ANALYSING EXPORTS IN SOUTH AFRICA'S CHEMICAL SECTOR: A PANEL DATA APPROACH

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Abstract

Under the Industrial Policy Action Plan of 2007, the South African government identified priority sectors that need to be promoted and developed in order to accelerate growth, reduce unemployment and alleviate poverty. Among these, the chemical sector was identified as a priority sector that needs to be developed for this purpose. This paper analyses exports within the chemical sector using a gravity model approach. It further investigates whether there is unexploited trade potential between South Africa and its trading partners within this sector. The paper identified unexploited trade potential in Austria, Czech Republic, Finland, France, Greece, Hungary, Japan, Malawi, Mauritius, Spain, Tanzania, United Kingdom, United States and Zimbabwe. The analysis concludes by identifying stable and reliable export destinations within the chemical sector which could be targeted to alleviate unemployment, poverty and stimulate growth.

1. Introduction

The National Industrial Policy Framework (NIPF) was adopted by cabinet in January 2007. The purpose of this framework sets out the broad approach to industrialisation in South Africa in line with the Accelerated and Shared Growth Initiative (ASGI-SA). In July 2007 the cabinet endorsed the Industrial Policy Action Plan (IPAP) which provided key actions and timeframes for the implementation of its industrial policy. Four lead sectors were identified as priority sectors that need to be developed and promoted in order to accelerate growth and halve poverty by 2014. Among these, the chemical sector was identified as a priority sub-sector that needs to be developed for this purpose (DTI, 2007). Therefore, this paper sets out to analyse South Africa's chemical sector's exports in order to contribute to achieve goals set by the NIPF.

The origin of the South African chemical industry dates back to the late nineteenth century. Its development was largely dictated by the mining industry's need for explosives, the political environment and the large quantity of coal available in the country. The industry was established to assist the domestic mining industry by

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providing chemicals used in explosives (Swiss Business Hub South Africa, 2007). The local mining industry imported dynamite from Germany and France up to 1896 where after a dynamite plant was constructed in Modderfontein. The demand for explosives was the result of the growing mining industry fuelled by the discovery of diamonds, gold and coal fields around the country (CAIA, 2003). In 1950, the government created the Phosphate Development Corporation (Foskor) to manufacture phosphate concentrates. The political regime of the time forced the industry to adopt an inward orientated approach. As a result, small-scale factories were constructed to cater for local demand of chemicals. Consequently, exports of locally-manufactured chemicals have usually been less competitive. The gasification of coal was also a prominent feature in the growth of the industry mainly because South Africa has no confirmed oil reserves. Since the country opened up to the global market in the mid nineties, the chemical industry in South Africa increasingly focused on being internationally competitive (CAIA, 2003). The identification of export potential and reliable export destinations in the chemical sector is thus imperative to enhance goals set by government.

The objective of this paper is to analyse factors in the chemical export sector by applying a gravity model approach. The paper also investigates the presence of any unexploited trade potential between South Africa and its trading partners within this sector. The rest of the paper is organised as follows. A literature review on the chemical sector will be presented in Section 2[1]. This will be followed by a discussion on the gravity model in Section 3, and the estimation methodology in Section 4. Section 5 presents the estimation results and Section 6 elaborating on the potential trade. Section 7 will conclude the paper.

2. Overview of the chemical sector

The three major companies dominating the primary and secondary sectors in South Africa are Sasol, AECI and Dow Sentrachem. These companies have lately widened their interest in tertiary products with export potential (Media Club South Africa, 2009). Generally, chemicals manufactured in the industry can be classified into four groups. Base chemicals (e.g. petro-chemicals and inorganics), intermediate chemicals (e.g. waxes, solvents and rubbers), chemical end-products (e.g. paints & explosives) and speciality end-products (e.g. pharmaceuticals, agrochemicals and plastic additives) (Southern Africa Trade Office, 2006).

