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Comparing International Market Selection Methods Using Export Potential Values for South Africa

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ABSTRACT

Resources for export promotion are scarce, and incorrect market selection can be costly. In the literature, the gravity model, International Trade Center's Export Potential Map, and decision support model all estimate export potential values. Although the same concept is measured, different methodologies are used. This study aimed to compare the rankings assigned to the export potential values by each approach. The results indicated that 45% of the rankings differed by more than five places, while one-third were ranked in the top 10 of only one approach. Given these inconsistencies, alternative approaches for prioritization after identifying export opportunities are recommended.

KEYWORDS

Decision support model; export potential map; export potential values; export promotion; gravity model; international market selection

I. Introduction

Resources for export promotion purposes on the firm and country levels are scarce, and incorrect market selection can lead to significant losses in the face of market failures (Papadopoulos and Denis 1988; Rahman 2003). Therefore, markets with the highest export potential need to be identified and prioritized to ensure that the scarce resources are used in ways that contribute to firm profitability and, more broadly, economic growth (Shankarmahesh, Olsen, and Honeycutt 2005).

In the literature, three international market selection approaches attempt to estimate export potential values, namely, the gravity model, the Export Potential Map of the International Trade Centre (ITC), and the decision support model (DSM). Although the methodologies used by these international market selection approaches differ, all three attempt to estimate export potential values. It is, however, challenging to attach a specific value to export potential as an accurate evaluation is not always possible if the potential is not actively pursued and/or realized in actual trade (ITC 2017).

This study, therefore, sets out to compare the three mentioned international market selection approaches. To this end, the estimated export potential values

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of the three approaches are expected to differ. It is, thus, necessary to compare the rankings/priorities assigned to the same product–country combinations, which can ultimately inform export promotion decisions.

Section 2 visits the literature on the importance of exports, export promotion strategies, and international market selection for a country, while Section 3 provides an overview of the literature on the determinants of exports. Section 4 provides an explanation of the respective approaches used to estimate the export potential values of South Africa's top manufactured exports. This is followed, in Section 5, by a brief explanation of the tests used for comparison purposes, with a discussion of the results thereof presented in Section 6. Finally, Section 7 provides a conclusion to the study, together with recommendations for the practical application of the results and future studies.

II. Literature review on the importance of exports and export promotion strategies

Exporting is one of the main contributors to economic growth (Awokuse 2008; Belloumi 2014; Riaz 2010; among others). The extent of the positive relationship between exports and economic growth is, however, different for each country as they have different economic structures and because economic growth can itself contribute to export growth (Jayachandran and Seilan 2010). Nevertheless, export-orientated trade policies, which are designed to boost exports, help countries to take advantage of positive externalities, which ultimately enhance economic growth (Awokuse 2008; Sheridan 2012).

A positive externality of increased exports is the spillover of knowledge (Thirlwall 2000). By learning from international competitors, industries can improve and even optimize their management and production techniques. This may ultimately enhance innovation and lead to the expansion of production in the respective industries (Görg and Greenaway 2003). Increased exports also lead to more productive and efficient exporting industries as a result of enhanced specialization (Jayachandran and Seilan 2010; Sheridan 2012).

In view of the well-established link between exports and economic growth, governments often pursue export promotion strategies (Belloumi 2014). If a country exports more through the implementation of such strategies, it may enjoy an improved trade balance and, in turn, enhanced economic growth (Barker and Kaynak 1992). Furthermore, exporting industries in countries that follow an export-orientated strategy tend to be more competitive, owing to foreign competition (Riaz 2010; Thirlwall 2000). It is also argued that export promotion strategies assist countries in attracting higher levels of foreign exchange, which can be used to pay for imports of intermediate and other goods (Thirlwall 2000). Awokuse (2008) asserts that increased foreign exchange earnings will help a country to drive its capital formation efforts, thereby stimulating the growth of outputs.

Moreover, increased exports can lead to increases in employment and income (Awokuse 2008). The World Trade Organization (WTO 2001) supports this view, stating that countries with open economies are able to reduce poverty more effectively than countries with closed economies. Furthermore, Nasiri and Haji Hassani Asl (2013) note that when a country exports more, it is easier to diversify into other export markets. Through diversification, exporting industries are expected to see improved productivity and reduced average costs when producing goods and services, owing to economies of scale and economies of scope (Xuefeng and Yaşar 2016).

Considering the mentioned positive spillovers in the South African context, Rangasamy (2009) estimated that a 10% increase in real exports can lead to an increase of approximately 8.5% in South Africa's real GDP, along with an increase of 8% in real non-export GDP in the long term. Cipamba (2015) recorded similar results and established that export growth led to higher GDP growth in South Africa through spillovers such as productivity gains in the international trade sector.

In addition, South Africa's National Development Plan (NDP) highlighted that the country would realize higher levels of income if export volumes increased, as the country would be earning significantly more foreign exchange. These foreign exchange earnings would not only assist in the purchase of inputs, which could be used to support further industrialization, but could also enhance infrastructure investment and encourage employment. This would again spur productivity and contribute to the realization of the economic growth target of 5.4% by 2030, as set out in the NDP (NPC 2012; National Treasury 2019).

In pursuing this growth target, the National Treasury (2019) stated that the high-value exports from the manufacturing sector, among other factors, constitute a strong competitive advantage, which should be leveraged to drive export-led growth. This complements the Department of Trade, Industry and Competition's (DTIC) Integrated National Export Strategy (INES), whose main aim is to double manufacturing exports by 2030 (Oliveira 2017). If South Africa, therefore, focuses its resources on promoting the exports of manufactured goods to the correct markets, unemployment could potentially be reduced and economic growth enhanced.

