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Do country sizes matter? What motivates China's trade decision in Southern Africa?

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Abstract

Purpose – This paper aims to test the political-economy hypothesis that country sizes are related with constraints associated with Chinese trade.

Design/methodology/approach – This study applies a generalized linear mixed approach on panel data of Southern African (henceforth SADC) economies from 2001 to 2014 to observe common Chinese trade patterns among SADC countries.

Findings – Empirical results support the hypothesis that structural differences exist and smaller SADC countries are disadvantaged in their trade relations with China.

Research limitations/implications – This paper is exploratory by nature. Its scope and the depth of analysis is constrained by data availability.

Originality/value – The manuscript has been approved by the author and has never been published, or has been considered for publication elsewhere.

Keywords SADC, Chinese trade, Country size, Finite mixture model, Southern Africa

Paper type Research paper

1. Introduction

Differences exist among sizes of countries. The size of a country can be measured in terms of its population, land mass or gross national product[1]. Extant studies on the relationship between country size and economic performance have elicited mixed responses. A school of thought argues that larger countries tend to be more successful because of "scale effects", whereas another school of thought theorizes that smaller countries tend to be better structured organizationally, and a third school of thought emphasizes trade-offs between country sizes and benefit cost. Helpman and Krugman (1985) cites improved integration of factor levels of production, greater productivity derived from specialization and a higher ability to inculcate technological flows as advantages of scale effects. Barro and Sala-i-Martin (1995) listed increased technological spill-overs as a by-product of the scale effect and concluded that larger economies tend to grow faster, whereas Jones (1999) applied the endogenous growth model and noted that economic size has an impact on the growth rate in the long run, as larger economies are able to support more research which leads to higher productivity rate. Krugman (1991) expatiated on size effects using an economic geography approach and posited that larger economies experience an increasing return to scale, which is higher than that of smaller economies. Alesina and Spolare (2003) discussed the advantages of a larger population size as increased productivity arising from specialization, lower cost per capita of public goods and a higher capability to redistribute wealth in the economy. They, however, noted political and economic cost arising from heterogeneity in culture and languages as trade-offs relative to the advantages of size. If scale effects only

JEL classification – F14, F21, F23

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derive benefits, then countries around the world would be configured as a single entity. Myrdal (1968) argued that larger states require strong leadership which leads to authoritarianism or oligarchies as a form of government. They also stated that larger economies tend to place greater emphasis on internal stabilization. According to Easterly and Levine (1997), as nations expand in size, the rise in administrative and bureaucratic cost might outweigh the advantages of size while other drawbacks include heterogeneity of citizens (nationals). They further stated that heterogeneity among African nations, caused by artificial borders created by colonial masters, is a significant factor in market failures and economic collapse in Africa, as the borders transverse tribal lines in an inefficient manner. Are smaller countries affected by their smallness? Easterly and Levine (1997) provided evidence that smaller countries require relatively less goods, and this creates higher cost per unit which act as a disincentive. Alesina and Spolare (2003) further listed disadvantages of a smaller country size to include fewer resource endowment and weaker inter-sector linkages and listed benefits to include reduced transport cost, as it is easier to transport goods at a relatively lower cost. Alesina *et al.* (2005), furthermore, observed that smaller economies tend to be more susceptible to external economic conditions and are thus more likely to apply competitive trade strategies geared towards boosting exports, as the small domestic market does not provide option for loss of market share. Rose's (2000) study, additionally, proved that significant relationship exists between a country size and economic growth on a global level. He further stated that smaller countries tend to have higher per capita GDP[2] borne largely from specialization, and smaller countries tend to be more open to international trade than bigger countries. Olson (1982), again, pointed out that smaller economies tend to be more homogenous, and thus have a greater incentive and capacity to create wealth. Also, Feldman (2006) observed that among the Eurozone economies, countries with larger economies tend to have a higher degree of unemployment.

Research on Chinese trade and investment in Africa has been growing over the past years, and a few of these papers have explored the locational choices of Chinese trade using different sources of data and empirical techniques. Buckley *et al.* (2007) and Kolstad and Wiig (2012) observed that the partner country's income level determines Chinese trade and investment decisions. Amighini *et al.* (2011) by analysing Chinese trade and investment noted that Chinese economic relations tend to be sector-specific. Li and Liang (2012) further disclosed that Chinese trade and investments decisions are drawn to politically risky economies, usually because of harmonious political relations between both economies rather than because of risk preference. Duanmu (2012) observed that Chinese trade is attracted to countries with abundant endowment of natural resources. Results are, however, inconclusive as to whether Chinese diaspora population in a partner country is a draw or an attraction for trade decisions. Ramasamy *et al.* (2012) and Song (2011) observed varying responses from survey data analysed. The objective of this paper is to analyse the locational determinants of Chinese trade. This study attempts to evaluate Chinese trade decisions from a country size perspective, using population as a proxy for country size (Sachs and Warner, 1995; Cicone and Alcala, 2004). The motivation for looking at scale effect is that theoretically, they provide an important mechanism linking growth to trade. This paper analyses the trade internationalization location decisions of Chinese trade in Southern African Development Community (SADC) from 2001 to 2014, using a generalized mixed model. Market-seeking determinants are first evaluated on Chinese trade data to observe their impact on SADC economy, and then we apply the mixture model to sort country clusters based on their posterior probability. This study is exploratory by nature. Its scope and the depth of the analysis are constrained by data limitations of China's trade flows. The paper is organized as follows. Sections 2 and 3 provide the theoretical model and descriptive and empirical

analysis, respectively; Section 4 presents the methodology and results. Section 5 discusses the findings and conclusion.

