is zero, thousands of tariff lines are aggregated and there is no trade amongst other tariff lines, the results from the measurement will be insignificant for the respective country (Pelikan and Brockmeier, 2008). A low level of tariff aggregation will understate the true levels of protection in the economy (Bach and Martin, 2001). In disregarding weights of goods this model offers no indication of the level of protection afforded to producers by tariffs nor the costs of this protection to the economy.

To address the problem of the distorted average tariff weighing problem in trade - economists developed the trade-weighted average tariff measure. The trade-weighted average tariff measure considers the importance of the traded good and provides it with a weight. The greater the importance of the product in trade, the greater the weight it will be given (Pelikan and Brockmeier, 2008). This method is flawed in that the weight of a trade good will be less important when the tariff of the traded product increases (Bach and Martin, 2001). The forces of demand and supply distort the actual weight of the product when the price rises due to high tariffs distorting the exact value of the product. Coughlin (2010) has shown that the imposition of a tariff results in increased prices and a decrease in the demand for the goods which have tariff imposition. The increased cost of the traded good provides an illusion that the good carries more value in trade than the reality through the higher total amounts recorded in trade. The trade-weighted average tariff method is favourable in that it uses two levels of information: a country's total customs are divided by the total value of the imports (Bowen and Irwin, 2015). It has been recommended that the average weighted average tariff should be measured in trade as a division of customs and the total value of imports (Coughlin, 2010) as import values are easy to obtain on internationally available databases such as in the World Integrated Trade Solutions (WITS) and from COMTRADE and the South African Revenue Services. The flaw of this method of measurement is that under free trade it would be difficult to measure import values (Pelikan and Brockmeier, 2008).

The weighted and simple average tariffs have been employed in partial equilibrium analyzes but are not limited being applied to it only. Partial equilibrium analysis refers to an analysis that only considers the effects of a policy on the market that is directly affected, in this case, all interactions between with other markets are ignored (WITS, 2010). Considering that the imposition of a tariff occurs because of a policy change, this change is fed into the partial equilibrium as evidence of effect. Pitigala (2009) shows the partial equilibrium interaction in the figure below.

Partial Equilibrium Impact of Tariffs on Welfare

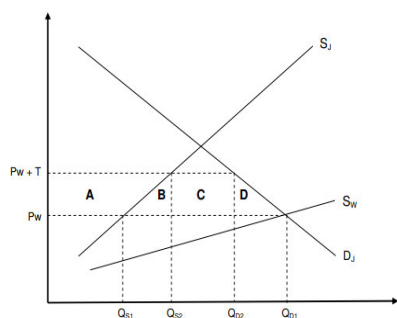


Figure 3

Source: Pitigala (2009) Trade and Tariff Reforms in Jordan.

The tariff charged is denoted as T and the world price is denoted as P_w . The imposition of a tariff raises the domestic price to $P_w + T$ from P_w , this shows that the import price has risen due to the tariff imposition and so the domestic price of the good will rise to $P_w + T$. Production rises to Q_{s2} the price increase inspires producers to produce more, consumption drops to Q_{d2} due to the higher prices faced by consumers. The tariff allows domestic producers to make sales at a higher price that is consistent with $P_w + T$. The higher price experienced by consumers results to a loss in consumer surplus that is equal to $A + B + C + D$. The producer's benefit from the tariff imposition is equal to the area A , this benefit is shared with foreign producers as well resulting in the domestic country experiencing a higher deadweight loss. This welfare distribution analysis allows us to critically analyze the effect of a tariff imposition on the economy.

Anderson and Neary (1996) found that the previously implemented simple average tariff measure underestimates the restrictiveness that exists under trade by at least fifty percent and, as such introduced the Trade Restrictiveness Index (TRI). The TRI represents the uniform price level which when applied to changing levels of prices will yield the same levels of welfare for consumers. The Trade Restrictiveness Index deflates the distorted prices of goods at the new level of prices so that it maintains the old level of welfare for consumers while considering the budget constraint of the economy. It provides weight to different trade policies, and it assumes that the ideal weights of goods will not necessarily reflect the ideal trade weights of the goods. Policymakers can find an incentive to provide the weight of a good that does not reflect a weight as market conditions would determine. To measure restrictiveness Anderson and Neary (1996) look at tariffs and quotas and considers all other non-tariff restrictions as quota restrictions. The structure used to show this is as follows:

$$d(\pi^1, u^0, \pi^0) = B(\pi^0, u^0)$$

π^0 is the old price level, π^1 is the new price level and u^0 is the old level of utility and $B(\cdot)$ is representative of the balance of trade function. The balance of trade function provides the transfers from outside the country that should be maintained to achieve constant levels of utility/welfare. The first limitation of this model is that the welfare of the consumer is based only on external contributions from outside of the country as the model only factors goods produced for consumption outside of the country and non-traded goods. Other limitations of this model are that the model is only optimal for measurement of welfare/utility changes only for a small country and the TRI is an unreliable measure of specific sector restrictions (Bach and Martin, 2001). Anderson (1993) applied this model as an inputs-output model where inputs are a function of technology and labour, imported inputs that are subject to tariffs and quotas. The constant elasticity of substitution relating the input to the output is then used to obtain the outcome. The TRI can be used as both an ex-poste and ex-ante analysis tool, as an incidence tool tariff data that is old and new are assimilated then the TRI is calculated for the new policy change.

Finally, Estefania-Flores et al. (2022) introduce the Measure of Trade Restrictiveness (MATR). The MATR differs from Anderson and Neary's (1996) TRI in that it provides an intrinsic measure of trade protection as it measures the existence of a trade restriction instead of providing its weight; the intensity and efficacy of values are ignored. This is a simple method as it displays the number of trade restrictions that one country has and measures the impact of the direct existence of protection. The advantages of employing the MATR are that it is based on an easily accessible array of data that are reliable and transparent and that it is based on clear quantitative restrictions and includes quantification of both tariff and non-tariff barriers (Estefania-Flores et al. 2022). A higher MATR index, that is an index close to 22 shows that a country practices prominent levels of trade protection. The restrictions accounted for by the MATR index amongst tariffs include restrictions on currency practices, exchange measures enacted for security purposes, currency requirement prescriptions, payment agreements, control administration, arrears in payment, controls on exports and imports of banknotes, foreign exchange budget, financing requirements for imports, documentation requirements for the release of foreign exchange for imports, import licenses and other non-tariff measures, state import monopoly, repatriation requirements, financing requirements, documentation requirements, export licenses, export taxes, payments for invisibles, transfers and current transfers, repatriation requirements on proceeds, surrender requirements on proceeds, and restrictions on the use of funds can all count as restrictive measures in trade Estefania-Flores

et al. (2022). The presence or absence of any of the restrictions in trade contributes towards the 22-count MATR index. The MATR captures the output of the economy as a function of employment, labour productivity, inequality, the trade balance, investment, consumption, exports, and imports with the inputs being the MATR objects.

2.12 Measuring Trade using General Equilibrium Models

In the modern age, the differing trade protection measures have often been assimilated into one general equilibrium measurement approach that lumps together weighted and unweighted tariffs, simple indexes of the number of tariffs and the existence of non-tariff factors in trade. These approaches can measure the economic consequences of protectionist measures on the economy by measuring the incidence of trade protection and the outcome of trade protection (Plummer, Cheong, and Hamanaka, 2010; Hiscox and Kastner, 2002).

The simplest property of the general equilibrium measurement approach is that it observes the effect of the forces of demand and supply across markets on prices. It plays a crucial role in equilibrating the forces of demand and supply such that sellers who are able and willing to sell can do so without limitations in the market, and all demanders who are able and willing to buy can do so without excess on either side (Levin, 2006), like in the partial equilibrium.

The general equilibrium approach differs from the partial equilibrium approach in that it may not be reliable to speak of an equilibrium with information of only one good in the economy, as a single market is interrelated to many other markets (Piermartini and Teh, 2005). A consequence of interlinked markets is that events occurring across markets will have effects on other interlinked markets; for example, in the case where the tariff on wheat dropped, this would increase the demand for wheat in the market due to lower costs, which would induce a reduction in the prices of wheat's substitutes and would increase the price of the goods that are complementary to wheat (Piermartini and Teh, 2005). These changes invoke a ripple effect in the economy as the reduction in tariffs in the wheat industry results in increased wheat production, which can be transferred to the exports sector or result in a wheat shift towards the rice sector, which is a substitute for wheat as the prices drop in the rice sector as more wheat is consumed. It was the reduction of tariffs in the wheat sector that opened up opportunities for growth in other sectors of the economy (Piermartini and Teh, 2005).

Due to the ability of the general equilibrium model to link effects across different markets, it is optimal to make use of this model for multi-lateral relations and multi-regional analysis, as the effect of a reduction of tariffs in one market can affect the markets of all other markets that are

trading with it, which is true for trading countries as well (Piermartini and Teh, 2005). To satisfy the general equilibrium position in an open economy, four conditions have to be met. There has to be a balance in the force of demand and supply for all the goods in an economy; the total demand for labour should equal the total supply of labour, and the capital account of the economy must offset the balance in the external current account and government budget should be allocated between government expenditure and savings (Devajaran and Go, 1998).

Devajaran and Go (1998) have shown that in an open economy – that is, an economy that is open to trade – a tariff reduction will be offset by an increase in domestic taxes that are charged by the government so as to maintain consistent revenue or a sustainable external account balance. For example, when their study reduces the tariff rate on final imports to eight percent, imports increase by 0.8 percent, and exports increase by 0.6 percent, but then the fall in domestic prices due to the reduced tariff is offset by the increased domestic tax adjustment such that there is almost no change in the consumption levels. In the short run, there is a small welfare improvement of 0.0016 percent, and in the long run, the tax adjustment is larger, amounting to an increase in the tax rate to 7.1 percent. Due to the reduced tariff and increased domestic taxes, the study also finds that investment falls by 3.5 percent to 2.7 percent, and as a result of the lost wealth, consumption, which initially rose, falls by 1.3 percent. While exports rise initially, they eventually fall due to a reduction in capital stock, and so a contraction of the tax base calls for a higher domestic tax adjustment to ensure a balance in the current account, resulting in a welfare reduction of 0.0202 percent. In this case, the reduction of a tariff induces lower levels of welfare. The evidence of this occurrence is shown in the figure below.