Nevertheless, to make a valuable comparison between the gravity, ITC, and DSM approaches, it is also necessary to understand from the literature which factors generally influence exports, as they form part of the foundation of the analysis of export potential values. The next section discusses these factors or determinants.

III. Determinants of exports

In the international trade literature, the determinants of exports are used to estimate the export potential of goods and services. Table 1 summarizes the typical determinants of exports, along with their effects on trade.

From Table 1, it is clear that several factors influence international trade and, specifically, exports. The identified determinants of exports form the basis of the methodologies used by the gravity, ITC, and DSM approaches to market selection. These three approaches are explained in the section below.

IV. Three approaches to estimating export potential

Gravity model

The main premise of the gravity model is that bilateral trade flows between importing and exporting countries are determined on the basis of the attraction and resistance between them (Jordaan 2015). Potential trade flows are, therefore, analyzed in terms of two core factors, namely the size of the countries (attraction) and distance (and other trade cost estimators that serve as forms of resistance) between them.

Although several criticisms have been leveled at the gravity model, the most applicable one for this study came from Decreux and Spies (2016). They argue that estimating export potential values based on detailed product-level data can be "computationally burdensome" as a vast number of coefficients and equations must be estimated. Moreover, most variables used in the gravity model are on the country level, which makes product-specific analysis challenging. Nevertheless, as stated by Jordaan (2015), a gravity model can provide valuable insights into the relationship between the direction and volume of bilateral trade.

The gravity model uses panel data which provide for the possibility of individual effects. For this reason, either a random-effects model or a fixed-effects model must be used. The test of overidentifying restrictions is used to establish which model is suitable for the data. With this test, the random-effects model is preferred if the null hypothesis (the error term is uncorrelated with the regressors) is not rejected. Conversely, if the null hypothesis is rejected, the fixed-effects model is preferred (Park 2011). To calculate export potential values, a separate gravity equation must first be estimated for each product with South Africa as the exporting country.[1] This equation takes the

[1]A selection of 15 of South Africa's main manufactured exports in 2015 were used in this study, based on data availability and comparability, and number of significant variables. All export potential values of the three approaches were, thus, estimated for 2015. A list of the products used can be found in Appendix 1 online. Furthermore, the top 50 South African export destinations for each product were included in the gravity analysis. In total, 580 product-country combinations were used for the analysis. A limited number of countries with missing values, and those subject to collinearity in the gravity model, were omitted in the calculation of export potential values. Also see Footnote 9.

Table 1. Determinants of exports.

Determinant	Effect on exports	Other findings/additional information
Size and growth of import demand and export supply	**Positive** (Ashby et al. 2016; Nilsson 2000)	When estimating determinants of trade, the GDPs of countries are often used as a proxy for the size of supply and demand. This is because countries with higher GDPs usually trade more as they have higher incomes and production levels, as well as a wider variety of available goods and services. However, the population of the importer and the exporter can also be used along with GDP values (thus, GDP per capita) as an indication of the potential supply and demand (Arnold and Quelch 1998). According to Nilsson (2000), a country's population can influence international trade in two ways. On the one hand, a large population is an indication that a country is more self-sufficient, has a larger domestic market, and therefore, does not need to trade that much. On the other hand, if a country's population is large, more opportunities arise for trading with a wider variety of goods. This is because labor is more divisible, and economies of scale can be achieved. Therefore, although there is an expected positive relationship between GDP and bilateral trade growth, it is difficult to determine the relationship between exports and the population of a country *a priori* (Ashby et al. 2016; Nilsson 2000). Armstrong (2007), however, states that a positive relationship is usually expected for developing countries as they typically specialize in labor-intensive exports. Conversely, Martinez-Zarzoso and Nowak-Lehmann (2003) expect a negative relationship to exist if countries with large populations experience an absorption effect.
Political risks	**Negative** (Moser, Nestmann, and Wedow 2008)	Stapenhurst (1992) asserts that the general assumption is that exporters have less capital at stake than foreign direct investors, and therefore, political risks are not as important to them. Gillespie (1989), however, states that the value of expropriated assets is usually significantly less than the loss of expected future revenues. A more recent study by Agarwal and Feils (2007) supports this view and elaborates by saying that, although exporters will not lose their facilities, they have already shipped their goods, are faced with nonpayment, and may also lose expected future sales, thereby reducing trade.
Exchange rate risks	**Negative** (Nicita 2013)	The general argument is that increased exchange rate volatility leads to reduced trade owing to the transaction costs and risks related to the variability in exchange rates (Nicita 2013). However, it has been reasoned that exchange rate volatility is not necessarily a serious concern for international trade. This is mainly because of the increased availability of financial instruments (such as currency options and forward contracts) used by firms to hedge against exchange rate risk (Auboin and Ruta 2012).
Market concentration/ international competition	**Negative** (Cuyvers et al. 1995)	Cuyvers et al. (1995) stated that a significantly concentrated import market is difficult to enter because only a few exporting countries have a substantial market share in the country, thereby resulting in a strong competitive edge. In this regard, Williamson et al. (2006) asserted that exporters attempting to compete in a highly competitive country will experience greater pressure in terms of their profit margins. Furthermore, a few predominant exporters will enjoy the benefit of having superior knowledge about the market and of being well known by local customers (Cuyvers et al. 1995). However, Cuyvers et al. (1995) indicated that market concentration may be less of a concern in a relatively large and growing market than in a non-growing market.

(*Continued*)

Table 1. (Continued).