2. Theoretical model

We apply the model by Alesina *et al.* (2005)[3] which shows the interrelationship between country size, trade and economic growth. The production function can be expressed as follows.

Consider an entity with individuals located in a segment [0, 1], and the entity population is set to 1. The utility function of each individual $i \varepsilon [0, 1]$ is as follows:

$$\int_0^{\infty} \frac{C_{it}^{1-\sigma}}{1-\sigma} \mathrm{e}^{-\rho t}\, dt \tag{1}$$

With C_{it}, K_{it} and L_{it} as consumption, capital and labour at time $t. \sigma > 0$ *and* $\rho > 0$. A specific input X_{it} is produced at each specific location. By using the location-specific capital in the linear production function:

$$X_{it} = K_{it} \tag{2}$$

Each specific location i produces y_{it} unit output of the final good Y_t, based on the production function:

$$Y_{it} = A\left(\int_0^1 X_{ij}^{\alpha}(t)dy\right)L_{it}^{1-\alpha} \tag{3}$$

With $\alpha < 0 < 1$. X_{ijt} implies intermediate input j used in i at time t, whereas A denotes the total factor productivity. Profit maximizing firms in perfectly competitive markets can trade intermediate goods across N different countries. Country 1 has size S_1 […]. Country $N-1$ has size S_{N-1} with country $S_N = 1 - \Sigma_j^{N-1} = S_j$. We assume no constraints to local trade, and constraints exist in external trade. Thus, a unit intermediate good produced in country n' and transported to location i in another country n'' will be $1 - \beta_{n'n''}$ at country n'' with $\beta_{n'n''} \leq 0 \leq 1$.

If $D_{in'(t)}$ implies domestically produced and consumed input i and $F_{in''(t)}$ implies input i transported to n'', only $(1 - \beta_{n'n''})F_{in''(t)}$ units of input will be used in production as $n' \neq n''$. Thus, as intermediate goods are assumed to be perfectly competitive, in equilibrium, i will be traded at a marginal product price both locally and externally. Thus:

$$P_{i(t)} = \alpha A D_{in''(t)}^{\alpha-1} = \alpha A(1 - \beta_{n'n''})^{\alpha} F_{in'(t)}^{\alpha-1} \tag{4}$$

With $P_{i(t)}$ as the market price of input i, the resource constraint for i from equation (2) will be:

$$S_{n'} D_{in'(t)} + \sum\nolimits_{n \neq n} \mathrm{S}_n F_{in(t)} = K_{in'(t)} \tag{5}$$

With $S_{n'}$ as the size of country n' and $K_{in'(t)}$ as the capital stock in location i.

Substituting equation (4) into equation (5):

$$D_{(t)} = \frac{K_{in'}}{S_{n'} + \sum_{n \neq n'} S_n (1 - \beta_{n'n''})^{\alpha / (1-\alpha)}} \tag{6}$$

And

$$F_{in''(t)} = \frac{(1 - \beta_{n'n''})^{\alpha / (1-\alpha)} K_{in'}}{S_{n'} + \sum_{n \neq n'} S_n (1 - \beta_{n'n''})^{\alpha / (1-\alpha)}} \tag{7}$$

Expectantly, trade constraints increase local utilization of intermediate products and discourage external trade. Thus, if we assume constraints to trade are homogenous across countries, $\beta_{i'i''} = \beta \; \forall i' \; and \; i''$ for different countries. Based on this assumption:

$$w = (1 - \beta)^{\alpha / (1-\alpha)} \text{ with } w \; \leq 1 \geq 0 \tag{8}$$

This implies that the higher the w, the lower the constraints for external trade, meaning w can be assumed as a measure for external openness[4]. If constraints are prohibitive, $\beta = 1 \; and \; w = 0$, implying autarky, and when trade openness exist, $\beta = 0 \; and \; w = 1$, implying openness abounds.

Therefore, equations (6) and (7) can be expressed as:

$$wD_{in'(t)} = \frac{K_{in'(t)}}{S_{n'} + (1 - S_{n'})w} \tag{9}$$

And

$$F_{in'(t)} = \frac{wK_{in'(t)}}{S_{n'} + (1 - S_{n'})w} \tag{10}$$

For each i, households net asset is equal to the capital stock $K_{in'(t)}$. As individual unit of K yields i, the net return on capital equalizes to the market price of $P_{i(t)}$. The Euler equation can be derived from the intertemporal optimization:

$$\frac{\delta C_{it}}{\delta_t} \frac{1}{C_{it}} = \frac{1}{\sigma}[P_{i(t)} - P] = \frac{1}{\sigma}\{\alpha A[w + (1 - w)S_{n'}]^{1-\alpha} K_{in(t)}^{\alpha - 1} - \rho\} \tag{11}$$

And the steady-state capital level at i for $S_{n'}$ becomes:

$$K_{in'}^{ss} = \left(\frac{\alpha A}{\rho}\right)^{\alpha/1-\alpha} [w + (1 - w)S_{n'}] \tag{12}$$

If we substitute equation (12) into equations (9) and (10) and use equation (3), we derive the following premise.