The chemical industry in South Africa is currently the leading such industry in Africa and a world leader as far as gas-liquids technologies and coal-based synthesis is concerned (Media Club South Africa, 2009). In 2007, growth of 6,3 per cent was achieved corresponding to a value of US$ 13,9 billion for the chemical sector in total (DataMonitor, 2008). It produces approximately 300 types of basic or pure chemicals and contributes about 5,5 per cent to the country's GDP (Seeletsi & Demana, 2006). The major contributors in South Africa to global chemical output includes three sub-sectors namely liquid fuels, bulk formulated chemicals and pharmaceuticals. The liquid fuels, consumer formulated and plastic sub-sectors are

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[1]Assistance from P Kanda is acknowledged

the three sectors with the biggest contribution towards South Africa's GDP (DTI, 2006).

The heart of international trade in South Africa is trade in intermediate inputs such as chemicals (Schaling, 2006). The chemical industry accounts for 25 per cent of the manufacturing sector's export output (Seeletsi & Demana, 2006). Between 2002 and 2005, South African chemical products' exports were in the range of R15,7 billion to R19,7 billion per annum compared to imports which ranged between R26 billion and R30 billion during the same period of time. The chemical industry in South Africa has continuously recorded an intensely negative trade balance in the range of R10 billion to R12,8 billion per annum for the corresponding time period. Pharmaceutical products and raw materials are the main factors responsible for the overall negative trade balance of the South African chemical industry. In 2005, exports of pharmaceutical products were valued at just above R773 million in contrasts to imports which approximately attained R7,5 billion (Seeletsi, & Demana, 2006). The total labour force employed by the South African chemical industry is approximately 150,000 (United Nations Environment Programme, 2007), while investment in annual upgrades amounts to approximately R2 billion (Seeletsi and Demana, 2006).

Notably, the exports of chemicals from South Africa have been recording a robust growth and competitiveness in Africa. This is partly explained by the lower transportation costs due to the closeness of South Africa to the Sub-Saharan African markets. Perfumes and cosmetics and soaps and pharmaceuticals are among the chemical products mainly responsible for the increase in exports to African markets. The extension of the South African mining sector into Africa will further enhance the export of explosives (Engineering News, 2007).

The Southern African Development Community (SADC), European Union (EU), United States of America (USA), India and Japan make up the most important export destinations of chemical manufactured goods from South Africa (DTI, 2006). South Africa is the African, Caribbean, and Pacific group of countries' (ACP) major chemical exporter (Ackerman, 2006). Exporters in the chemical industry are exposed to challenges that are tariff as well as non-tariff in nature. For instance, major South African Customs Union (SACU) manufacturers do not get enough motivation through negotiations for lower tariffs to export to MERCOSUR since the latter has complex non-tariff barriers (NTBs) (DTI, 2006). Chemical imports into South Africa mainly originate from the EU, USA and Australia followed by other less notable trading partners such as the Latin American countries (MERCOSUR), Taiwan and China (DTI, 2006).

Two noticeable features recently characterise the South African chemical industry. Firstly, it is constituted by a concentrated and well developed upstream sector as well as a diversified and underdeveloped downstream sector. Secondly, petro-chemicals, synthetic coal and natural gas-based liquid fuels currently dominate the industry (Media Club South Africa, 2009). Structural inefficiencies exist in the chemical industry as a result of the excessive industry protection and regulation from the past. There is a low level of rivalry in the upstream, world-class and outward-oriented sector of the industry with a small number of upstream manufacturers responsible for 60% to 70% of the overall chemical industry's output. On the other hand, high rivalry, lack of innovation and product differentiation, low levels of exports and global focus characterise the inward-oriented downstream sector which is composed of a large number of small scale manufacturers (DTI, 2006). Improved upstream and downstream relationships, skills development, stimulation of the downstream sector and enhanced foreign linkages are important factors to be considered for enhancing the chemical industry's sustainable productivity, export and growth (Engineering News, 2007).