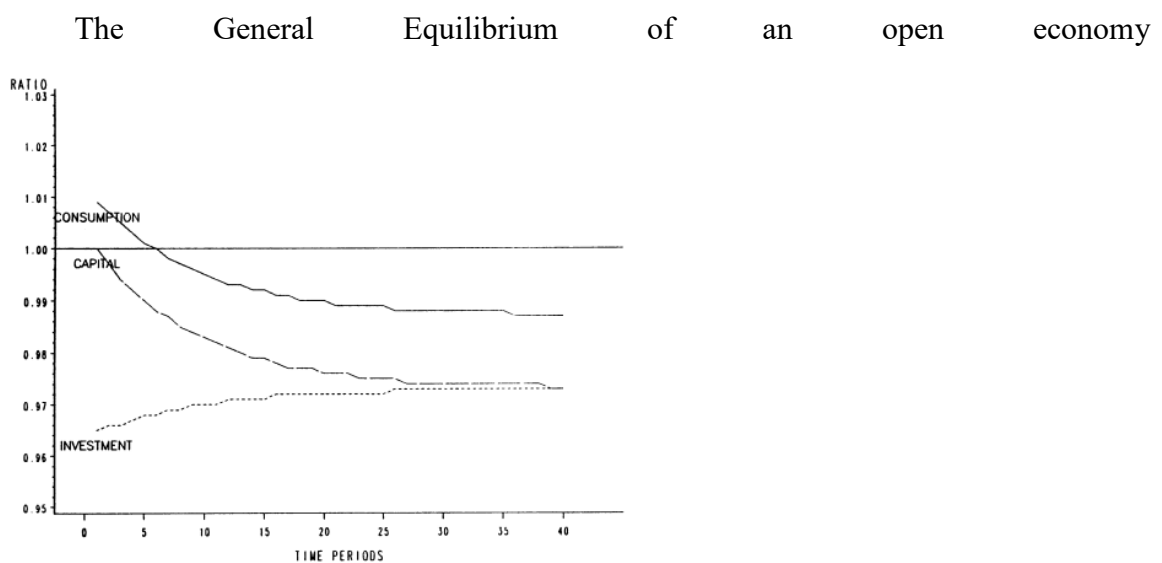


Figure 4

Source: Devajaran and Go (1998). Reducing trade protection effects on consumption and investment.

Various other studies have shown varying results of the effects of more open trade and trade protection on the economy by making use of general equilibrium models. Muchopa et al., (2020) makes use of the Global Trade Analysis Project (GTAP) model which is a multiregional and multisector computational general equilibrium model to analyze economy wide welfare impacts of trade. The study simulates trade liberalisation at an aggregated level to analyze tariff effects on trade. The study finds that when protectionism is reduced, that is when tariff restrictions are reduced in size, South Africa's output from frozen juices increases by 0,04 percent while the output of its trading partner which is the EU28 and the rest of the world decreases.

Chinembiri (2010) also makes use of a general equilibrium model and finds that import penetration has a positive effect on the tertiary sector of South Africa in that a one percent increase in foreign competitiveness (which occurs as a result of increased trade) increases employment within the tertiary sector by 0.006 percent, in the same sector, a one percent increase in wages (which is a proxy for trade liberalisation), induces a 0.04 percent increase in employment. In the primary and the secondary sector, a one percent increase in wages will result to an employment decrease of 0.083 percent and 0.062 percent, respectively. A foreign competition increase of one percent will decrease employment levels by 0.04 percent in the secondary sector and decrease employment in the primary sector by 0.003 percent.

Lubinga et al. (2018) makes use of the ordinary least squares measure and the Poisson and finds that a one percent increase in export promotion and market development levy translates to a rise in social welfare ranging from 0.1 percent to 0.8 percent. The European ban of South African citrus led to an increase in social welfare for South Africa. This has been attributed to various factors such as South African exports not being limited only to the European Union. Another reason has been that the ban might have had a stimulus on other exports that had not been affected by the ban.

Edwards et al. (2022) estimate the consumer price effects of trade policy in South Africa. This study shows that when importing chicken, South Africa is a price taker, and tariffs and other import duties are fully passed on to the consumer. From this study, the impact the tariff on consumer prices depends on internal transport costs, changes in margins that are charged by wholesalers and retailers and price responses of domestic products. The study shows the

coefficient on MFN tariffs in 2013 and in 2014 are associated with a price increase. In 2013, there was a seventeen percent increase in prices and in 2020, a 1,9 percent increase. A ten percent increase in weighted average applied import duties is associated with a 4.8 percent increase in consumer prices.

2.12.1 The Computable General Equilibrium

Estimations of the general equilibrium in the modern world are normally conducted using computer estimations due to the complexity associated with real-world data observations across different markets, which span over many years (Piermartini and Teh, 2005). One of the computational methods used is the computable general equilibrium model, which is a computational simulation that combines the structure of the general equilibrium model with real-world economic data to calculate the levels of supply, demand, and prices numerically across a given set of markets (Wing, 2004). The computable general equilibrium model executes empirical analyzes to estimate the welfare impacts of policies (fiscal policy, trade policy, and environmental policy) that are carried out through taxes, subsidies, and quotas (Wing, 2004; Böhringer, Rutherford and Wiegard, 2003).

In international trade, the Computational General Equilibrium method, unlike the simple general equilibrium model, subsumes that a change in policy – e.g., a reduction in a tariff by an importing country in the wheat industry, will subsequently affect many other sectors and can change the structure of the entire economy (Piermartini and Teh, 2005). In international trade, the CGE estimates of welfare are commonly employed by the use of the equivalent variation method, which is a monetary measure that calculates the effect of exogenous variables on the welfare of a country. This method is plausible as it provides an intuitive measurement of welfare (Piermartini and Teh, 2005).

Böhringer, Rutherford, and Wiegard (2003) show that to build up the CGE, it is required to derive a total differential of the market equilibrium, and a system of equations should be solved for the changes in the variables that are included in the model as the structural changes observed in the system of equations requires a mathematical analysis. In summary, there are five steps required to be able to construct CGE models (Böhringer, Rutherford, and Wiegard, 2003):

1. A policy issue and the required data to solve the issue must be identified to decide on the appropriate model to be used

2. An economic justification of the study that drives the mathematical results should be derived. In this step, the model formulation implementation on a set of data delivers the framework of mathematical analysis

3. There is calibration, a mathematical process that is used to select parameter values for the model, which requires a set of data that is a single observation over a space of time shown as an average of a panel set or an average of years of data.

4. A change in the exogenous variables, which are the policy changes and parameters, is captured in the model, and a new equilibrium is found. This change is captured in outcome variables such as in employment, in production, on consumption, and on prices.

5. The model results are interpreted based on sound economic theory.

While the CGE can employ intuitively correct simulations as a welfare estimator, like through the equivalent variation, many other exogenous variables and parameters can be added to the model. These parameters and variables may contain unreliable information and have no theoretical background, which qualifies the model to achieve reliable results in the model (Wing, 2004). In this light, a strong theoretical background is key to measuring the effect of variables in international trade.

One of such applications was conducted through the CES production function which is calibrated as

$$y = \gamma \left(\sum_i \alpha_i x_i^\rho \right)^{1/\rho} = \bar{y} \cdot \gamma \left(\sum_i \left(\gamma^{-\rho} \cdot \theta_i \cdot \bar{x}_i^{-\rho} \right) x_i^\rho \right)^{1/\rho} = \bar{y} \cdot \left[\sum_i \left(\theta_i \cdot \left(\frac{x_i}{\bar{x}_i} \right)^\rho \right) \right]^{1/\rho} \quad (2.2.1)$$

which is derived from the demand function

$$\alpha_i = \gamma^{(1-\sigma)/\sigma} \cdot \left(\frac{x_i}{y} \right)^{1/\sigma} \frac{w_i}{p} \quad (2.2.2)$$

where α denotes the distribution parameter for input i , γ is the scale parameter, σ is the substitution parameter, ρ is the substitution elasticity parameter, x_i is benchmark demand for input i , w_i is the benchmark output level, p is the benchmark output price (Bohringer, Rutherford and Wiegard (2003).

One model that has sought to address the problems associated with the CGE model is the gravity model of international trade.

2.13 Conclusion

The chapter has explored those various theories associated with international trade. Initially, the study observes trade in relation to the theory of absolute advantage that was initiated by Aristotle and pioneered by Adam Smith, it then proceeds to explore the scholastic and Christian schools of thought which are followed by the Mercantilist theories. Having explored the shortfalls of existing trade theories the study proceeds towards the theory of comparative advantage initially pioneered by Ricardo and later overtaken by Heckscher-Ohlin. During studies of comparative advantage, the chapter shows the development of the Leontif Paradox, which proves the theory of comparative advantage as a limited model of trade and so, the chapter proceeds towards new trade theories which do not limit trade to competition but agree that collaboration amongst competitors is possible and may lead to improvement in trade. The chapter further identifies the strategic trade theory, citing that the government should only be involved in trade minimally which is through policies. The chapter further explores Porter's theory, a theory commonly applied to management studies and heavily critiqued in economics as it lacks theoretical and mathematical underpinnings for causality which called for an exploration of models with mathematical and theoretical underpinnings such as the gravity model of international trade, the partial equilibrium analysis used in traditional international trade studies and computational general equilibrium models.