Steady state level of Y in i of $S_{n'}$ becomes:

$$Y_i^{ss} = A1 / (1 - \alpha)(\alpha/\rho)^{\alpha / (1-\alpha)}[w + (1 - w)S_{n'}] \tag{13}$$

This implies that:

$$a.\ \frac{\delta Y_i^{ss}}{\delta w} > 0 \quad \text{output per capita in steady state increases with trade openness} \tag{14}$$

$$b.\ \frac{\delta Y_i^{ss}}{\delta S_{n'}} > 0 \quad \text{output per capita increases with country size} \tag{15}$$

$$c.\ \frac{\delta Y_i^{ss}}{\delta S_n \cdot \delta w} < 0 \quad \text{The higher the degree of openness, the smaller the impact country of size and vice versa} \tag{16}$$

From the above premise, we can deduce that trade openness and country size have a positive impact on growth, but size is less important in a more open economy, and if no barrier to trade exists ($w = 1$), Y will be independent of the country size.

The model shows the advantages of country size decrease as trade openness increases. Also, the smaller the country size, the bigger the advantages of trade openness. Both size and openness have an impact on growth as they determine the degree of economic interrelationship. We also see that openness mitigates the cost of size for smaller countries.

2.1 Explanatory variables

For the econometric analysis, openness will be substituted for Chinese trade, and we apply variables which measure relevant factors in Chinese trade decisions as identified in the above-mentioned literature.

Chinese trade (*ctrade*) is derived as trade from China as a proportion of total trade to enable us distinguish the size of Chinese trade in individual SADC countries.

Population (*mkt_size*) is a proxy for host country's size of market (Rose, 2000) and assesses the trade-seeking behaviour of Chinese firms. A higher population rate is considered an attractive draw for Chinese trade decisions.

GDP per capita income (*gdpc*) is an indicator for developmental level of a country and a benchmark to appraise the market influence of a country and the degree to which Chinese companies are drawn to more affluent countries in the region (Buckley *et al.*, 2007; Kolstad and Wiig, 2012). It evaluates the degree to which Chinese trade is attracted to wealthy markets.

Investment (*inv*) shows the value of gross capital formation as a percentage of GDP in market prices and is a benchmark of the value of investment. A positive coefficient is an indicator of productivity gains.

Inflation (inf *l*) reflects the purchasing power per unit of money in an economy and is a barometer for economic stability. Previous studies on determinants of FDI indicate that inflation has a negative impact on investment, but studies on Chinese FDI have observed that Chinese firms are attracted to economies with unstable economic position (Buckley *et al.*, 2007).

Geographical location (*geo*) is a dummy to indicate if a country has access to sea or if it is landlocked. This is to evaluate if a country's location encourages trade decisions. Ramasamy *et al.* (2012) noted that countries with seaports have a higher trade ratio relative to landlocked countries.

Natural resources (*nat*) and its availability are important factors in trade decisions of Chinese firms according to previous literature(Kolstad and wiig, 2012; Buckley *et al.*, 2007).

Taxation (*tax*) is a proxy for fiscal pressure. Fiscal pressure is considered to have a negative impact on trade decisions (Hines, 1999).

Domestic credit (*cred*) refers to financial resources provided to the private sector by financial corporations such as trade credit and loans.

The data[5] are drawn from the World Bank's World Development Indicator and the International Trade Centre.

2.2 Descriptive analysis of SADC trade to China and rest of the world

Southern Africa is the region comprising the southern part of the African continent. It constitutes approximately 27 per cent of the African population, 33 per cent of its total land mass, and it is the largest GDP contributor in the African region. Considered one of the most richly endowed mineral regions in the world, it boasts numerous renewable and non-renewable resources such as gold, diamond, platinum, coal, copper and crude oil.

The SADC was established in 1980. It comprises 15 member states that include Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mozambique, Mauritius, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe. Its goal is to further socio-economic cooperation and integration as well as political and security cooperation among member states.

SADC comprises economies with varying demography and economic sizes. The population ranges from 97 thousand in Seychelles to 77 million inhabitants in the Democratic Republic of Congo[6]. Also, GDP ranges from US$312.9bn in South Africa to US$1.4bn in Seychelles.

South Africa and Angola are both the largest exporters and importers in the SADC region, with mineral fuel export accounting for 40 per cent of total SADC exports (World bank, 2014). Other major exports include pearls and precious stones, tobacco, ores, copper, automobiles and coal. Its major imports are mineral fuel, automobiles, machinery, clothing and textile and pharmaceuticals.

China is SADC's largest trading partner and the most important regional destination for Chinese imports and exports among all regional blocs in Africa. SADC exports to China were valued at US$89bn in 2013, accounting for approximately 76 per cent of all Chinese imports from Africa (Tralac, 2014). Also, SADC accounts for approximately 32 per cent of the total imports to Africa. South Africa, Angola, Congo, Zambia and Democratic republic of Congo account for the top five source markets for Chinese imports, with mineral products dominating the composition of imports from Africa; South Africa, Nigeria, Egypt, Algeria and Angola represent the top five export markets for Chinese exports in Africa. Figure 1 shows the annual growth rate of Chinese imports to Africa and SADC. It shows that they both share similar growth patterns between 2001 and 2013, signifying the importance of SADC countries to Chinese trade relative to the African continent. Figure 2 shows a less expansionary pattern, but still highlights the regions' significant share of export to China. Comprehensively, the region has significant value to china's economic interest, relative to other African regions.