3. A gravity model

A gravity model is an important instrument to determine the export potential in a given sector. The gravity model is used to analyse the relationship between volume and direction of bilateral international trade. Tinbergen (1962) and Pöyhönen (1963) pioneered the idea of explaining bilateral trade flows using Newton's law of gravity. The economic mass of a country, generally measured by gross domestic product (GDP) acts as the attraction factor between two countries. However, the attraction would partially be offset by the distance between the countries, which serve as a resistance factor. In theory, one would thus expect that countries with a stronger GDP and which are in close proximity to one another would experience higher volumes of bilateral trade. Conversely, the smaller the GDP and the further away the countries from one another the less trade would occur. Anderson (1979) and Bergstrand (1985, 1989) emphasised that the gravity model is a good representation irrespective of the structure of product markets.

Being a proxy for transportation costs, distance is normally expected to be negatively related to the flow of exports i.e. the higher the distance, the higher the costs involved in trading and therefore a negative effect on trade flows. However, as shown by Marimoutou, Peguin and Peguin-Feissolle (2009) and Brun, Carrère, Guillaumont and de Melo (2005), distance can bear a different role in a gravity model of bilateral trade. Marimoutou *et al.* (2009) particularly show that the larger the trading partner country's GDP, the less the effect of distance on trade flows.

The basic gravity model is augmented with a number of variables to enhance the explanatory power of trade between countries (Martinnez-Zarzoso and Nowak-Lehmann, 2003). These variables include infrastructure, differences in per capita income and exchange rates. Bergstrand (1985, 1989) included the population size, while Oguledo and Macphee (1994) included a measure of the price variable.

The basic gravity equation explains the extent of exports between country i and country j by three factors. These factors are the total supply of the exporting country (i), the potential demand of the importing country (j), and the various factors which represents the resistance to trade flow between countries. In its basic form, exports from country i to country j are determined by the economic sizes (GDP), population, geographical distances and a set of dummies which represent some institutional aspects. The gravity model is generally specified as (Martinez-

Zarzoso and Nowak-Lehmann, 2003; Jakab, Kovacs and Oszlay, 2001; Breuss and Egger, 1999):
+

$$\ln X_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j + \beta_5 \ln DIS_{ij} + \beta_7 \ln A_{ij} + u_{ij} \quad \ldots (1)$$

where

X_{ij} is exports of goods from country i to country j, Y_i and Y_j are the GDP of the exporter and importer countries, POP_i and POP_j are the populations of the exporter and importer, DIS_{ij} is the distance in kilometres between the capitals of the two countries, A_{ij} represents any other factor enhancing or restricting trade between the countries, and u_{ij} is the error term. Several studies such as Mátyás (1997) and Tri Do (2006) extended the gravity equation by including the exchange rate. Equation (1) is then re-specified as:

$$\ln X_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln POP_i + \beta_4 \ln POP_j + \beta_5 \ln ER_{ij} + \beta_6 \ln DIS_{ij} + \beta_7 \ln A_{ij} + u_{ij} \quad \ldots (2)$$

where,

ER_{ij} is the nominal exchange rate (rand/US$) between countries i and j. A higher rate of exchange (depreciation of the rand) generally leads to an increase in exports, while a lower rate of exchange (appreciation) leads to a decrease in exports. It is therefore expected that the coefficient β_5 should be positive when the real exchange rate depreciate and negative when the real exchange rate appreciate.