Chapter Three

Methodology

3.1 Introduction

This study makes use of the gravity model as the model of departure towards of the cost of trade protection on the economy of South Africa. With the gravity model serving as the key analytical framework, the objectives of this chapter are (i) to outline the baseline estimation technique, (ii) to provide a coherent explanation of the process to be followed during estimation, and (iii) to justify the chosen methods for examining trade flows.

The gravity model of international trade is the choice model for this analysis as it is well-suited to analyze and predict trade relationships across regions and is found to be robust in estimating trade compared to other models, as discussed in the previous chapter. A combination of estimation techniques and diagnostic checks will be defined in this chapter to capture both economic gravity and policy-related influences on trade, as discussed in the theoretical overview provided earlier.

The gravity model utilized in this study derives its sense from Head and Mayer (2014) and Chaney (2011). In this context the gravity equation is assumed to be multiplicative, whereby the multiplicative nature of it is consistent with Newtons Universal Law of Gravity. It is important to note that while the gravity model used in the study is multiplicative, the multiplicative form is not necessary for estimation. The function of the gravity model relies on the value of production of the exporter and the expenditure structure of the importer (Head and Mayer, 2014). This function is shown as:

$$X = GS_i M_n \phi_{ni} \quad (3.1.0)$$

Where i represents the country of origin, n the destination country S represents the capabilities of the exporter, M captures the characteristics of the destination market and ϕ represents the ease of accessibility of the exporter into the economy of the importer.

Now, trade between any two countries begins at the firm level, to depict this clearly, there is an assumption that the exporter produces intermediate and final goods. The intermediate goods are distributed worldwide, and final goods are consumed locally. Focusing on intermediate goods, the process begins with firm i (firm from country i) purchasing goods from a given set of suppliers k which are an element of K_i , this output is sold to j an element of J_i which are customers in country i . The interaction of the purchasing process is captured by the following equation:

$$Q_i = \left(\int_{k \in K_i} q_i(k)^{\frac{\sigma-1}{\sigma}} dk \right)^{\frac{\sigma}{\sigma-1}} L_i^{1-\alpha} \quad (3.1.1)$$

In the equation firm i combines labour with $q_i(k)$ units of differentiated intermediate products from each supplier to produce Q_i units of output. In the equation $0 < \alpha < 1$ which represents the share of inputs into production and $\sigma > 1$ which is the substitution between two intermediate inputs. As firm i faces constant elasticity of demand from j , an element of J_i .

$$p_j(i) q_j(i) = \frac{p_j(i)^{1-\sigma}}{\int_{k \in K_j} p_j(k)^{1-\sigma} dk} \alpha X_j \quad (3.1.2)$$

This equation shows that with constant elasticity firm i charges j the price $p_j(i) X_j$ becomes the total spending on intermediate goods by j . Given the constant elasticity of demand, firm i charges j a markup of $p, \sigma/\sigma-1$ over the marginal cost shown as:

$$p_j(i) = p_i = \frac{\sigma}{\sigma-1} w^{1-\alpha} \left(\int_{k \in K_i} p_i(k)^{1-\sigma} dk \right)^{\frac{\alpha}{1-\sigma}} \quad (3.1.3)$$

w becomes the wage rate. Provided that the suppliers are in perfect competition the price level is the same across all suppliers therefore, customers will be charged the same price. Given the perfect competition assumption, the total sales of firm i will be dependent on the number of suppliers and on those of the customers, this is shown by the following equation:

$$p_i Q_i = \int_{j \in J_i} p_i q_j(i) dj = \|K_i\|^\alpha \times \|J_i\| \times \left(\alpha \frac{X}{\|K\|^{1+\alpha}} \right) \quad (3.1.4)$$

This equation shows that the number of suppliers and customers increase output size, sales and ultimately profits. This result shows that an increase in the amount of trade between countries increases the access of firms to supplies and a customer base allowing for an increase in the totality of the economy. The gravity equation, initially based on income and distance bases its income factor from the above-derived analysis, distance is accounted for through the costs factored in through prices when trade takes place between the trade partners.

3.2 Baseline Estimation of the Gravity Model

The structure of the gravity model used in this study remains consistent with traditional formulations, adjusted for South Africa's trade context. Chapter Two provided an extensive explanation of the theoretical underpinnings of the gravity model; here, we apply the model

using specific variables tailored to capture trade determinants relevant to South Africa's unique economic and geographic position.

The empirical specification of the gravity model in this study is as follows:

$$\ln X_{ijt} = \alpha + \beta_1 \ln(\text{SA GDP}) + \beta_2 \ln(\text{GDP}) + \beta_3 \ln(\text{Distance}_{ij}) + \beta_4 \ln(\text{Tariffs}) + \beta_5 \ln(\text{Population Size}) + \beta_6 \ln(\text{Fixed Capital}) + \beta_7(\text{Preferential Trade Agreement}) + \beta_8(\text{Common Language}) + \beta_9(\text{WTO membership}) + \gamma + \delta + \sigma + \epsilon \quad (.3.2.1)$$

In equation (3.2.1), subscript *i* represents the exporting country (South Africa), and subscript *j* represents South Africa's trading partner among 127 countries, *t* is representative of the year of observation of trade activity standing for years from 2010 to 2022, α and β are the coefficients in the dataset that are being estimated. The dependent variable, representative of trade, is the export flows from South Africa measured in Rand values to its trading partners in each period denoted as $\ln X_{ijt}$. The \ln before the variables shows that these are the variables that have been added in their logarithmic form into the model. γ represents the importer's fixed effects, δ represents the exporters' fixed effects such as common language and distance. σ represents the year's fixed effects (year and country). ϵ is the error term.

The remaining set of variables of equation (3.2.1) represent specific economic, geographic, and policy-related determinants of trade flows:

Variables and Definitions

Table 1

Variable	Definition
SA GDP	South Africa's real GDP in local Rands currency in year <i>t</i>
GDP	Real GDP of the importing trade partner of South Africa in year <i>t</i>
Distance _{ij}	Distance between the capital cities of countries <i>i</i> and <i>j</i>
Tariffs	The average weighted Tariffs across all products in the economy of country <i>j</i>
Population	Population size of countries <i>j</i> at time <i>t</i>
Fixed Capital	Gross capital formulation measured in US dollars in year <i>t</i>
Preferential Trade Agreement	Preferential Trade agreement dummy showing if a country has a direct trade agreement in year <i>t</i>

Common Language	Dummy variable that captures if the countries share common officially recognized languages as South Africa at time t
WTO membership	Dummy variable that captures if the trading country is a member of the World Trade Organization at time t

Source: Author's own table.

3.3 Data Selection, Sources, and Limitations

This study analyzes trade between South Africa and 127 partner countries from 2010 to 2022. The selection of these countries was based on two criteria: data availability, and representation of major trading partners across all global regions (Africa, Asia, America, Europe, and Oceania). The study notes that while it estimates data for consecutive years a selection bias can occur as this can produce suspicious estimates due to the short adjustment time associated with changing years between the dependent and independent variables (Yotov et al., 2016). Yotov et al. (2016) initially suggested using data that is split between a few number of years as this could yield acceptable results. The limitation in the amount of years hindered this study from following from Yotov et al. (2016).

To ensure accuracy and relevance, data was sourced from reputable international databases. Primary data sources include the South African Revenue Service which provided the study with export data of South Africa and information on the status of South Africa's preferential trade agreements with its trade partners. The World Bank's Development Indicators provided the study with information on GDP, average weighted tariffs, population size, and fixed capital. The United Nations World Factbook provided the study with data on common language and World Trade Organization membership. Data on physical distances between countries was obtained from the Centre d'Études Prospectives et d'Informations Internationales (CEPII).

3.4 Model Comparisons

3.4.1 Linear Models: Ordinary Least Squares

Equation (3.2.1) encompasses specifications that are non-linear in the explanatory variables such as the dummy variables on Common Language, Preferential Trade Agreement and the World Trade Organization. This implies that the baseline model may not be suitable to conduct a linear analysis as it may fail to make a good prediction based on the variables that the model has been fed (Clock backwards, 2009). Two ways that are advised to solve this problem are: (i) to explore a non-linear model that can encompass these variables (Fox, 2005) and (ii) to

transform the data such that it is linear (Clock backwards, 2009). If this study transforms equation 3.2.1 such that it returns a non-linear model, there will be:

$$\ln X_{ijt} = \alpha + \beta_1 \ln(\text{SA GDP}) + \beta_2 \ln(\text{GDP}) + \beta_3 \ln(\text{Distance}_{ij}) + \beta_4 \ln(\text{Tariffs}) + \beta_5 \ln(\text{Population}) + \beta_6 \ln(\text{Fixed Capital}) + \gamma + \delta + \sigma + \varepsilon \quad (3.4.1)$$

This would imply that the model converts into the basic ordinary least squares measure – a linear regression. Note that 3.2.1 is also an ordinary least squares measure albeit having additional non-linear explanatory variables. This has been a common acceptable addition into the model (Clock backwards, 2009).

It is the standard of the OLS that, albeit having the ability to accept non-linearities requires the dependent variable to be logged ($\ln X_{ijt}$) to be able to achieve consistency across the model. Logging the dependent variable of the regression encompasses its own problems as the dependent variable must assume strictly positive values (Silva and Tenreyro, 2006).

The requirement of ensuring that the dependent variable is log transformed can introduce a bias into the model when the values that require log-transformation are equal to zero, are non-positive values, are missing values and when the data is heteroskedastic (Santos Silva & Tenreyro, 2006; Ugrinowitsch et al. (2005)).

It is worth noting that one of the other standards of the OLS are for the residuals of all the explanatory variables to be constant. According to Shepherd (2013) it is mostly smaller economies that experience issues when log-transforming the dependent variable when applying OLS model.