3. Econometric model

Recent literature on cross-country analysis of economic models have shown that contrary to the homogeneity specification among countries as specified by Solow (1956) and Mankiw *et al.* (1992), heterogeneity exists in panel data regression parameters (Bloom *et al.*, 2003; Durlauf, 2001; Paap *et al.*, 2005) (Figure 3).

Differences in parameters across countries, missing and omitted variables as well as violation of the linearity assumption in the production function have been cited as reasons for heterogeneity. Previous approaches to tackling heterogeneity have been to include dummies or country effects or use a predetermined threshold level when analysing cross-sectional data. Although this method helps control for averages in variable rates, their inability to control for differences in marginal effects has been a cause of concern. Also, although a predetermined threshold level might enable countries to be group based on contrasting patterns, this approach creates outliers' issues in the regression analysis. This paper applies

a finite mixture model (FMM)[7] procedure on the panel data. FMM fits the mixture models, thereby enabling descriptions of data with different distribution mixtures and solving heterogeneity and over-dispersion issues by using Bayesian techniques. This is achieved by application of a mixture of parametric distribution to model the observation, estimating both the parameters for the separate distributions and the probabilities of component membership for each observation. A fitted component distribution and the estimated mixing probabilities are used to compute a posterior probability of component membership. An observation is assigned a membership to the component with the maximum posterior

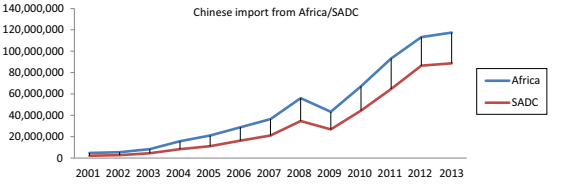

Figure 1.
Chinese imports from Africa, SADC

Source: Tralac (2014)

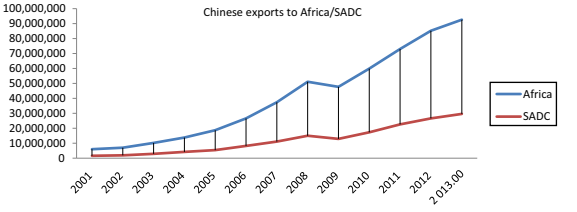

Figure 2.
Chinese Exports to Africa, SADC

Source: Tralac (2014)

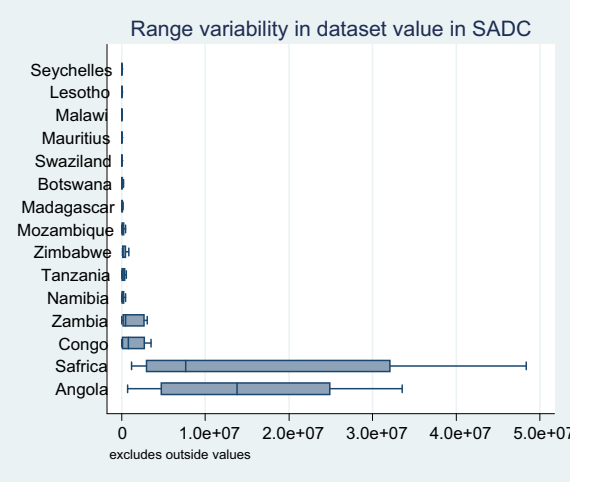

Figure 3.
Range variability in trade values

probability, thereby enabling estimation and hypothesis testing within the framework of standard statistical theory (McLachlan and Basford, 1988).

Assuming that Chinese trade may differ across countries, reflecting differences in country sizes, natural resource endowment, degree of openness, institutions, recipient country income level and so on, and a set of individual latent effects μ_i encompasses the effects of unobserved heterogeneity, the regression model can be defined as follows:

$$E(Y_{it}|x_{it}\mu_i) = A + \beta_1(gdpc) + \beta_2(\inf) + \beta_3(mkt\_size) + \beta_4(nat) + \beta_5(tax) + \beta_6(geo) + \beta_7(inv) + \beta_8(cred) + \mu_i \quad (17)$$

With Y_{it} defined as Chinese trade as a percentage of total trade of a country i at time t, *gdpc* as gross domestic product per capita, *mkt_size* as the population rate, *inv* as investment, *tax* as taxation rate, *nat* as natural resources, *geo* as geographical location, *cred* as credit and μ_i as the latent variable. The mixture model can be expressed as follows:

$$E(Y_{it}|x_{it}\mu_i) = \gamma + x_{it}\gamma_i + \mu_i \quad (18)$$

With γ as the intercept term and μ_i as country specific latent effects which are visible in the linear model. The μ_i premise can be waved aside by linking the random parameters to some components of the explanatory variables to enable us derive a random coefficient model. Equation (18) is fitted by maximum likelihood which maximizes the likelihood function. To enable our set of observation to be independent and identically distributed, the joint density or likelihood function of the model can be written as follows:

$$f_i = f(Y_{it}|x_{it}, \mu_i) = \Pi_{t=1}^{T}\{f(Y_{it}|x_{it}, \mu_i)\} = \Pi_{t=1}^{T} f_{it} \quad (19)$$

$$\Pi_{t=1}^{T}\left\{\frac{1}{2\sigma^2}\exp\left[-\frac{1}{2\sigma^2}(Y_{it} - \gamma_{0i} - \gamma_i x_{it})^2\right]\right\} \quad (20)$$

Ascribing the latent parameters as unknown or nuisance parameters and integrating them out, the likelihood function can be derived as follows:

$$L(.) = \Pi_{i=1}^{n}\left\{\int_{\mu}^{\cdot} f_i dG(\mu)\right\} \quad (21)$$

With $G(\mu)$ as the distribution function of μ_i.