Determinant	Effect on exports	Other findings/additional information
Trade agreements and tariffs	**Trade agreements: positive; tariffs: negative** (Ashby et al. 2016; Lorde et al. 2020)	Trade agreements are intended to reduce trade barriers and trade costs between countries, thereby improving the chances of exporting/importing higher volumes of goods (Ashby et al. 2016). Baier and Bergstrand (2007), for example, established that two member countries of a free trade agreement would experience an increase in trade of approximately 100% after 10 years. However, Breytenbach and Jordaan (2010) argued that trade agreements can have a positive or negative relationship with exports as it could lead to either trade creation or trade diversion. Nevertheless, average tariffs among WTO members have been declining over the past 15 years. Yet, global trade has slowed down, mainly due to an increase in trade protection in the form of alternative trade-restricting measures, such as non-tariff barriers (NTBs) (Yalcin, Felbermayr, and Kinzius 2017).
Non-tariff barriers (NTBs)	**Negative** (Hoekman and Nicita 2008; Melo et al. 2014)	After analyzing the effect of trade restrictions and trade facilitation on international trade for 104 importers and 115 exporters in 2006 (excluding South Africa), Hoekman and Nicita (2008) estimated that trade would increase by 1.8% if NTBs were reduced by 10%. Similarly, Evenett (2002) determined that US sanctions imposed against South Africa during the apartheid era resulted in South African exports declining by one third. Melo et al. (2014), however, established that the negative effect of NTBs on trade would be greater if a developed country imposed the regulations. This is because most developing countries' exports are more concentrated in agriculture, while developed countries generally export more high-value goods or services. Therefore, when developed countries, for example, impose more stringent health and food safety regulations, developing countries find it more difficult to export their (agricultural) goods (Hoekman and Nicita 2008).
Trade time and cost	**Negative** (OECD and WTO 2015)	Increased time to trade and high trade costs lead to countries being more isolated from world markets (OECD and WTO 2015). There are several proxies for trade time and costs, such as the availability and quality of trade facilitation, being landlocked, geographical distance, sharing borders, as well as cultural differences. Each of these aspects is discussed next.
Efficient logistical services	**Positive** (Korinek and Sourdin 2011)	Efficient logistical services assist in reducing trade time and costs as they aim to tackle issues relating to transportation, storage, and packaging in an efficient manner (Korinek and Sourdin 2011). Logistical service efficiency (and the time and cost associated with it) can be divided into three dimensions, namely at-the-border (for example, border procedures), between-the-border (such as infrastructure for transport and communication), and behind-the-border (for instance, domestic regulations and product standards) (OECD and WTO 2015). All three of these dimensions have a significant impact on trade competitiveness; therefore, if a country improves its trade logistics, its exports can increase (Korinek and Sourdin 2011).
Landlocked countries	**Negative** (WTO and UNCTAD 2012)	Limão and Venables (2001) estimated that landlocked countries with poor infrastructure typically trade approximately 60% less than countries with a coastline because of trade costs, specifically transport and information costs, being approximately 50% higher. Trade, therefore, tends to be less with countries that are landlocked (WTO and UNCTAD 2012).

(*Continued*)

Table 1. (Continued).

Determinant	Effect on exports	Other findings/additional information
Geographical distance	**Negative** (Ashby et al. 2016; Breytenbach and Jordaan 2010)	The negative relationship is due to distance being associated with trade costs, such as transport cost and time. Batra (2013) indicated that greater geographical distance can be linked to more pronounced differences in culture between countries, which ultimately negatively impacts trade because of increased information and search costs. The WTO (2018), however, established that the overall international trade costs decreased by approximately 15% from 1996 to 2014. This is mainly due to increased globalization and the use of digital technologies, which may ultimately reduce the relevance of distance (WTO 2018).
Neighboring countries	**Positive** (Rahman and Ara 2010; WTO and UNCTAD 2012)	According to Limão and Venables (2001), countries sharing a border usually have integrated networks, thereby reducing transhipments. Countries with a common border also typically have agreements regarding customs and transit, which contributes to faster export time and reduced trade/transport costs.
Culture: shared language or colonial history	**Negative** (Rahman and Ara 2010; WTO and UNCTAD 2012)	Language and colonial history are associated with search and information costs. Trading countries with a shared language or colonial history, therefore, tend to trade more than countries that have no shared language and/or colonial history (Fejzić and Čovrk 2016). Countries with common cultural backgrounds also know more about one another and may understand one another's rule of law, business practices, competitiveness, and delivery reliability better (WTO and UNCTAD 2012). The latest trade figures do not, however, back these statements. In this regard, China has changed the so-called "playing field" as it was the largest exporter in 2019 (having a 13.3% share in world exports), as well as the second largest importer, with a 10.9% share in world imports (ITC 2020). However, its main export destination is the USA, with whom China does not share a colonial history nor a common official language (ITC 2020). China is also South Africa's main trading partner, although these two countries do not share a colonial history or official main language (ITC 2020). Nevertheless, cultural differences are still often used in the determination of export potential values to select international markets (Miečinskienė, Stasytytė, and Kazlauskaitė 2014).