A high level of GDP in the exporting country indicates a higher level of production potential and implies increased volumes of export availability. Similarly, a higher importer's GDP represents increased potential demand for imports. The coefficients β_1 and β_2 are therefore expected to have positive signs. According to Martinez-Zarzoso and Nowak-Lehmann (2003) and Armstrong (2007), there is no clear *a priori* relationship between exports and the populations of both the exporting and importing countries. The estimated coefficient of the exporter's population could either be positive or negative. A large population indicates a large domestic market with high levels of consumption (absorption effect) and thus lower quantities to export (Nilsson, 2000). Large populations may also encourage division of labour (economies of scale) and this means higher production levels and thus opportunities to export more. In the same vein, the estimated coefficient of the trading partner's population could either be positive or negative. Thus, the effects of population for both the exporting and importing countries cannot be assigned *a priori*. It is thus expected that β_3 and β_4 to have ambiguous signs (Oguledo and MacPhee, 1994). The coefficient of distance (β_6) is expected to be negative as longer distances generally relate to higher transport costs which may deter the possibility of trade.

The existence of a common language and regional trade agreements between the exporting and importing countries may also promote or impede trade. To account for these, dummy variables (included in A_{ij}) are also taken into account. The dummy variables take the value of one where English is the official language in both countries or zero otherwise and one for membership of the same trade agreements between two countries and zero otherwise. The introduction of dummy variables modifies Equation (2) as:

$$\ln X_{ij} = \alpha_{ij} + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln POP_{it} + \beta_4 \ln POP_{jt} + \beta_5 \ln ER_{ij} + \beta_6 \ln DIS_{ij} + \beta_7 LANG + \beta_8 EU + \beta_9 AFRICAN + u_{ijt} \quad \ldots (3)$$

where

X_{ij} is exports of goods from South Africa, α_{ij} is the individual effects, LANG is for countries with a common language (in this case English), EU is the dummy variable for membership of the European Union, and AFRICAN is the dummy variable for countries belonging to the African continent. A common language is expected to promote trade. Membership of similar regional trade groupings or being from the African continent is also expected to cause a rise in trade (Nilsson, 2000; Carrere, 2006; Jakab, Kovács and Oszlay, 2001). The coefficients $\beta_7, \beta_8 \text{and} \beta_9$ are thus expected to be positive.

4. Estimation methodology

A panel data approach would be used to estimate the gravity model of bilateral trade as many advantages such as the role of the business cycle and the interactions between variables over a long period of time can be captured (Egger, 2000; Egger and Pfaffermayr, 2003; Martinez-Zarzoso and Nowak-Lehmann, 2003). In addition, the risk of getting biased estimates is lowered and country-specific effects that do not change over time can be analysed. Panel data involves different models that can be estimated such as pooled, fixed and random effects. The pooled model assumes that countries are homogeneous, while fixed and random effects introduce heterogeneity in the estimation. The pooled model is restricted and assumes a single intercept and same parameters over time and across countries and country specific effects are not estimated. However, the unrestricted models (fixed or random effects models) allow the intercept and other parameters to differ across countries. As countries do differ from one another, a decision should thus be made whether to use a random or fixed effect model since the regressions include individual country effects. When estimating the trade flows between a randomly drawn sample of trading partners from a large population, a random effects is more appropriate. The fixed effects model is again more appropriate when estimating the flows of trade between an ex ante pre-determined selection of countries (Egger, 2000; Martinez-Zarzoso and Nowak-Lehmann, 2003). This paper analyses the trade between South Africa and a pre-selection of 31 trading partners, and therefore the fixed effects will be the preferred model. These trading countries were selected based on the trade statistics of chemical products for the period 1999 to 2008.

However, the fixed effects model cannot estimate variables directly that does not change over time (time invariant), such as distance, because the inherent transformation wipes out such variables. This problem was addressed by Martinez-Zarzoso and Nowak-Lehmann (2003) which suggested that these variables can be estimated in a second regression by running the pooled model. In this second estimation the individual effects, obtained in the first estimation through the fixed effect model, will be used as the dependent variable with time invariant and dummy variables as explanatory variables. This is estimated as:

$$IE_{ij} = \eta_0 + \eta_1 DIS_{ij} + \eta_2 LANG + \eta_3 EU + \eta_4 AFRICAN + \mu_{ij} \qquad \dots (4)$$

where

IE_{ij} is individual effects from the first estimation and other variables are as defined before.