Evaluating equation (18) with the likelihood function, the intercept term γ_{0i} is assumed to differ among countries, to enable us observe country specific characteristics. If we accept the distribution function as unknown because of the fact that specifying the number of parameters can be constraining, we can estimate the number of classes using the integral in equation (21). If we assume the number of classes as j, then:

$$L(.) = \prod_{i=1}^{n}\left\{\sum_{j=1}^{J} f(y_{it}|x_i, \mu_j)\pi_j\right\} = \prod_{i=1}^{n}\left\{\sum_{j=1}^{J}[f_i j \pi_j]\right\} \quad (22)$$

π_j is the posterior probability, and $f_i j$ indicates the probabilistic distribution of the response variable in the *jth* element. In the mixture model, we treat μ_j and π_j as anonymous parameters and apply the empirical Bayes rule to calculate the J component posterior probabilities via

penalized likelihood estimation. Designating δ as the parameter vector, we derive the following equation:

$$\frac{\partial[L(\delta)]}{\partial \delta} = \frac{\partial(\delta)}{\partial(\delta)} = \sum_{i=1}^{n} \sum_{j=1}^{J} \left\{ \frac{f_i j \pi_j}{\sum_{j=1}^{J} f_i j \pi_j} \right\} \frac{\delta_{fij}}{\partial \delta} = \sum_{i=1}^{n} \sum_{j=1}^{J} \pi_{ij} \frac{\delta_{fij}}{\partial \delta} \quad (23)$$

With the posterior probability expressed as π_{ij}, indicating that the *ith* part is derived from the *jth* portion of the mixture model. Mixture models have been applied in empirical studies by Quah (1996) and Alfo *et al.* (2008). This model clusters countries which have a homologous steady state, similar to all countries in the group and distinct from another group of countries. This model is run using the generalized linear latent mixed model (GLLAMM) routine to enable us observe the correlation between countries from the same cluster which share specific but unobserved Chinese trade relation properties in the SADC region (Table I).

4. Methodology and results

Because measurement bias may exist in the production function data, we first estimate the probability density function of our variables using a Kernel density distribution. Figure 4 shows the density function, which clearly suggests that heterogeneity exists, necessitating the use of the generalized mixed model as a better alternative in our empirical analysis. The K-density indicates an asymmetric distribution with different modes, implying a Gaussian or *t*-distribution approach will not provide a satisfactory model for the data. Also, because non-standard conditions exist in our model, it restrains our ability to apply standard parametric processes in our analysis of goodness of fit (Mclachlan and Peel, 2000). As sensible starting values are crucial for mixture models, we initially fit a model with two points (integrating factors) and subsequently introduce further mass points to yield a larger maximized likelihood. This can be done by keeping all other parameters at their current values and adding an extra integrating point. The iteration process produces a mixture component (latent class) with a mixing probability (prior probability) of countries which are divided into groups[8]. Iteration of the sample data derived a mixture component (or latent class) with a small mixing probability (or prior probability) estimated as 0.36 and a larger class estimated probability of 0.64. The results of the parameterized model and standard errors for the parameters as well as the location for the estimated probability ($P2_1$, $Z2_1$) are presented below. Table II shows the estimation results with interaction terms. Population

	Count	Mean	Minimum	Maximum	Sum
exportchina	225	2,441,832	0	4.84e + 07	5.49e + 08
exportworld	204	9,349,092	121,552	1.08e + 08	1.91e + 09
importchina	225	987,882.7	1,115	1.68e + 07	2.22e + 08
importworld	204	9,144,871	412,721	1.04e + 08	1.87e + 09
mkt_size	210	2.155138	−2.628656	3.555304	452.579
infl	207	12.47975	−9.616154	359.9366	2,583.308
geo	225	0.6	0	1	135
nat	225	0.7333333	0	1	165
inv	203	256.0879	6.663808	2,537.895	51,985.84
gdpc	211	5,763.013	399.8601	26,385.6	1,215,996
fdi	209	4.909011	−5.496736	54.06343	1,025.983
cred	167	33.69784	0.4913875	160.1249	5,627.54
N	225				