Source: Authors' own compilation.

form of a log-log model.[2] By using the specified supply and demand, as well as trade time and cost determinants (as identified in the literature in Table 1), the primary gravity equation, used to estimate the export potential values for each of the 15 South African-manufactured export goods in this study, is as follows:[3]

$$\begin{gathered}\ln(tradeflow_{ijt}) = \beta 0 + \beta 1 ln(imports\_d_{jt}) + \beta 2 ln(exports\_o_{it}) \\ -\beta 3 ln(distw_{ij}) + \beta 4(contig_{ij}) + \beta 5(comlang\_off_{ij}) + \beta 6(colony_{ij}) + \\ \beta 7(FTA_{ij}) - \beta 8(landlocked_{ij}) - \beta 10 ln(cost\_d_{it}) \pm \beta 9 ln(exchange\_rate\_o\_di_{jt}) + \varepsilon i\end{gathered} \tag{1}$$

The dependent variable ($tradeflow_{ijt}$) represents the exports of 15 of South Africa's main manufactured goods from South Africa to country j. Instead of the traditional GDP values, South Africa's total exports ($exports\_o_{jt}$) and the destination countries' total imports ($imports\_d_{jt}$) of each product to and from the world serve as proxies for supply and demand capacities.[4] Therefore, the total import values of the destination countries represent the income variable in this study. This is because this study focuses on specific products and not on total trade, as it specifically sets out to compare export potential values on a product–country basis. Hence, the gravity model is slightly adjusted to be more product-specific. Nevertheless, proxies for trade costs include the weighted distance from South Africa to the destination country ($distw_{ij}$), dummies for a common border ($contig_{ij}$), shared official language ($comlang\_off_{ij}$), shared colonial history ($colony_{ij}$), and free trade agreements/shared customs unions ($FTAij$) between South Africa and the destination country. Other proxies for trade costs include a dummy for landlocked countries ($landlocked_{ij}$) and the total costs to import in the destination country, per container ($cost\_d_{it}$). Lastly, the exchange rate between the South African rand and the currency of country j expressed in rand serves as a proxy for the exchange rate risk.

[2]In the South African context, the double log specification of the gravity model has been primarily used specifically for the estimation of export potential values (see, for example, Breytenbach and Jordaan (2010), Jordaan (2011), Jordaan and Eita (2011, 2012), and Muronda (2018)). For this reason, this study also makes use of the double-log specification.

[3]The 15 gravity datasets each contained data from 2007 to 2015. This is because the Logistics Performance Index (LPI) was available only from 2007 onwards, while the method of collection of the cost data from the World Bank Doing Business report changed after 2015. Therefore, if data outside of these years were used, it would have led to inconsistent and incomparable results. The LPI, as a proxy for trade facilitation, was, however, significant for only two products and was, therefore, included in HS 330499 and HS 842139 only. Instead of trade facilitation, only the costs to import were taken into consideration for the other products, since weak trade facilitation will ultimately increase the costs associated with trading goods and services (see Table 1).

[4]Five products' import and export values were, however, not significant, and the importer's and exporter's GDPs (sourced from the World Bank) were used instead. These products are: HS 290129 (unsaturated acyclic hydrocarbons), HS 720241 (ferro-silico-manganese in granular/powder form), HS 732690 (articles of iron/steel), HS 870410 (dumpers designed for off-highway use), and HS 880330 (parts of aeroplanes/helicopters).

Export Potential Map of the International Trade Centre

With[5] the aim of increasing transparency when investigating export markets, sectors, and/or products, the ITC developed the Export Potential Map in 2016. It is an online tool that enables trade advisors, policymakers, and private companies to assess the export potential of existing products based on detailed market access and trade information (Decreux and Spies 2016; ITC 2019). Although the tool consists of two indicators, only the data captured by the export potential indicator (EPI) is used for the purpose of this study. In short, the EPI (inspired by the gravity model and which can be specified on an HS 6-digit level) provides information on the export potential of established export products to existing and/or new markets (Decreux and Spies 2016).

The EPI is built on a structural model that estimates export potential values[6] from supply capacities in the exporting country, demand conditions in the importing country, and bilateral connections between the two countries (which impact the easiness to trade).[7]

To determine the supply capacity of the exporting country, the EPI uses a dynamic adaptation of the exporter's market share in the target country, where certain elements that interfere with the measurement of true export performance are modified. The supply function, therefore, takes into consideration the augmented exporter's capacity, the export–import ratio, and the global margin of preference for each product–country combination when export potential values are determined.

Furthermore, the demand conditions of the importing country are measured by combining projected import values with factors related to the target market's openness to products from the exporting country. Such factors include the exporter's margin of preference and the distance advantage between the importer and exporter.

The easiness to trade component is based on the actual trade of products with potential between importer j and exporter i relative to the hypothetical trade if exporter i's share in world markets and in market j are the same. On average, exporter i will find it easier to trade with market j than it will with world markets when *Easinessij* >0 (and vice versa). This can be because the two countries share the same language or culture, are located close to each other, or

[5]This section relies heavily on Decreux and Spies (2016), who wrote the methodology for the Export Potential Map on behalf of the ITC.

[6]Any product–country combination is considered to have export potential if it either has a total export potential value (to the world) of US$200,000 or more, or if it is partially covered by the 95% cumulative export potential of products that are ranked by the exporting country in descending order. Furthermore, products should have been exported over the past three years and also imported over the past five years to be included in the EPI (Decreux and Spies 2016).

[7]The ITC's Export Potential Map does have a few limitations. Of most relevance to this study is the fact that export potential assessments abstain from reporting any potential dollar value that may be related to identified diversification opportunities; therefore, only within-market rankings of products are provided (Decreux and Spies 2016). Furthermore, the costs related to export promotion activities are not considered in the Export Potential Map, which may influence the feasibility of exporting certain products.

enjoy a business history. This will ultimately expand exporter *i*'s trade potential with market *j*, irrespective of the product *k* (Decreux and Spies 2016).