Santos Silva and Tenreyro (2006) further indicate that while the OLS can encompass the error term ε , this error term in OLS gravity models is frequently heteroskedastic, leading to inconsistent estimates unless these issues are accounted for.

To address the problems associated with the ordinary least squares model several other models have been explored such as the Gamma Pseudo Maximum Likelihood (GPML), ET-Tobit, Non-linear Least Squares (NLS), and the Poisson Pseudo Maximum likelihood amongst other models. Santo Silva and Tenreyro (2006) found that the ET Tobit models are inadequate in estimation as these models require a modification of the dependent variable resulting to a bias in data, the NLS model is inadequate as it is found to cause erratic behavior in the data, the gamma pseudo maximum likelihood is fairly good as it has standard errors and biases that are

low but not as good as the Poisson pseudo maximum likelihood model as the GPML also has its problems of overestimation of coefficients.

3.4.2 Poisson Pseudo Maximum Likelihood

Focusing on Poisson Pseudo Maximum Likelihood method proposed by Santos Silva and Tenreyro (2006), a popular method in estimations of the non-linear multiplicative gravity model. This method hails from a family of probability distributions which does not necessarily contain the true distribution of a sample. In essence, the Poisson pseudo maximum likelihood model provides consistent and asymptotically normal estimators of parameters involved in the true distribution.

Amongst its specifications, the PPML method follows the assumption that conditional variance is proportional to the conditional mean, that is $E[y_i|x_i]$ is proportional to $\text{Var}[y_i|x_i]$ and parameters may be estimated by solving for the following first order condition:

$$\sum_{i=1}^n [Y_i - \exp(X_i B)] X_i = 0$$

X_i are exogenous variables associated with i^{th} observation and B are unknown parameters. Y is a function of explanatory variables and disturbances. As a result of the assumption of $\text{Var}[y_i|x_i]$ proportional to $E[y_i|x_i]$, the estimator does not take full account of heteroscedasticity, as equality is unlikely to hold. In totality, $\exp(X_i B)$ is interpreted as the conditional expectation of y given x and is denoted $E[y_i|x_i]$.

The same assumption of conditional variance being proportional to the conditional mean provides the same weight to all observations, allowing for a consistent observation which avoids overspecification of noisy variables. Silva and Tenreyro (2006) proved that the PPML method is robust in differing variance situations.

Another specification of the model is that the endogenous Y_i should be a real number (Gourieroux, et al., 1980), however, for this to be achieved, exogenous X_i variables should be positive for any given observation.

The Poisson distribution formula is defined by:

$$P(Y=k) = e^{-\lambda} \lambda^k / k!, \text{ where } k=0, 1, 2, \dots$$

Where Y is a random variable following a Poisson distribution, k is the number of times an event occurs, $P(X=k)$ is the probability that an event will occur K number of times, e is Eulers constant, λ is the average number of times that an event will occur and, $!$ is the factorial function. λ is a real number/non-integer. When this number is low the probability distribution will be skewed to the right. As λ increases the probability distribution will look more like a normal probability distribution. A high λ is more representative of a Poisson distribution. Therefore, the λ is representative of mean and variance – mean and variance are specified by one single λ due to the assumption of proportionality, and λ also can be specified as

$$\lambda = \exp(XiB) = e^{\beta_0 + \beta_1 X_1 + \dots}$$

Previously, most gravity estimations employed the ordinary least squares method. The standard procedure of this method is to log-linearise the gravity equation.

Amongst the specifications of this model is that the log of the error of the estimated equation should not depend on X , lest the model result to inconsistent estimates of β . The transformation of the dependent variable in the model will change the properties of the of the error term as the conditional expectation of $\ln(\eta)$ on the curvature of the distribution of η .

The dependency of the error term on each observation denoted, $\varepsilon_{ij} = Y_{ij} - E(Y_i|X_i)$ is likely to be heteroscedastic rendering the estimator inconsistent.

Amongst other critics of the ordinary least squares model, Silva and Tenreyro (2006) have identified that the first flaw of the OLS is that the endogenous variable can be zero which renders using the log-linearised method impractical. Secondly, if the observations of the endogenous variable are positive, the expected value of the measurement error will depend on the covariates which will render the use of ordinary least squares inconsistent.

Due to the inconsistencies associated with the traditionally used ordinary least squares measure, the PPML methods is preferable and has been used in various studies of trade determination between countries.

The specification of the PPML in this study is as follows:

After controlling for fixed effects:

$$X_{ijt} = \exp \{ \beta_1 \ln(\text{SA GDP}) + \beta_2 \ln(\text{GDP}) + \beta_3 \ln(\text{Distance}_{ij}) + \beta_4 \ln(\text{Tariffs}) + \beta_5 \ln(\text{Population Size}) + \beta_6 \ln(\text{Fixed Capital}) + \beta_7(\text{Preferential Trade Agreement}) + \beta_8(\text{Common Language}) + \beta_8(\text{WTO membership}) + \gamma + \delta + \sigma + \epsilon_{ij,t} \} \quad (3.4.2a)$$

Before controlling for fixed effects the PPML model is as follows:

$$X_{ijt} = \exp \{ \beta_1 \ln(\text{SA GDP}) + \beta_2 \ln(\text{GDP}) + \beta_3 \ln(\text{Distance}_{ij}) + \beta_4 \ln(\text{Tariffs}) + \beta_5 \ln(\text{Population Size}) + \beta_6 \ln(\text{Fixed Capital}) + \beta_7(\text{Preferential Trade Agreement}) + \beta_8(\text{Common Language}) + \beta_8(\text{WTO membership}) + \epsilon \} \quad (3.4.2)$$

Point of focus: the dependent variable X_{ijt} - not logged.

3.4.3 Diagnostic Testing and Robustness Checks

To validate the reliability of the estimates, several diagnostic tests are applied to the study beginning with the Breusch Pagan test, a test of heteroscedasticity followed by the White test and the Park Test, a linear test of adequacy for estimation. The study expands to robustness tests such as the Regression Specification Error Test (RESET). These checks ensure that model assumptions are met and that the chosen estimation techniques yield consistent results.

3.4.3.1 Breusch Pagan Test

As mentioned in section 3.4.1 of this study, ordinary least square regressions often have a heteroskedastic error term and do not perform well when there is heteroskedasticity in the data. Another basic assumption of the OLS is that there should be constant variance in the model. This calls for analysing if data is heteroskedastic when observing datasets and addressing the problem associated with heteroskedasticity if it applies to the dataset. The aim is to achieve estimates that are not affected by heteroskedasticity as these would be biased.

Heteroskedasticity occurs when the variance of error term deviates widely across the error terms of all the explanatory variables of the model. This leads to inefficient estimates of the regression coefficients that are unreliable, as the standard errors may be biased, leading to incorrect conclusions (White, 1980). Ignoring heteroskedasticity in gravity models can lead to misinformed policy making. To address heteroskedasticity PPML will be used.

To test for heteroskedasticity in data the Breusch-Pagan test, which detects heteroscedasticity in the dataset is implemented using the hypothesis:

H_0 : The variance of the error term is spread evenly across the data (constant variance)

H₁: The variance of the error term is not spread evenly across the data (Presence of Heteroskedasticity)

When the P-value that is returned from running the Breusch-Pagan test is significant, the null hypothesis of the error term being constant is rejected and it is concluded that the data is heteroscedastic. After confirming that the data is heteroscedastic then the PPML can be used which naturally addresses heteroskedasticity in data (Wooldridge, 2013).

3.4.3.2 The White Test

Is an extension of the Breusch-Pagan test and it determines if the variance of the residuals in a model are constant in OLS models. In its essence, the test requires adding the squares of regressors to detect non-linearities. The derivation of this test requires regressing the dependent variable to the independent regressors allowing for determining the residual value. After the residual value has been determined it should be regressed with the independent regressors, and an additional predictor then calculate the coefficient of determination. The code for this method on STATA is `*estat imtest, white`. The null hypothesis for this method is:

H₀: homoscedasticity

H₁: heteroscedasticity

If the p-value is significant it means that the null hypothesis can be rejected and there is heteroscedasticity in the data. If the p-value is insignificant, resembling a value that looks like p-value 0.1100 this would imply that the null hypothesis of homoscedasticity cannot be rejected.

Graph of Skewness of Residuals

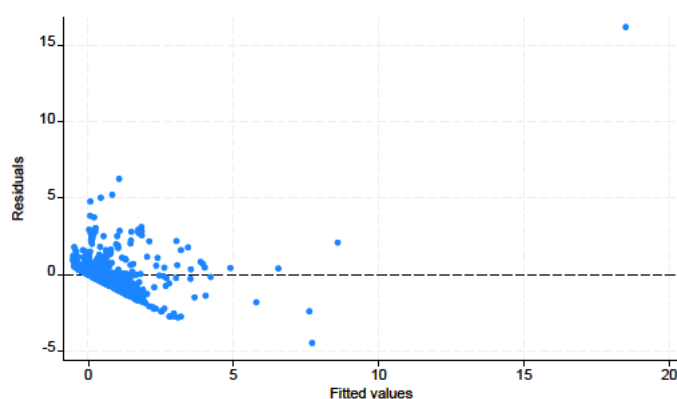


Figure 5

Source: Authors own simulations

This graph (figure 5) shows that the residuals are skewed to the right indicating the majority of the residuals are on the lower side and clustered around zero. This shows that there are small residuals and a few large positive outliers. The graph also shows a higher spread of residuals as the fitted values increase indicating heteroscedasticity which shows that the model may suffer from misspecification.

The Park test can also be used in the study as it further evaluates the OLS model's adequacy in capturing linear relationships. A significant result from this test would reinforce the choice of PPML, supporting the preference for a non-linear model given the heteroskedasticity observed in trade datasets (Park, 1966).