Table I.
Summary statistics

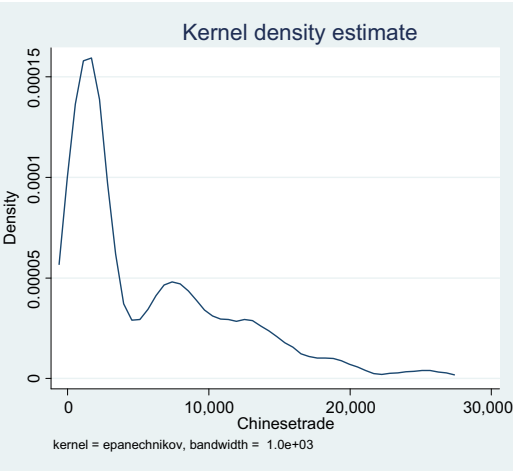

Figure 4.
Density estimate of Chinese trade

	(M1) b/se	(M2) b/se	(M3) b/se	(M4) b/se
ctrade				
mkt_size	1.57*** (0.17)	1.47*** (0.17)	0.76*** (0.19)	1.83*** (0.15)
gdpc	7.55*** (1.30)	6.00*** (1.26)	3.19** (1.19)	
infl	−0.00 (0.01)	−0.00 (0.01)	−0.01 (0.01)	−0.01* (0.01)
inv		0.00*** (0.00)	0.00*** (0.00)	
geo			0.03*** (0.00)	
tax			−0.38*** (0.04)	
nat				2.19*** (0.34)
cred				0.64 (0.33)
_cons	5.91*** (0.61)	5.97*** (0.59)	10.33*** (0.94)	5.14*** (0.67)
lns1				
constant	0.77*** (0.05)	0.73*** (0.05)	0.50*** (0.06)	0.72*** (0.05)
z2_1_1				
constant	−3.53*** (0.58)	−2.33*** (0.51)	−2.98*** (0.74)	−2.43*** (0.53)
p2_1				
_cons	−1.30* (0.65)	−0.59 (0.56)	−0.56 (0.63)	−0.67 (0.56)
N	194	187	145	207
R^2				

Notes: Standard errors in parentheses; $*p < 0.05$, $**p < 0.01$, $***p < 0.001$

Table II.
Bivariate finite mixture model: augmented model

(*mkt_size*) is significant in attracting Chinese trade and is consistent with findings by Amighini *et al.* (2011) and Deng (2009). It is observed that the statistical hypothesis of trade-seeking behaviour prevail in the sample, implying that markets with a larger population size attract Chinese trade compared to markets with smaller sizes, and these economies tend to have the larger share of Chinese trade. The coefficients of per capita income (*gdpc*), investment (*inv*), natural resources (*nat*) and geography (*geo*) are significant and confirm trade-oriented hypothesis. Inflation (infl) is also significant, and similar to previous studies, it is observed to be negatively correlated with Chinese trade. This implies that Chinese trade has a negative impact

on inflation rate and aids macroeconomic stability in SADC economies. Domestic credit (*cred*) coefficient is positive, but not statistically significant to Chinese economic activities. This might be because of the fact that most trade activities are undertaken by state-owned enterprises which have access to Chinese state financial institutions. Overall, this confirms studies by Ramasamy *et al.* (2012) and Amighini *et al.* (2011).

Next, we use the Gateaux derivative method to check if the introduction of a further mass point will yield a larger maximized likelihood, and GLLAMM estimates the parameters by allowing the residual variance to vary with the covariates. Table IV contains the posterior means [empirical Bayes predictions (*ebm*1)] of the random effect and enables individual countries to be assigned to classes based on their modal posterior probability (Table III).

Table IV shows the result from the FMM estimation. In examining the groupings, it is important to note that these countries are grouped together because of the conditional distribution of Chinese trade, the covariates and the latent effects such as institutional and technological factors. The posterior probability shows that many of the SADC economies have a larger probability of being assigned to cluster 3, which can be termed as smaller economies in the SADC region. These countries have a common number of structural features: their population and therefore their markets are small, their resource base is narrow and fragile, they typically depend on foreign exchange on a small range of primary product export and they generally have limited domestic capital for productive investments. Also, agriculture tends to constitute the backbone of these economies, providing the main source of livelihood and being a major export earner. An interesting observation is Namibia, which has strong institutions, land mass and availability of natural resources, but seems hampered by a small population base (2.5 million inhabitants). Democratic Republic of Congo and Tanzania comprise cluster 2. Although Congo has an abundance of natural resources and a large population size (the most populous in SADC), it has suffered decades of instability and is plagued by weak institutional factors, ranking high in

Table III.
Location and probabilities of FMM

Location	Probability
0.2144	0.7856
0.3564	0.6436
0.3636	0.6364

Table IV.
Bivariate posterior classification

Country	eb3m1	linpred	K3
Angola	−0.3645153	7.879352	1
Zambia	−0.3645153	8.527069	1
S. Africa	−0.3645153	9.282459	1
Tanzania	−1.621803	6.638652	2
Congo	−1.621803	7.506938	2
Zimbabwe	0.7836105	8.847019	3
Madagascar	0.7836105	8.527069	3
Namibia	0.7836105	8.863152	3
Botswana	0.7836105	8.888128	3
Mozambique	0.7836105	8.982146	3
Mauritius	0.7836105	9.368083	3
Malawi	0.7836105	9.490566	3
Lesotho	0.7836105	9.658149	3
Seychelles	0.7836105	9.835406	3
Swaziland	0.7836105	9.847019	3