Finally, by combining the supply, easiness to trade, and demand components, export potential values can be estimated using the following formula (Decreux and Spies 2016):

$$EP_{ijk=}Supply_{ik}^{EP}x\,Easiness_{ij}x\,Demand_{ijk} \tag{2}$$

Decision support model

The[8] decision support model (DSM), initially developed by Cuyvers et al. (1995), is based on the idea of Walvoord (1983), which, in principle, uses a screening process to evaluate international market opportunities. The DSM was specifically developed to crystallize, from all possible worldwide product–country combinations, those with realistic export potential for a particular country. This is achieved by using four consecutive "filters," which serve to eliminate potentially unviable export opportunities. Realistic export opportunities (REOs) are then categorized and prioritized for the exporting country, and an export potential value is estimated for each of these REOs (Steenkamp 2011; Viviers et al. 2014).[9]

The first filter of the DSM eliminates countries on the basis of their political and/or commercial risk to the exporter (Filter 1.1) and whether or not countries indicate acceptable macroeconomic size and growth (Filter 1.2). The first filter, therefore, eliminates all countries that show a lack of potential on a country level, thereby allowing only a limited set of product–country combinations to enter the more detailed filters discussed below (Cuyvers et al. 2012).

In the second filter, the remaining product categories are assessed in order to identify which markets indicate sizable and growing import demand. The criteria used for this filter include import market size, short-term import growth, and long-term import growth (Cuyvers et al. 1995). Furthermore, the selection criteria are based on specified shares of world imports and world averages in import growth per product (Cuyvers et al. 2017).

If a product–country combination is selected on the basis of its size and growth, it is not necessarily easy to enter the market in question (Cuyvers et al. 1995). Therefore, the third filter determines the remaining markets' accessibility by examining the degree of market concentration, as measured by the Herfindahl-Hirschman Index (Filter 3.1) and market entry barriers (Filter 3.2) (Viviers et al. 2014).

[8]This section relies heavily on the methodology explained by Viviers et al. (2014).
[9]For this study, export potential values were only estimated using the gravity model and the Export Potential Map of the ITC for those countries that the DSM identified as having realistic export potential.

No markets are eliminated in the fourth and final filter. Instead, the REOs identified in the previous filters are categorized and prioritized. This is done by comparing the exporter's market share in each product–country combination that entered the fourth filter with the market shares of the six largest competitors (Viviers et al. 2014).

The above description briefly explains the four filters of the DSM. However, all the filters have not been applied for the purposes of this study. The starting point of the DSM is to consider all possible worldwide product–country combinations, with the original intention of Filter 1 being to eliminate, early in the process, small and stagnant countries posing high political/commercial risk. It was, therefore, not necessary to apply Filter 1, as this study focuses only on specific products and countries for comparison with other methods.

Moreover, the original Filter 3.2 is a proxy for the "absence of trade barriers." This filter, however, cannot be applied in the case of South Africa since South Africa's export performance is much better than its neighbors. Hence, its neighbors' export specialization cannot be used as a proxy for South Africa's export potential in a particular market (Steenkamp 2011).[10]

Lastly, Filter 4 involves the categorization of REOs for export promotion purposes, which is not of specific interest when comparing export potential values in this study. Therefore, only Filters 2 and 3.1 were applied for the purposes of the study.

Export potential values are determined for each product–country combination that has been identified as an REO by taking the average market share of the top six competitors in each market. This allows for the relative size of export opportunities to emerge. It also corresponds with Filter 4, where the top six competitors' market shares are compared with that of the exporter.

This concludes the discussion of the methodologies used in the gravity, ITC, and DSM approaches to calculate export potential values. The next section presents the overall results of this study, based on three tests used to compare the rankings assigned to the product–country combinations by the respective approaches. These tests entail correlation and frequency distributions, as well as a comparison of the rankings of each product's top 10 countries.

[10]Later applications of the DSM for South Africa included an alternative analysis of trade barriers in Filter 3.2 (Steenkamp 2011). Trade costs were collected for each potential market worldwide. As cutoff values are based on world averages and South Africa's transportation cost data are not readily available in an updated dataset, this would have involved an extensive and time-consuming data collection exercise. For the purposes of this study, where the focus is on the potential value calculation for a selection of 15 products, an update of this filter was, therefore, not included. Moreover, the potential value calculation of the DSM did not include market access variables.

V. Results

Spearman rank-order correlation test

The Spearman rank-order correlation test is a nonparametric technique used to evaluate how the rankings of the results involving two independent variables compare and correlate (Bon-Gang 2018; Gauthier 2001). When comparing the assigned ranks, the calculated correlation coefficient (r_s) can take any value between −1 and 1. The closer r_s is to ±1, the stronger the correlation between the rankings (Gauthier 2001). For this study, a correlation of ±0.7 is considered relatively high, a correlation lower than ±0.5 is considered relatively low, and therefore, a correlation between ±0.5 and ±0.7 is considered moderate.

Table 2 provides a summary of each product's correlation coefficient (between the respective approaches), as determined by the Spearman rank-order correlation test.

In Table 2, it is evident from the results of the Spearman rank-order test that the ITC and DSM approaches had the highest overall correlation (0.694), followed by the ITC and gravity approaches (0.650). Conversely, the correlation between the DSM and gravity approaches was significantly lower (0.377), meaning that the rankings of the approaches in question were less comparable.

Furthermore, by analyzing the correlation between the different methods in respect of each product, it is clear that the ITC and DSM approaches had the most products (12 of the 15) with a correlation above 0.7, while the other three products showed a moderate correlation between 0.5 and 0.7. In terms of the ITC and gravity approaches, nine of the 15 products had a correlation higher than 0.7, five products had a correlation between 0.5 and 0.7, and one product (HS 870410: dumpers designed for off-highway use) had a low correlation less than 0.5. Lastly, the DSM and gravity approaches had only four products with a correlation above 0.7, followed by eight products with a moderate correlation between 0.5 and 0.7. Three products had a correlation less than 0.5.