3.4.3.3 The Park Test

To test for the adequacy of the ordinary least squares methods we make use of the traditional Park Test (1966) as computed by Silva and Tenreyro (2006) this is a test of heteroscedasticity on linear models which also provides a clear expression on the form of heteroscedasticity. The Park test observes whether the original gravity equation can be estimated using the log-linear form.

Initially, Jiang and Deng (2006) follow the below regression to test for the adequacy of this model.

$$\ln e^2 = \ln \sigma^2 + \beta \ln X_i + \mu_i \quad (3.4.3.3)$$

If β is statistically significant, there is heteroscedasticity and if β is insignificant then there will be no heteroscedasticity.

Prominent studies in international trade have made use of a more robust specification shown as follows:

$$\ln(y - \hat{y}_i)^2 = \ln(\lambda_0) + \lambda_1 \ln(\hat{y}_i) + \mu_i \quad (3.4.3.4)$$

In this model \hat{y}_i denotes the conditional mean of Y given X ($E(Y_i|X_i)$). This model tests if heteroscedasticity patterns of the model are acceptable

which shows that:

H0: $\lambda = 2$ which implies that, the model is log-linear and tested against,

H1: $\lambda = 0$ which implies that, the model is not log-linear.

The acceptance of the null hypothesis allows for the use of using the log linearized model for estimations if ordinary least squares.

3.4.3.4 RESET Test

The Ramsey Regression Equation Specification Error Test (RESET) robustness test checks for the adequacy of the estimated models and tests if the conditional expectation of the model is correctly specified. The test performs checks of the significance of additional explanatory variables in a model.

RESET adds polynomial variables to the original ordinary least squares fit to detect forms of model misspecification

To see this test, we observe the regression:

$$y = \beta_0 + \beta_1 x_1 + \dots + \beta_k x_k + \dots \quad (3.4.3.5)$$

During RESET this equation will be fitted as

$$\beta_0 + \beta_1 x_1 + \dots + \beta_k x_k + \delta_1 \hat{y}_2 + \delta_2 \hat{y}_3 + e \quad (3.4.3.6)$$

the \hat{y} on the equation are non-linear functions of the explanatory variables, δ represent the products of the residuals on the equation. This equation is used to test whether the main estimation equation has missed any important nonlinearities.

H0: The equation (3.4.3.5) is correctly specified and, there are no omitted variables as there is a correct functional form of model

H1: the alternative hypothesis is that (3.4.3.5) is incorrectly specified

A significant p-value implies that the model is incorrectly specified, and the functional form should be revised, or it indicates that there are omitted variables in the model, and they should be added. An insignificant p-value would imply that the model is not mis specified, and the results are reliable for policy making. Conducting the RESET differs across the OLS and PPML. When using STATA (a regression analysis statistical platform), to conduct the RESET initially the OLS regression should be run followed by the command: OVTEST which indicates

that the RESET test is being run. When employing the PPML, an additional polynomial should be added into the PPML regression.

Together, these diagnostics confirm the reliability of the chosen estimation methods, and the validity of the gravity model to be able to draw reliable estimates. Conducting South African trade estimation using the gravity seems like the legitimate method to follow.

The major drawback facing use of the RESET is that this model will have no power to detect patterns of heteroscedasticity (Wooldridge, 2013).

3.5 Descriptive Statistics Summary Statistics

Table 2

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Export Value	1,468	8.759329	1.22783	3.230449	11.5879
ln_SA_GDP	1,468	0.0947451	1.043993	0	11.66105
ln_GDP	1,468	10.72804	1.158864	4.837222	13.41068
ln_distance	1,468	3.820793	0.3885752	1	4.22907
ln_Population	1,468	6.965961	0.7959156	4.611596	9.149945
ln_Tariffs	1,468	0.5440529	0.4173491	-1.69897	2.013553
ln_Fixed_Capital	1,468	10.19442	0.9389656	7.800841	12.8858
Preferential Trade Agreement	1,468	0.5735695	0.4947264	0	1
Commonlanguage	1,468	0.369891	0.4829395	0	1
WTOMembership	1,468	0.9162125	0.2771632	0	1

Source: Author's own calculations based on data obtained from South African Revenue Services, The World Bank, CEPII and The World Factbook

Table 2 simplifies the large dataset used in the study by presenting the summary statistics of the gravity model. These statistics summarize the key aspects of the data such as presenting central tendency through the mean, dispersion of the data to the mean through standard deviation, nature and range by defining the minimum and maximum and the number of observations of the variables.

3.5.1 Standard deviation

The value of the standard deviation of variables that show as above one reflects high levels of dispersion in the data of these variables. In table 3.5 The value the standard deviation for exports, South Africa's GDP and the GDP of South Africa's trade partners are high, reflecting a high deviation from the mean. The high value of the standard deviation of Export Value can be attributed to the different trading relationships that South Africa has with its trade partners which is high for some and low for others. The large dispersion in \ln_GDP can be attributed to the diverse trade relationships that South Africa fosters as it trades with both small and large economies. The standard deviations of the other variables are relatively low as they are all below the value of one which is low showing that there is some degree of variation on the different variables of the countries that South Africa trades with.

3.5.2 The mean, minimum, maximum and the number of observations

The mean across all the variables represents the average of the variables after the data with all the other trading partner countries have been combined. The minimum and the maximum show the range of which the variables lie, the minimum would be the lowest recorded value in the dataset and the maximum is the highest recorded value of each variable. The total number of observations in the study is 1468 across all the variables, which shows that this is a vast set of data thereby increasing the chances of accuracy for the regression analysis.

3.5.3 Justifying the variables

3.5.3.1 Distance

Distance is one of the most widely studied metrics in the determination of bilateral trade between countries, as it has one of the most robust findings, which is that it is negatively correlated to trade (Huang, 2005). In the gravity model, distance is intrinsic due to the gravitational law of physics required in estimations of the gravity model. However, distance is not only limited to geographical distance between the trading countries and has often been associated with other means. Huang (2005) equates distance in trade to transport costs incurred amongst trading partners and to unfamiliarity between the trading partners. Equating distance to transport costs implies that despite the geographical distance between trading partners, if the trading partners can reduce transport costs in trade, then distance might not be a large factor in trade. Limao and Venables (2001) support the claims indeed transport costs are a more defined method to measure distance by asserting that countries with good transport and communication infrastructure would be met with lower transport costs making it easier to trade as the distance

factor is reduced. Transport costs are counted as freight rates and shipping prices (Hummels, 2009). However, using transport costs has also been critiqued as factors such as shipping delays can be encountered resulting to higher transport costs that are not directly related to distance. Another distance factor that is observed is the internal distance, the distance that it takes for a good to be moved from the point of production to the port of exports/departure (Query, 2015). Internal distance indicates that good infrastructure plays a vital role in determining transport costs. Query (2015) shows that a 10 percent decrease in the distance that a good travels before leaving the country will increase the exports of that good by 16 percent. This shows that internal infrastructure can determine the fate of trade between trading partners. While it is important to note that distance in international trade does not rely solely on geographical distance as geographical distance can be substituted for by lower transport costs which can supersede the physical laws, geographical distance still plays a large role in determining trade. This study observes geographical distance initially measured in kilometers between the capital cities of the trading partners. The kilometer metric was then logged due to the high value of distance between the trading countries.

3.5.3.2 Income

The relationship between income and trade shows bidirectionally interesting results as studies have shown that trade can impact income positively and income can impact trade positively. This interesting relationship is shown initially by Taspinar (2009) who shows that countries that export a large share of their production seem to grow faster than others as the growth of exports stimulates technological spillover and other externalities. Erpek (2014) also shows that a one percent increase in international trade increases income by 1.57 percent. Kim (1996), on the other hand, shows that an increase in income because of increased production will result in an increase in the overall trade balance as, in the short run, a supply-side shock improves the trade balance.

In studies of international trade, income is measured in two ways (i) as a measure of Gross Domestic Product and (2) as a measure of Gross Domestic Product per capita. The World Bank defines the two as GDP per capita is the sum of gross value added by all resident producers in the economy plus any product taxes (less subsidies) not included in the valuation of output, divided by mid-year population. GDP per capita on the other hand, is the sum of gross value added by all resident producers in the economy plus any product taxes not included in the valuation of output, divided by mid-year population. Growth is calculated from constant price

GDP data in local currency. In this study, income is measured as a GDP metric only as it captures the GDP of South Africa and its trade partners.

3.5.3.3 Language

In trade, speaking the same language aids in communication, it eases transactions, and it results in increased transparency (Fidrmuc and Fidrmuc, 2016). To supplement Fidrmuc and Fidrmuc (2016), Ferro and Ribeiro (2018) identify the different ways in which countries communicate to aid trade,

“ i) they can share the same language and use it to communicate; (ii) they can each speak in their own language and be understood by the other; (iii) they can choose one of their two languages provided that one of them speaks their counterpart’s language; (iv) they can choose a foreign language that both of them can speak; (v) they can hire the services of an intermediary, such as a translator or an interpreter.”

In this way communication in any direction mentioned above can aid the practice of trade.

Researchers have found that sharing a common language or similar languages between countries increases trade. Ferro and Ribeiro (2016) conducted a study of Portuguese exports to European countries using the gravity model and found that Portuguese exports are higher to countries which it shares a similar language with, that being that exports from Portugal are higher to the countries which it shares a Romance language with. Ferro and Ribeiro (2016) employ two methods to measure the impact of language on trade, initially, the study compares between the official language of the country and its trading partners and there is no significant effect of the official language on the trade that occurs in Portugal. The study proceeds to use family language proximity to estimate the effects of a common language and finds that there positive and significant impact on trade. To justify Ferro and Ribeiro (2016) results of an official language being of less importance in trade and sharing a similar language being of more importance indicates that an official language used by a country is not related to speaking a language that is known by trading partners. Speaking a similar language reduces translation costs that will be faced by all trading partners, this may not be true for having an official language that may not resonate with trading partners. Alternatively, Lohman (2011) shows that there will be a negative effect when the common spoken language spoken differs by ten percent which results to a reduction of trade by 6.8 percent to 9.8 percent. This study identifies one common spoken language between South Africa and its partners in trade and it creates a dummy

equal to one to indicate that South Africa shares a common spoken language with the partner, and it creates a dummy equal to zero where the trading countries share no common spoken language. The language of reference for South Africa is English.