corruption index and low in the rule of law, which have acted as obstacles to trade. Despite being Africa's largest aid recipient from China, Tanzania is a non-mineral exporting country with its main export comprising dry seafood, logs, leather and wooden handcrafts. Also, regulations in 2009 by the Tanzanian Government forbidding Chinese from owning shops in Dar es Salaam as well as persistent complaints of police harassment, searches and unfair treatment related to ivory and rhino horn smuggling have acted as a disincentive to Chinese trade in Tanzania. Unsurprising South Africa, Angola and Zambia constitute cluster 1, with a posterior probability of 0.7836105. These countries are rich in mineral resources and are among the most populated in the SADC region. South Africa has China's largest diaspora population in Africa, is China's largest trading partner in Africa and, until recently, Africa's largest economy. Angola is China's biggest oil importer in Africa and Zambia and its biggest importer for copper. These countries are ranked among China's top ten trading partners (Tralac, 2014). The coefficient on Chinese trade is statistically significant at the 1-per cent level, signifying the positive influence Chinese trade has on SADC growth. This implies that the SADC economy is highly dependent on trade relations with China for growth, as Chinese trade enhances SADC economic growth.

Also, geographical proximity seems to play a significant role in the trade decisions as island nations, and landlocked economies have relatively less trading activities. The exception is Zambia, which might be because of its availability of rich natural resources and large population.

Overall and within-group country clusters conditioned to 2001-2015 are follows:

- *Group 1*: Angola, Zambia and South Africa.
- *Group 2*: Tanzania and Congo.
- *Group 3*: Zimbabwe, Madagascar, Namibia, Mauritius, Mozambique, Botswana, Malawi, Lesotho, Swaziland and Seychelles.

5. Findings

Generally, trade relations between the SADC region and China are relatively unbalanced, and from an individual country perspective, it is easy to determine the trade patterns (Figure 5). However, significant differences emerge when the data are disaggregated[9]. In this study, we analysed the market-seeking behaviour of Chinese trade in 15 SADC member states by applying

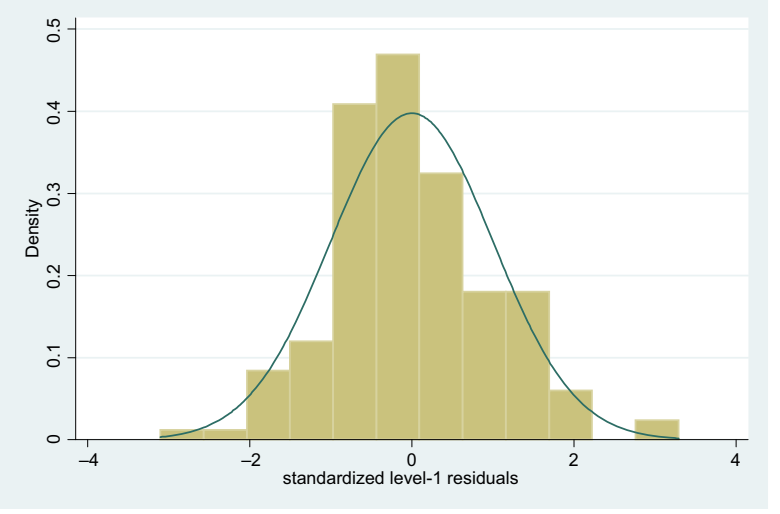

Figure 5.
Residual plot

FMM to endogenously identify trade patterns. This analysis is important because China is Africa's biggest trade partner and China's economic policies have a significant impact on Africa's economic growth. By applying a mixture technique, we observed that heterogeneity exists in trade patterns among SADC economies, upholding the hypothesis that larger economies tend to attract Chinese trade more than smaller economies and Chinese trade decisions are driven by market sizes of recipient economies. Chinese trade tends to be concentrated more in countries with a higher population, as indicated by the positive and significant coefficient of population on trade. Host country market size seems to be a significant factor because of the fact that larger economies tend to provide larger economies of scale and spillover benefits (OECD, 2006). Also, partner country's per capita income does not seem to be a determining factor in its trade decisions. Higher per capita economies such as Seychelles and Mauritius have lower trading ratios compared to lower per capita economies such as the Democratic Republic of Congo and Angola. Availability of resources, rather, is noted to be a significant factor in China's trade decisions. Its top trading partners are all major mineral producers. Risk and instability seem to play a limited role on trade decisions, as Angola, Congo and Zimbabwe have higher trade ratios than stable economies such as Mauritius, Botswana and Namibia. Landlocked and island economies also seem to be disadvantaged in their economic relations with China, as majority of such countries are in cluster 3. A possible suggestion might be hindrance to easy transportation of goods and services. From the analysis, the results can thus be surmised as follows: firstly, we strongly reject the hypothesis that the countries in our sample follow a common trade pattern in favour of a pattern in which three distinct trade patterns occur. Secondly, from our analysis, Chinese trade decisions are based on factors such as population sizes, availability of mineral resources and geographical location.

6. Policy implications

Although trade is generally assumed to be a significant contributor to economic growth, an important challenge for SADC economies entails attracting Chinese trade to specific countries.