The Spearman rank-order correlation test, therefore, indicated that the ITC and DSM approaches had the strongest relationship, with the relationship between the ITC and gravity approaches following closely behind.

The test was carried out first to get an overall idea of how the rankings assigned to the export potential values compared across the different approaches. The correlation test also established whether there were relationships between the rankings assigned to the export potential values by the respective approaches. For more in-depth comparisons of the rankings, further tests were conducted in this study as explained below.

Comparison of frequency distributions

The frequency distributions of two approaches were compared for each product–country combination to obtain a more detailed comparison of the

Table 2. Correlation coefficients between approaches.

		Correlation coefficient		
Harmonized System (HS) product code and description	Approach	Gravity	International Trade Centre (ITC)	Decision support model (DSM)
	Gravity	1	0.650**	0.377**
Overall	ITC	0.650**	1	0.694**
	DSM	0.377**	0.694**	1
HS 290129	Gravity	1	0.723**	0.692**
Unsaturated acyclic	ITC	0.723**	1	0.878**
hydrocarbons	DSM	0.692**	0.878**	1
HS 330499	Gravity	1	0.677**	0.640**
Beauty/make-up and	ITC	0.677**	1	0.860**
skincare preparations	DSM	0.640**	0.860**	1
HS 480419	Gravity	1	0.548**	0.817**
Uncoated kraftliner in	ITC	0.548**	1	0.705**
rolls/sheets	DSM	0.817**	0.705**	1
HS 720230	Gravity	1	0.648**	0.611**
Ferro-silico-manganese	ITC	0.648**	1	0.785**
in granular/powder form	DSM	0.611**	0.785**	1
HS 720241	Gravity	1	0.599**	0.620**
Ferro-chromium in	ITC	0.599**	1	0.981**
granular/powder form	DSM	0.620**	0.981**	1
HS 721049	Gravity	1	0.714**	0.685**
Flat-rolled products of iron	ITC	0.714**	1	0.802**
or non-alloy steel	DSM	0.685**	0.802**	1
HS 732690	Gravity	1	0.880**	0.730**
Articles of iron/steel	ITC	0.880**	1	0.882**
	DSM	0.730**	0.882**	1
HS 840999	Gravity	1	0.793**	0.469**
Parts used solely with	ITC	0.793**	1	0.690**
certain engines of HS 84	DSM	0.469**	0.690**	1
HS 841391	Gravity	1	0.701**	0.372*
Parts of specified pumps	ITC	0.701**	1	0.729**
	DSM	0.372*	0.729**	1
HS 842139	Gravity	1	0.755**	0.701**
Purifying machinery and apparatuses	ITC	0.755**	1	0.837**
for gases	DSM	0.701**	0.837**	1
HS 843149	Gravity	1	0.748**	0.503**
Parts used solely with	ITC	0.748**	1	0.743**
certain machinery of HS 84	DSM	0.503**	0.743**	1
HS 847490	Gravity	1	0.622**	0.510**
Parts of the machinery of	ITC	0.622**	1	0.625**
HS 8474	DSM	0.510**	0.625**	1
HS 870410	Gravity	1	0.447**	0.414**
Dumpers designed for	ITC	0.447**	1	0.667**
off-highway use	DSM	0.414**	0.667**	1
HS 870421	Gravity	1	0.703**	0.541**
Motor vehicles for the	ITC	0.703**	1	0.775**
transportation of goods	DSM	0.541**	0.775**	1
HS 880330	Gravity	1	0.761**	0.851**
Parts of aeroplanes/	ITC	0.761**	1	0.852**
helicopters	DSM	0.851**	0.852**	1

Note: † The overall correlation coefficient was also estimated by means of the Spearman rank-order correlation test.
** Correlation is significant at 1%. * Correlation is significant at 5%.
Source: Authors' own estimates.

rankings assigned to the export potential values. The differences in rankings (X) between the estimated export potential values of each product–country combination were categorized into groups of five. The allocation of categories was as follows:

Category 0: $0 \leq X \leq |5|$, indicating that rankings differed minimally;
Category 1: $|5| < X \leq |10|$;
Category 2: $|10| < X \leq |15|$;
Category 3: $|15| < X \leq |20|$;
Category 4: $|20| < X \leq |25|$; and
Category 5: $X > |25|$, indicating that rankings differed substantially.

For example, Category 3 would apply if there were a difference of 19 places (or rankings) between the ITC and DSM approaches (or similarly, between the ITC and gravity approaches or DSM and gravity approaches) for the product–country combination *ki*.

Ultimately, the frequency distributions (in other words, how many product–country combinations fall into each category) provide a measure to determine the extent to which the rankings of the export potential values differ across the three approaches. The lower the differences in rankings, the better the approaches' estimated export potential values compare.

Figure 1 provides an overall comparison between the respective approaches over the six categories.