3.5.3.4 Common Trade Agreement

Tsygankova et al. (2022) describe a free trade agreement as an agreement that aims to construct a zone of free trade whereby groups of two or more customs territories cancel customs duties and other restrictive measures which originate from the trading countries. Yang and Liu (2024) substantiate the definition of a free trade agreement as an agreement that consistently reinforces cooperation and one that induces trade creation. While conducting a study on the effect of a free trade agreement on trade, French and Zylkin (2024) find that while trade occurs amongst countries, the implementation of a free trade agreement increases trade between the countries trading. Harada and Nishitateno (2021) show that a one percentage point reduction in tariff rates due to sharing a free trade agreement with a trading partner increases traded wine imports by 0.006 percent and increases the exports from member countries significantly.

Trade agreements have two possible impacts [1] the impact of trade creation which means that the policy agreement between the trading countries eliminates trade barriers and therefore creates trade between them or [2] trade diversion which means that the trade agreement shifts trade away from more efficient imports to inefficient imports simply by the virtue of sharing a trading agreement (Shujiro and Misa, 2007). Magomani (2022) shows that in the South African context the presence of the South African Democratic Countries (SADC excluding South African Customs Union countries) results to an increase in exports of wood and wood products by 0.65 percent, this is a trade creating effect. On imports the SADC (excluding South African Customs Union countries) increases imports in the textiles industry by 1.36 percent.

To measure common trade agreements the normal application is by using a dummy variable that captures the direction of trade formation (Piermartini and Teh, 2005). This study follows Piermartini and Teh (2005) as it captures trade agreements with a dummy of one where South Africa shares a common trade agreement with its trading partners, and it creates a dummy of zero where South Africa does not share a common trade agreement. Two metrics of common trade agreements are used in this study. Initially, the study captures direct trade agreements between the countries trading as recorded in South African Revenue Service documents and it captures if South Africa and its trading partners are all members of the World Trade Organization.

3.5.3.5 Fixed Capital:

Fixed capital in the study refers to investments into indestructible assets such as equipment and machinery, residential and non-residential buildings, construction works, infrastructure development and transport equipment. This variable is an important determinant of economic growth for a country due to the weight of change that investment towards fixed capital formation contributes towards the economy.

Federson et al. (2017) have shown that increasing capital formation leads to an increase in exports and economic growth depicted as shown in figures 6 and 7

Response of economic growth to one standard deviation shock of capital formation

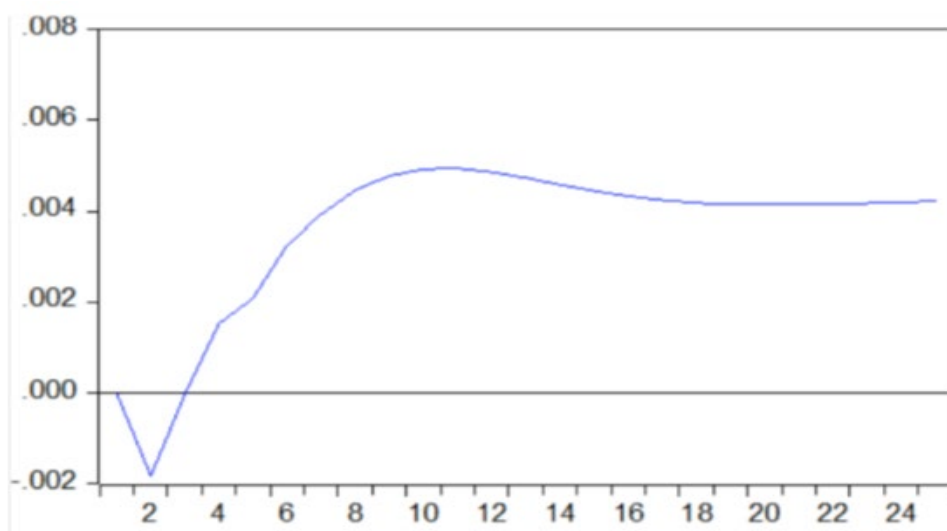


Figure 6

Response of Exports to a one standard deviation shock of capital formation

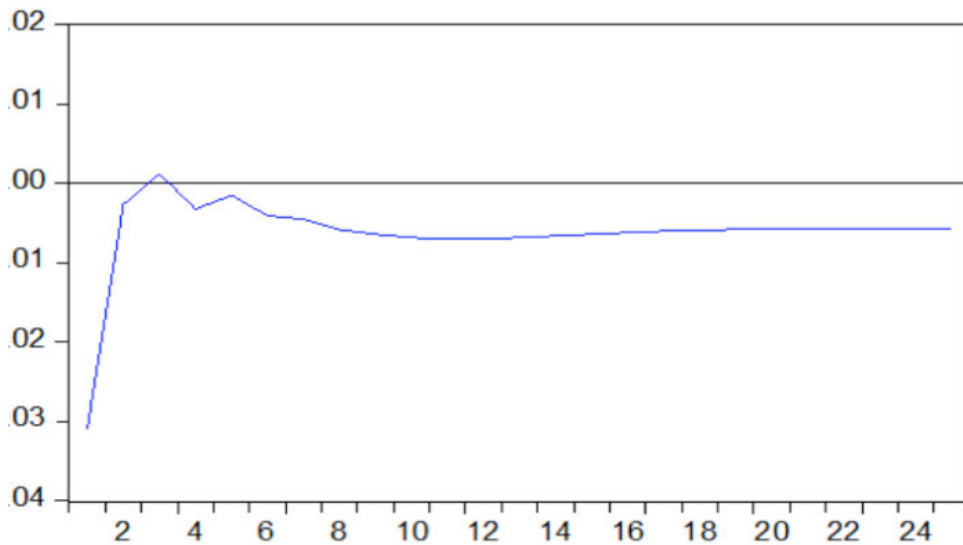


Figure 7

Source of Figures: Fedderson, Nel and Botha (2017). *Exports, capital formation and economic growth in South Africa.*

These results show that the impact of capital formation is not foreign to determining trade shocks on the economy and has been proven to improve both exports and economic growth directly and indirectly.

To put South Africa’s capital formation patterns into perspective we look at figure 8 :

Real Gross Fixed Capital Formation

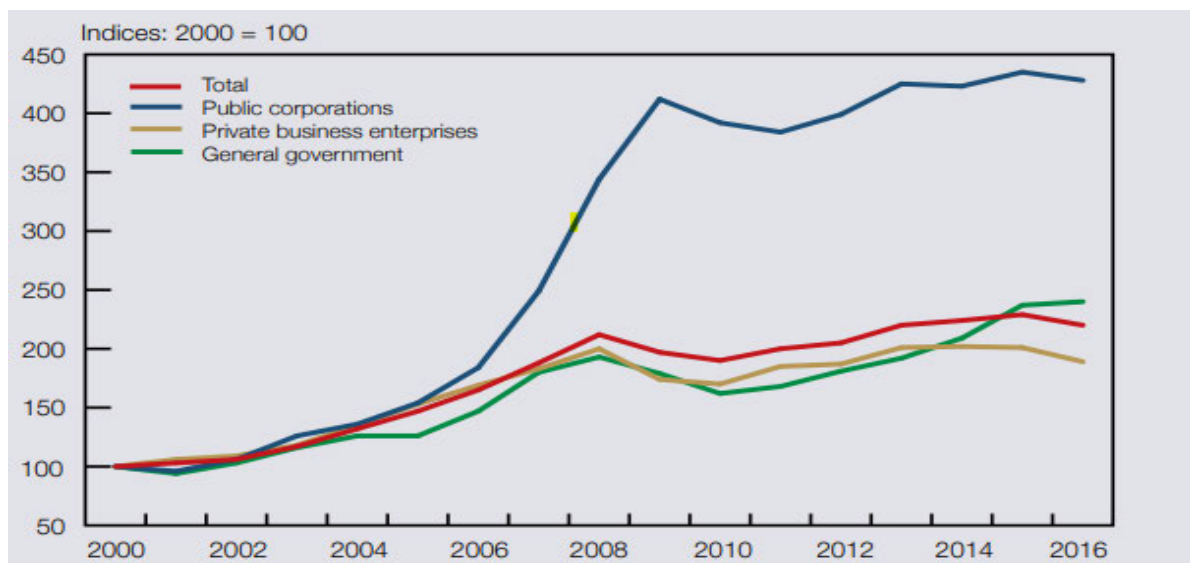


Figure 8

Source: South African Reserve Bank. 2017. The evolution of Gross Fixed Capital Formation in South Africa.

Figure 9 shows that investment into fixed capital in South Africa had been increasing exponentially since 1994. Investment in fixed capital increased some more after the 2008 Global Financial Crisis especially in public companies. This growth may not only be attributed towards a response to the Global Financial Crisis but also to an increase in investments in the economy as the country would soon host the FIFA world cup which would have required an increase in investment. With regards to South Africa's exports the expectation would have been for an exponential increase as affected by fixed capital formation.

3.5.3.6 Population

The economic expectation about population size is that as the population rises, the economy is expected to expand due to the increased labour in the economy, which can induce higher productivity in the economy. Increased productivity should encourage for some goods that are produced within the economy to be exported. Morrison (1977) shows the reality of this economic expectation by observing the size of the population and export performance across countries. This result is not surprising in economics as the size of the economy is likely to rise due to higher population density, this can be attributed to a larger labour force which is able to serve the economy and generate a larger output that can also be exported. This study observes the population sizes amongst South Africa and its trading partners over a stipulated number of years and it logs these values due to the high values contained in population size.