Based on this analysis, with China as SADC's largest trading partner, opportunities certainly exist for SADC states to derive greater value from China's new influence. Opportunities exist for SADC countries to implement reforms needed to enhance Chinese trade relations. There is a need for member states to develop comprehensive policies geared towards creating a level playing field in their engagement with China to enable them exploit potential benefits. Such policies can include the adoption of a common currency, promulgation of a common regional trade and investment agency, establishment of free trade zones and reassessment of tariffs. Smaller and landlocked countries need to integrate further and engage in trade openness with bigger neighbouring SADC countries to enable them have easier access to Chinese trade and investment. Reforms on 1997 SADC trade and investment laws are long overdue, for instance, the SADC protocol fails to provide differential treatment for "least developed members (LDC)". In the context of a regional grouping which comprises countries at different levels of economic development, and where prevailing trade balances are unsustainable, the trade protocol fails to provide preferential treatment to member countries categorized by the World Trade Organization as LDC. Also, the trade law's cumbersome and restricting rules of origin, multiple memberships of regional organizations and diverse external trade policies all tend to undermine SADC regional trade.

Emphasis should also be placed by member countries towards overcoming informal obstacles such as language, custom, religious and ideological barriers. Informal barriers have been mooted to cause frictions between SADC member states and Chinese entrepreneurs, thus reducing bilateral trade and investment flows. Although there is a need for government to properly regulate the relationship between Chinese trade and other political, social and cultural aspects, the key issue on Chinese trade may not be with the trade itself, but the degree of openness. SADC

countries need to engage in a program of economic reforms such as further liberalization and deregulation to increase trade relations, because sustainable growth is a significant attraction to trade. Also, finally, SADC countries can access the successes and failures of other regional blocs' (such as NAFTA[10] and EU[11]) trade and economic relations with China to enable them cultivate an inclusive strategy to more effectively balance the engagement of other trade partners with China to leverage its own strength and create a plan for sustainable development that resonates with its citizens.

7. Conclusion

This study contributes to extant literature by exploring the determinants of Chinese trade in the SADC region. Trade flows originating from China are distinguished from flows originating from the rest of the world with the stated intention of determining market-seeking determinants of Chinese trade.

The result from our analysis suggests that Chinese trade patterns in the SADC region are not homogeneous in pattern. Our result further shows that smaller SADC countries tend to be disadvantaged in their trade relations with China. Higher economies of scale and the associated benefits, as well as availability of resources, seem to play a significant role.

On the whole, these findings support the view that opportunities exist for increased trade between China and the SADC regions' smaller countries, and provide support for policy measures aimed at reducing barriers to trade flows to enhance Chinese trade (Figures 6 and 7).

Notes

1. In this study, "entity", "country", "economy" and "states" are used interchangeably and imply a distinct entity in political geography.
2. Gross domestic product (GDP) is the total monetary value of final goods and services produced in a finite period.

Figure 6.
Relative convergence in Chinese trade

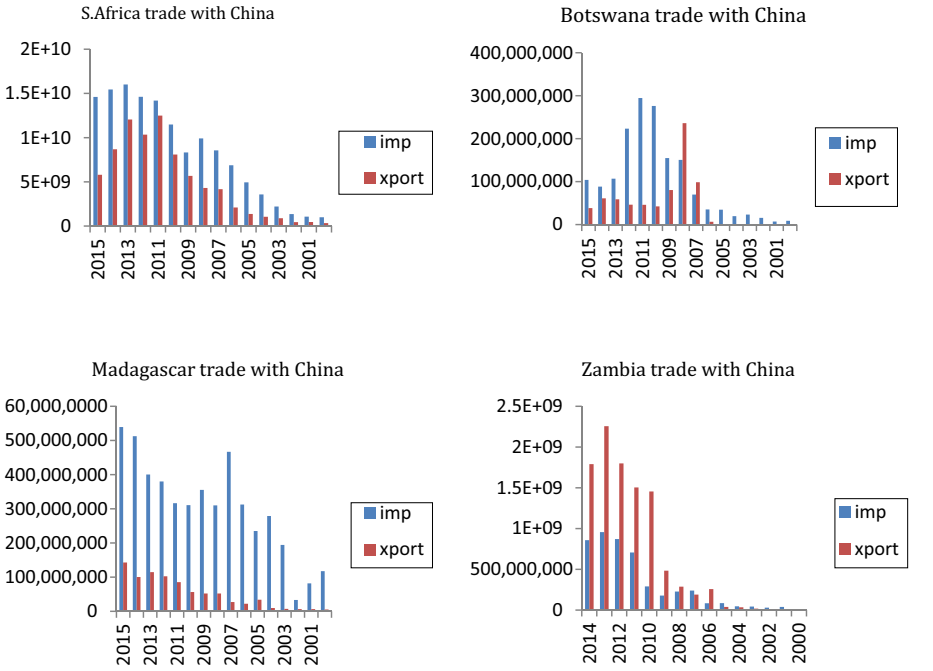

Figure 7.
Selected SADC countries trade with China

3. Alesina *et al.* (2000) and Alesina and Spolare (2005).
4. Openness level is the degree in which a country lowers barriers to trade
5. China's trade data that are consistent with the IMF and World Bank are available from 2001 onwards.
6. IMF July 2015 projections.
7. The FMM provides a natural representation of heterogeneity in a finite number of latent classes
8. GLLAMM performs maximum likelihood estimation by using adaptive quadrature. See Rabe-Hesketh (2002)
9. See Figure 7.
10. North American Free Trade Agreement.
11. European Union.

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