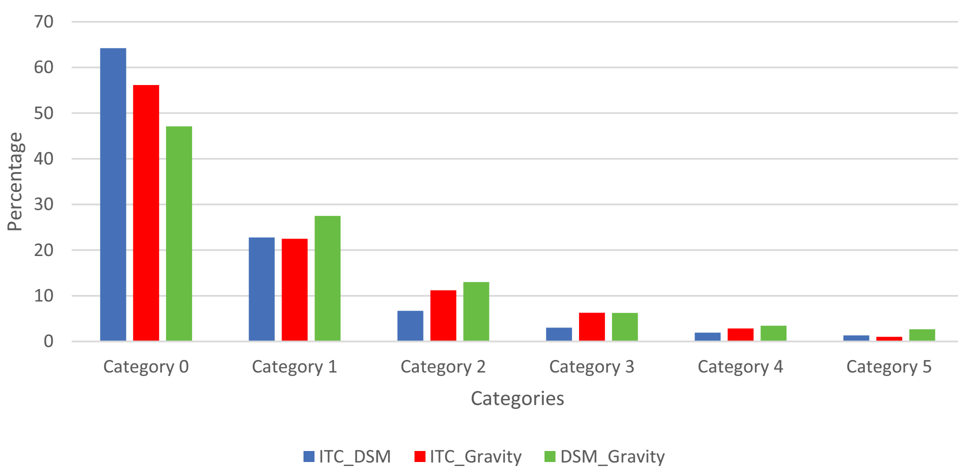

Figure 1. Comparison of the rankings of the gravity, ITC, and DSM approaches over the six categories.

From Figure 1, it is clear that the ITC and DSM approaches (ITC_DSM) compared the best, as they had the highest percentage (64%) of product–country combinations, with five or fewer differences in rankings of their estimated export potential values (Category 0). When adding Category 1 to this number, 87% of the product–country combinations showed differences in rankings of less than 10 places when the potential values of the ITC and DSM approaches were compared. This implies that the ITC_DSM comparison had a very low percentage (13%) of the product–country combinations in the remaining categories (Categories 2 to 5) with differences in rankings of more than 10 places.

Conversely, the DSM and gravity approaches (DSM_Gravity) had the lowest percentage (47%) of product–country combinations in Category 0. This means that less than 50% of the product–country combinations of DSM_Gravity had fewer than five differences in rankings. However, when adding Category 1 to this number, almost 75% of the product–country combinations showed differences in rankings of less than 10 places when the DSM and gravity approaches were compared. Therefore, a total of 25% of the product–country combinations in the remaining categories (Categories 2 to 5) had differences in rankings of more than 10 places, which can be regarded as relatively large differences between the two approaches.

The ITC and gravity approaches (ITC_Gravity) also showed a relatively fair comparison, with 56% of product–country combinations having five or fewer differences in rankings (Category 0). Almost 79% of the product–country combinations showed differences in rankings of fewer than 10 places when the ITC and gravity approaches were compared, leaving around 21% of product – country combinations with relatively large differences in rankings.

Overall, the differences in rankings were the smallest between the ITC and DSM approaches. Conversely, the DSM and gravity approaches had the lowest percentage of product–country combinations with differences in rankings of fewer than five places (Category 0) and the highest percentage of product–country combinations with large differences in rankings (Categories 2 to 5). Another interesting finding from the comparison of rankings was that, on average, 44.18% of the product-country combinations of the respective approaches showed differences in rankings of more than five places (Categories 1 to 5). Moreover, for Categories 2 to 5, an average of 19.92% of the product – country combinations of the respective approaches showed differences in rankings of more than 10 places. These results support the findings of the Spearman rank-order correlation test (see the previous subsection).

Comparison of each product's top 10 countries

Comparing each product's top 10 countries was the final technique/test used to compare the rankings of export potential values by the gravity, ITC, and DSM approaches. This technique showed whether or not the three approaches identified more or less the same top 10 countries with the most export potential for each product.

First, every product's top 10 countries were determined under each approach. Thereafter, a comparison was made between the rankings of the top 10 countries emanating from the three approaches. The closer the rankings were and the more the countries were included in all three approaches' top 10, the better the export potential values compared.

Figure 2 provides a summary of the overall comparisons of each product's top 10 countries.

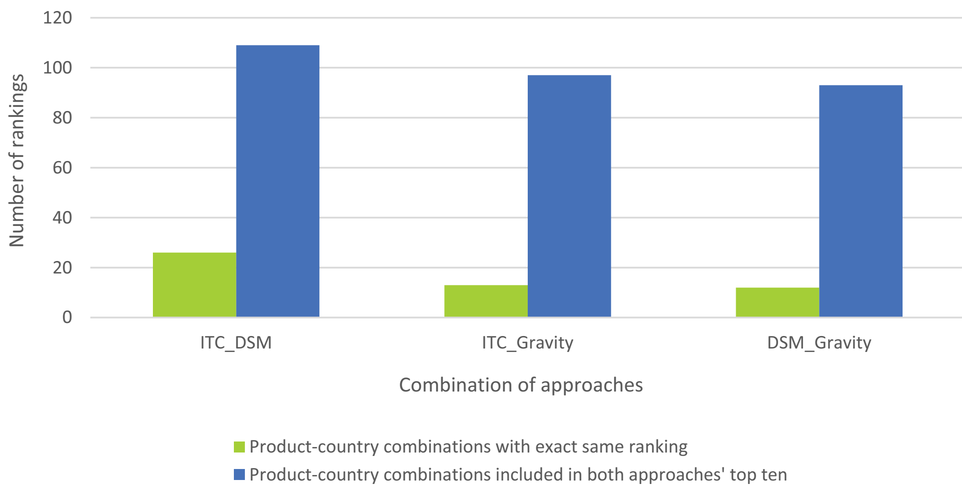

Figure 2. Overall comparison of product–country combinations included in the top 10 countries of each approach.