3.5.3.7 Tariffs

Hayakawa et al. (2018) identified various ways in which tariffs can affect a country's exports. Initially, the study cites import protection from the domestic economy as resulting in increased exports when the protected industry exhibits growth; the study also cites increased imports as a method that aids the rise in the country's traded goods because of foreign input. The aggregation methods of tariffs, while varying in structure from the simple average tariff to the average weighted tariff to the tariff index, should be carefully observed. In this study, the tariff rates of the countries studied are logged due to the high value associated with tariffs. An increase in tariff charges typically reduces the amount of two-way trade as the increase would inspire countermeasures and reduce the value of exports due to higher prices per exported item.

3.6 Conclusion

This chapter has reviewed the different equations applicable for this research and has explored the evolution of the paper from the ordinary least squares measure to the Poisson Pseudo Maximum Likelihood model. The study provides an overview of all the variables that affect trade and explores the different robustness checks to identify if the gravity model is indeed suitable for analyzes of the cost of trade protection on the South African economy. The Breusch Pagan test begins the search for robustness, the Park test is later explored and finally, the RESET test is explored.

5. Chapter Four

Results

4.1 Introduction

In this chapter, the study presents the empirical estimation results derived from the Poisson Pseudo Maximum Likelihood (PPML) and Ordinary Least Squares (OLS) models. The primary objective is to compare these methods to evaluate South Africa's trade performance and provide insights into the broader implications of trade protection for economic policy.

The comparison between PPML and OLS models is based on the two models' ability to capture trade dynamics, particularly the effect of key variables on South African exports. Table 3 highlights the estimated coefficients and their statistical significance.

4.2 Comparison of PPML and OLS Coefficients

Table 3

Variable	Ordinary Least Squares: Random Effects	Poisson Pseudo Maximum Likelihood: Random Effects	Ordinary Least Squares: Fixed Effects	Poisson Pseudo Maximum Likelihood: Fixed Effects
ln_SA_GDP	-.0369563***	-.0389905***	-.2030911	-.0389905***
ln_GDP	.0379983***	.0249204***	.0820603***	.0249204**
ln_distance	-.2070946***	-.2141059***	0	-.2141059 ***
ln_Population	.0172531**	.0092**	-.0321865	.0092
ln_Tariffs	-.0174583**	-.0130138*	-.0181696 **	-.0130138
ln_Fixed_Capital	.0423372 ***	.076056***	.0071411	.076056***
Preferential trade agreement	.0391981***	.0316441***	.0133821	.0316441**
Common language	.0431943***	.0406551***	0	.0406551***
WTO Membership	.0631762***	.0654917***	.0070761	.0654917***
R-Squared	.6915	.6350		

This table summarizes the results of the regression analyzes using the PPML and OLS models.

Significance levels are indicated as *, **, and *** for 10%, 5%, and 1%, respectively.

Source: Author's own calculations based on data feedings from the South African Revenue Services, The World Bank, CEPII and The World Factbook.

4.3 Results Discussion

4.3.1 Breusch Pagan Heteroskedasticity test

The estimations in the study began by operating the Breusch-Pagan heteroscedasticity test to find out if there is constant variance across the errors of the dataset or if there is heteroscedasticity in the data. The result of the Breusch-Pagan was equal to a chi-squared value of 86.14 and a p-value of 0.0000. The high chi-squared value and the p-value that is significant across all levels of significance show that there is heteroskedasticity in the data; this implies that the ordinary least squares measure is not sufficient to conduct an analysis of the coefficients for the study as it does not address the problem of heteroskedasticity leading to biased results. Nonetheless, the study continues to draw comparisons between the ordinary least squares and the Poisson Pseudo Maximum Likelihood.

4.3.2 The White Test

The white test alternatively shows that $\text{Prob} > \chi^2 = 0.000$. This implies that the null hypothesis of constant variance can be rejected at the five percent level of significance. The implication of this finding is that there is heteroscedasticity in the data.

4.3.3 The Park Test

The Park Test was conducted to test for linearity which was conducted by regressing the squared residuals on the independent variables on the ordinary least squares. The results indicate that $\ln x_1$, the log of exports has a β value of -52.653 and p-value of 0.000. A distance value of 0.682, with a p-value of 0.000, tariff value of -0.189, p-value of 0.004, fixed capital value of -0.240 at p-value 0.000, preferential trade agreement 0.328. p-value of 0.000, common language value of -0.106 at p-value 0.048. The statistical significance of these variables suggests that the model is not log-linear, therefore a consistent estimation method should be applied to address the issue of non-linearity .

4.4 Regression Analysis

4.4.1 Random Effects across OLS and PPML

The message in the random effects analysis is that each stated variable in Table 5.1, having a given magnitude, matters in explaining South Africa's exports to its trading partners across both the PPML and OLS. As such, it matters to explain the growth of the South African economy through exports. While most variables yield similar significant level results across the two models, the primary difference amongst the observations is in the significance of the effect of the tariffs on the exports of South Africa. In the OLS model, tariffs are significant at the five percent level of significance, and in the PPML model, tariffs are significant at the ten percent level of significance; this is viewed against the other variables in the models, which are all significant at the one percent level. This observation implies that the previous studies of the impact of tariffs on the economy before the use of general equilibrium models yielded results that may have a misguided policy as other factors that should be the point of focus of trade policy were ignored, especially in partial equilibrium models. This shows that the importance of tariffs on South Africa's exports is not as high as contemplated in the past when partial equilibrium models that only analyzed the effects of tariffs on trade mattered and affected trade policy.

The random effects analysis results show that the OLS overestimates coefficients, such as common language, WTO membership, population, distance and Preferential trade agreements which is consistent with the findings of Silva and Tenreyro (2006). This may be due to omission and information lost on some variables due to the need for a log transformation of the dependent export variable. To avoid the problem of missing information studies have often suggested using the PPML which avoids the problem of losing reliable information due to missing data or trade flows that are recorded as zero. According to Silva and Tenreyro (2006) the PPML naturally keeps information across the variables and most notably on the dependent variable as it accounts for heteroscedasticity in data. The functional form of PPML serves which refutes being log-transformed serves as the model's advantage. Since the OLS requires log-transformation of the dependent variable, naturally, it loses important information.

This trait is not accounted for by the OLS. The OLS's reliance on the transformed dependent variable form naturally omits zero trade flows, making it less reliable than the PPML.

In the random effects simulations, the R^2 of the PPML and the OLS are 0.6915 and 0.6350, respectively. The R^2 across the two models is interpreted similarly. R^2 in PPML implies that the explanatory variables in the model account for 69.15 percent of the variation in exports. Practically, \ln_SA_GDP , \ln_GDP , $\ln_distance$, $\ln_Population$, $\ln_Tariffs$, $\ln_Fixed_Capital$,

Preferential Trade Agreement, Common language, and WTO Membership collectively account for 69.15 percent of the variation of South Africa's exports. The R^2 of the OLS model implies that 63.50 percent of the model, similar to PPML, explains the variation of the log-transformed dependent variable – since the dependent variable (Exports Value) must be transformed into a log (to $\ln_ExportsValue$) for the OLS to be estimated.

4.4.2 The Poisson Pseudo Maximum Likelihood

Now focusing on the PPML on the random effects estimation: The PPML regression estimates between the explanatory variables and the value of the exports of South Africa. The PPML regression shows that in terms of South Africa's GDP, a one percent increase in South African GDP reduces South African exports by 3.9 percent. This result is counterintuitive to the economic expectations of international trade, which assume that increasing income should encourage increased trade. This result is consistent with the findings of Poswa (2020), which reflects that the domestic market of South Africa increasingly absorbs domestic goods as its income rises (Krugman, 1980), which is a good trait for the domestic economy.

The coefficient on the trading partners' GDP (\ln_GDP) is positive and statistically significant across all significance levels. The result suggests that a one percent increase in South Africa's trading partners' GDP increases exports by 2.49 percent. This result is in line with economic expectations of the gravity model, suggesting that a rising income will result in increased trade activity.

The coefficient on distance is negative and statistically significant at the one percent level of significance. The coefficient on distance shows that a one percent increase in distance reduces exports by 21.4 percent, which emphasizes the role of transport costs imposed by geographical distance. In this analysis, distance has the highest elasticity towards exports showing that it is a volatile determinant on exports and should be captured closely by policymakers. While distance is typically associated with transport costs and infrastructure development, it is safe to say that policymakers should focus more on such developments so that exports which benefit the economy positively will increase. The result obtained from the distance coefficient supports Huang's (2005) analysis, which ascertains that countries will trade more with their neighboring countries and less with further countries.

The coefficient on tariffs is negative and significant at the ten percent level of significance, indicating that a one percent increase in the average weighted tariff will reduce South Africa's

exports by 1.30 percent. The low elasticity level of the effect of tariffs on exports shows that while tariffs are important for the exports of the country policymakers should prioritize tariff policy much less when aiming to increase trade.

Population size has a coefficient of .0092 which shows a weak relationship between the size of the population size of a country and

Fixed capital has a positive and significant coefficient indicating that higher fixed capital/investments by the importing trade partners of South Africa are associated with increasing exports of South Africa. Promptly, a one percent increase in fixed capital by a country will result to a 7.6 percent increase on South Africa's exports. This result is justifiable in the short run as it may take a long time for countries to see returns on capital investments, and there is a possibility that the areas of capital investments of the trading countries are not in line with the exports of South Africa.

The coefficient the common trade agreement dummy is .0316, a positive and significant value at the one percent level of significance. This dummy shows that a country sharing a common trade agreement is associated with 3.16 percent average increase in exports of South Africa, *ceteris paribus*.

Sharing a common official language a with a country is associated with a 4.06 percent increase in South Africa's exports, on average, *ceteris paribus*. This coefficient is significant at the one percent level of significance which indicates that language plays a large role when it comes to the exports of South Africa. Policymakers should explore language and communication when attempting to increase revenue from exports.

Being a member of the World Trade Organization is associated with on average, a 6.3 percent increase in South Africa's exports, *ceteris paribus*. The coefficient of the dummy of the WTO is also positive and significant at the one percent level of significance which shows that commonality may foster good trade relations which is important for policymaking.

4.4.3 The Ordinary Least Squares

The Random Effects OLS model, like the PPML, shows that a rise in South Africa's GDP reduces its exports to its trading partners. The coefficient of the Gross Domestic Product of South Africa in the OLS model is equal to $-.0370$, a negative value that is significant at the one percent level of significance. This result shows that for a one percent increase in the GDP of

South Africa, South Africa's exports are expected to fall by 3.70 percent. This result shows proof of the statement made in chapter four, which is that the OLS model overestimates the elasticities towards exports. The negative coefficient on \ln_SA_GDP counterintuitive as the results show that exports respond to the GDP levels. If increasing GDP results to less exports this could be due to the comfort that the economy is doing well. To address this problem, policymakers should emphasise on increasing production in South Africa despite having a good economic standing. This could be done through efficiency enforcement programmes with partnership with countries.

The coefficient of distance in the random effects OLS model is negative and significant at the one percent level of significance. The coefficient is equal to $-.207$. This coefficient shows that a one percent increase in distance between South Africa and a trading partner export are expected to decrease, on average, by 20.71 percent. The value on this coefficient is high indicating the elasticity of distance on exports, which in the model is above higher than all of the other coefficients in the study. Distance is also overestimated in the OLS Model as compared to the PPML.

The coefficient on population is 0.017 . A positive value that is significant at the five percent level of significance. This result shows that a one percent increase in a trading partners population will result to an average increase of 17.25 percent increase in South Africa's exports, *ceteris paribus*. This result reveals that the OLS will overestimate coefficients. In this case there is a sixteen percent overestimation difference between the OLS and PPML.

4.4.5 Fixed Effects

After controlling for fixed effects, the study finds that only tariffs and the GDP of South Africa's trading partners are significant in explaining the resulting exports under the ordinary least squares. Under the Poisson Pseudo Maximum Likelihood, the size of the population and tariffs become insignificant in explaining the resulting exports of South Africa. These results are contrary to the findings under random effect estimates, but the results confirm that tariffs as the primary method of estimation in partial equilibrium models may have been overestimated in terms of the outcomes of trade.

4.5 Model Diagnostics

Ramsey Regression Equation Specification Error Test (RESET)

The RESET test is conducted to find out if the models are correctly specified; if the models are not correctly specified, it is required that additional variables that are valuable to the study are added or some variables in the model are removed until the model passes the RESET. To conduct the RESET, we added sq_u , a fitted variable that allows for testing of the correct specification. In the PPML, the fitted sq_u returned a p-value of 0.246, indicating that the model does not suffer from specification issues and that the results that are estimated can be trusted. The OLS returns a fitted variable of 0.438, indicating that the results in the OLS model can also be trusted for drawing analyzes. The inherent robustness of the PPML naturally makes the model superior to the OLS.

4.6 Conclusion

This chapter began with conducting the Breusch Pagan test to test for the presence of heteroscedasticity; it found that the dataset is heteroscedastic, which inevitably tells that the ordinary least squares will be biased in its estimations. The chapter proceeded to the White test, another test of heteroscedasticity to ensure that the results are indeed heteroscedastic, it is important to note that the White test hails from the family of Breusch Pagan tests. The study proceeded to the Park Test which rejected the assumption that the data should be estimated with a linear model. A non-linear model was then identified which would address the shortfalls against the OLS model, which in this study was the Poisson Pseudo Maximum Likelihood (PPML). The chapter then drew comparisons between the OLS and PPML, it found that the OLS overestimates coefficients and relied mostly on results obtained from PPML. The study initially conducted a random effects model across the OLS and PPML and then proceeded towards fixed effects models. The study opted to focus on random effect models as opposed to fixed effects as fixed effects models would hardly return results for the OLS model.

Chapter Five

Conclusion, Limitations and Recommendations

5.1 Conclusion

This study has examined the impact of trade determinants as proxies for costs on the economy of South Africa by making use of the gravity model of international trade. The study estimated the cost of protectionism by observing the coefficients elasticity to explaining the resulting export value. The more significant a variable is in explaining trade, the more important the variable is in determining trade flows, and the more important the variable should be in policy making. The study's most interesting finding is that tariff imposition by other countries on South Africa is not as important as it has been initially perceived in determining the exports of South Africa. While tariffs still should be regulated, other areas in the economy, such as sharing preferential trade agreements, being members of the World Trade Organization, distance costs, capital accumulation by other countries, sharing a common trade agreement, and the distance across the trade partners matter more in determining the exports of South Africa.

The study established the need for trade in the international economy, it found that there continues to be ambiguity as to whether countries should establish more protective boundaries in trade or should be more open to trade. It established that a good measure of trade would be able to address the ambiguity in trade as it would accurately reflect the true effect of trade protection and levels of openness on a trade variable that contributes positively to the economy. The study reflected on the various forms of measurement of the effect of trade protection on the economy and found that the gravity model is the optimal and reliable standard for measurement. Upon using the gravity model, the study drew comparisons between two approaches that can be used to measure trade: the ordinary least squares and the Poisson Pseudo Maximum Likelihood. The study found that the PPML is the most optimal measure for measuring trade due to its natural ability to address heteroscedasticity issues in data, and it yields the most reliable estimates that can be used for policy-making; the OLS fell short due to its inability to address heteroscedasticity and due to that it overestimates coefficients.

The study conducted a panel regression spanning from 2010 to 2022 covering South Africa and 127 of South Africa's trading partners. The empirical evidence of this paper suggests that variables such as GDP SA's trade partner, South Africa's GDP, distance, population, fixed capital, sharing a preferential trade agreement, sharing a common officially spoken language, and being a member of the World Trade Organization means a lot for South African exports. Tariffs, which have been a significant factor in determining trade protection across different

models, are only significant at the ten percent level of significance in the PPML and at the five percent level of significance in the OLS model, indicating that the measuring metric, even in the past may be skewed as being the basic measure of trade protection on the economy and the primary measure of trade policy.

5.2 Limitations

This study is limited in that it has a short estimation period, which is from 2010 to 2022. This limitation is due to the unavailability of export data of South Africa and its trade partners. This limitation shows that the results might not be reliable as the long-run effects are not accounted for. In fixed effects models of the PPML endogeneity problems could not be escaped which lead to the omitted variable bias, as such, analyses from fixed effect models could not be relied upon.

5.3 Recommendations

Against the findings of this study, the recommendation would be for policymakers to focus on other areas that affect exports for export maximization, such as increasingly developing infrastructure to address problems that arise from distance, such as introducing links that make it easier to access partner countries like investing in air and marine transport that is cheap for transporting goods. Policymakers should focus on increasing interpersonal links with its trade partners, such as signing more preferential trade agreements and increasing access to learning new international languages, which could aid trade. While tariffs do not influence South Africa's exports to a large extent, the country should keep its tariffs at regulated levels to avoid countermeasures and price increases so that it can benefit from its exports.

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Appendix A

List of countries used in the study.

Albania
Angola
Antigua And Barbuda
Argentina
Australia
Austria
Bahamas
Bahrain
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bermuda
Bolivia, Plurinational State Of
Bosnia And Herzegovina
Botswana
Brazil
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Canada
Cape Verde
Central African Republic
Chad
Chile
China
Colombia
Comoros
Congo
Costa Rica
Côte D'Ivoire
Croatia
Cyprus
Czech Republic
Democratic Republic of Congo
Denmark
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Estonia
Eswatini
Finland
France
Gabon
Gambia

Georgia
Germany
Ghana
Greece
Guatemala
Guinea
Guinea-Bissau
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Ireland
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Latvia
Lesotho
Lithuania
Luxembourg
Madagascar
Malaysia
Mali
Malta
Mauritania
Mauritius
Mexico
Mongolia
Morocco
Mozambique
Namibia
Nepal
Netherlands
New Zealand
Niger
Norway
Pakistan
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Romania
Russian Federation
Rwanda
Senegal
Sierra Leone
Singapore
Slovakia

Slovenia
South Africa
Spain
Sudan
Suriname
Sweden
Switzerland
Tajikistan
Tanzania
Thailand
Togo
Trinidad And Tobago
Tunisia
Uganda
Ukraine
United Kingdom
United States
Uruguay
Viet Nam
Zambia
Zimbabwe

Appendix B

Ethical Clearance



03-10-2023
Miss Rethabile Molapo (217002806)
School Of Acc. Economics&Fin
Westville

Dear Miss Rethabile Molapo,

Original application number: 00019267
Project title: Measuring the economic costs of trade protection in South Africa

Exemption from Ethics Review

In response to your application received on 28 September 2023, your school has indicated that the protocol has been granted EXEMPTION FROM ETHICS REVIEW.

Any alterations to the exempted research protocol, e.g., Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through an amendment/modification prior to its implementation. The original exemption number must be cited.

For any changes that could result in potential risk, an ethics application including the proposed amendments must be submitted to the relevant UKZN Research Ethics Committee. The original exemption number must be cited.

In case you have further queries, please quote the above reference number.

PLEASE NOTE:

Research data should be securely stored in the discipline/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours sincerely,

A black rectangular box redacting the signature of Prof. Josue Mbonigaba.

Prof Josue Mbonigaba
Academic Leader Research
School Of Acc. Economics&Fin

Appendix C
Turnitin Similarity Report

Dissertation 26.03.docx

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