From Figure 2, it is clear that the ITC and DSM approaches had by far the most product–country combinations with the exact same ranking (26 product–country combinations), as well as the most product–country combinations included in both approaches' top 10 countries (109 product–country combinations). The ITC and gravity approaches had the second most product–country combinations with the exact same ranking (13 product–country combinations), as well as the second most product–country combinations included in both approaches' top 10 countries (97 product–country combinations). The DSM and gravity approaches, in turn, had slightly fewer product–country combinations with the exact same ranking (12 product–country combinations) than the ITC and gravity approaches. The number of product–country combinations included in the DSM and gravity approaches' top 10 countries was also only slightly less (93 product – country combinations) than that included in the ITC and gravity approaches' top 10 countries.

Overall, the majority of the product–country combinations were in the top 10 of only one approach (34.80%), while 31.72% of the product – country combinations were in the top 10 of two approaches. Finally, 33.48% of the product – country combinations were in the top 10 of all three approaches.

After comparing each product's top 10 countries, as estimated by the different approaches, it can be said that the results were similar to those of the Spearman rank-order correlation tests and frequency distributions. A brief discussion of the results follows in the next section.

VI. Discussion of results

From the three frequency and distribution tests comparing the rankings/priorities assigned to the export potential values by the gravity, ITC, and DSM approaches, it is clear that the ITC and DSM approaches were the most comparable. Conversely, although they compared moderately, the rankings assigned by the DSM and gravity approaches had the lowest level of similarity among the respective approaches.

It should, however, be borne in mind that the main aim of the ITC approach is to determine export potential values on a detailed product level, while that of the gravity model is to analyze the determinants of bilateral trade on a country level. Furthermore, the DSM was specifically developed to crystallize, from all possible worldwide product–country combinations, those with realistic export potential for a country. In this regard, the DSM also includes products for diversification purposes, while the ITC does not calculate export potential values for products with diversification potential. Moreover, the DSM and gravity approaches run the export potential analysis from one exporting country's perspective at a time, while the ITC approach covers a wide range of exporting countries.

Nevertheless, an interesting finding in Section 5 is that approximately 20% of the rankings differed by more than 10 places between the approaches, while almost 45% of the rankings differed by more than five places. In addition, more than one-third (34.80%) of the product–country combinations were in the top 10 of only one approach. Therefore, although the three approaches measured the same concept, the rankings allocated by the approaches differed significantly. Possible reasons for these inconsistencies need to be explored.

One reason for the DSM and gravity, and the ITC and gravity, approaches not comparing very well might be that most variables used in the gravity approach are on a country level, which makes product-specific analysis challenging. Moreover, from the literature reviewed in Section 3, it is evident that some of the variables used in the gravity model can be considered outdated, such as cultural factors. The gravity model was also not specifically developed to estimate export potential values in detail on a large scale. The gravity approach can, therefore, be "computationally burdensome" when export potential values are estimated on such a scale, since it requires a panel regression analysis for each individual product, which is the case in this study (Decreux and Spies 2016). A vast number of coefficients and equations must, thus, be estimated (Decreux and Spies 2016).

In contrast, besides both the ITC and DSM approaches incorporating more relevant variables, they were also both designed to analyze export potential on a large scale and at the detailed product level. Although the DSM was not initially intended to estimate export potential values (the feature was added in later applications of the model), both approaches included variables that were country-specific and product-specific and could be used on a large scale.

VII. Conclusion and recommendations

In view of the unquestionable link between exports and economic growth, the National Treasury in South Africa identified increased exports of manufactured goods as a key driver in the quest to reduce unemployment and enhance economic growth. Resources for formulating and implementing export promotion strategies are, however, limited – not helped by the fact that incorrect market selection can lead to considerable losses. Important market selection and prioritization decisions are, thus, often based on estimated export potential values. Yet, attaching a specific value to export potential is challenging. For example, it is difficult to determine the accuracy of an estimated value because the potential is not always actively pursued and realized in actual trade.

Consequently, this study set out to compare the rankings/priorities assigned to the export potential values estimated for South Africa by three international market selection approaches. The three approaches used for this comparison were the gravity model, the International Trade Center's (ITC) Export Potential Map, and the decision support model (DSM). Although the approaches differ in aim and method, the same concept – export potential – was measured, with the comparison potentially contributing to the literature on international market selection and providing new insights that could refine and enhance each approach.

Overall, the results of the study revealed that the rankings based on the export potential values estimated by the ITC and DSM approaches were the most comparable among the three approaches, while the comparison between the rankings assigned by the DSM and gravity approaches showed the least similarity. The results also showed that a significant percentage of product–country combinations differed by more than five places in the rankings assigned by the approaches. Moreover, more than one-third of product–country combinations were included in the top 10 of only one approach. These inconsistencies between the rankings may suggest that alternatives to prioritizing between export opportunities should be considered. Since the motivation for calculating export potential values is to rank the identified export opportunities, one option is to rather calculate a composite index using variables to measure market attractiveness based on the literature.

Furthermore, to confirm whether some model combinations work better for specific countries only, or whether in a fixed approach one or two models work better overall, the analysis used in this study can be repeated for other countries for the purposes of comparison. It is also important to bear in mind that each of the three approaches has a specific purpose, benefits, and limitations. Thus, depending on the problem that needs to be addressed, the different approaches should be used for their intended purpose. In addition, other immeasurable components of export potential should be added to export potential analyses. Export promotion decisions should, therefore, not be based on (untapped) export potential values alone.

Ultimately, it is recommended that the different export potential approaches be used to enhance and complement one another. For example, if the purpose of the exercise is to "pick winners" from a large number of potential export markets, the DSM filtering process can be used as a starting point. The ITC's more comprehensive export potential assessment, which was inspired by a gravity-type framework, can then be used to attach export potential values to REOs identified by the DSM. The product diversification information from the ITC can, in turn, be used to differentiate between different types of export opportunities (intensive or extensive product margin) and prioritize the different opportunities.

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