4.1 Univariate characteristics of variables

Before the estimation of Equation (3) the univariate characteristics of the variables are first analysed using panel unit root tests. This is done to establish whether there is a potentially cointegrated relationship between the variables. If all variables are stationary, then the traditional ordinary least square (OLS) estimation can be used to estimate the relationship between the variables. If variables contain a unit root or are non-stationary, a cointegration test should be performed. This study applies two different types of panel unit root tests. The first test is that of Levin, Lin and Chu (2002) and assumes that the autoregressive parameters are common across cross sections. Levin, Lin and Chu (LLC) use the null hypothesis of a unit root. The second panel unit root test allows the autoregressive parameters to vary across cross sections as well as for individual unit root processes. The test was developed by Im, Pesaran and Shin (IPS) (2003) and combines individual countries' unit root tests. In the IPS test, the null hypothesis assumes all series contain a unit root while the alternative hypothesis is that at least one series in the panel contain a unit root. IPS is a one-tailed or lower-tailed test and is based on N(0,1) distribution. The results of the panel unit root tests are presented in Table 1.

Table 1: Panel unit root test

	LLC	IPS
Exports	-7,812 (0,000)***	-0,260 (0,397)
Exchange rate	-6,364 (0,000)***	-1,267 (0,102)*
Importer's GDP	-4,928 (0,000)***	1,308 (0,904)
South Africa's GDP	-10,638 (0,000)***	-2,117 (0,017)***
Importer's population	-3,545 (0,000)***	-0,738 (0,230)
South Africa's population	-15,040 (0,000)***	-6,125 (0,000)***

Notes: ***/**/* denotes rejection of the null at 1%/5%/10% level. Probabilities are in parenthesis.

Table 1 shows that the LLC reject the null of a unit root for all variables. A rejection of unit roots by at least one test assumes a verdict of stationarity. That implies that a cointegration test is not required and Equation (3) can be estimated using the OLS method. The detailed data source and description are provided in the Appendix.

5. Estimation results

Table 2 presents the results for the fixed effects model which estimates country specific effects and introduces heterogeneity. To check the poolability of the data, the F-test is performed and the results show that the null hypothesis of equality of the individual effects or homogeneity for all countries is rejected. This confirms that a model with individual country effects (fixed effects) is the preferred model. The Hausman test is also executed within the random effects model in order to detect misspecification or to ensure that the X-regressors and individual effects are not correlated. The results show that the Hausman specification test [0.000 (1.000)] accepts the null hypothesis of no misspecification. This result therefore indicates exogeneity of the X-regressors and thus no correlation between the individual effects and the X-regressors.

The results of the fixed effects model as shown in Table 2 indicate that the coefficient of South Africa's GDP has a positive and significant sign and this is consistent with the theory. As South Africa's GDP increases, exports of chemical products are stimulated as a result. An increase in the importer's GDP causes a small decrease in the exports of South Africa's chemical products and this is in contrast with the theoretical expectation. However, the coefficient is statistically significant which might imply that as importing countries' GDP increases, it results in a higher level of domestic production of chemical products in the importing country and therefore causes lower imports from South Africa.

Table 2: Estimation results

Variables	**Fixed effects model**
Constant	5,720 (5,961)***
South Africa's GDP	0,799 (10,809)***
Importer's GDP	-0,030 (-2,786)***
Importer's population	2,208 (4,403)***
Exchange rate	0,445 (3,778)***
Adjusted R-squared	0,974
F-test	245,61 (0,000)***

Notes: ***/**/* significant at 1%/5%/10% level.
The t-statistics of all variables are in parentheses

The importer's population has a positive and statistically significant effect on the exports of chemical products. An increase in the importer's population therefore implies that the importer's market is growing resulting in a higher degree of demand for chemical products abroad. The result is in line with theoretical expectations. The coefficient of the exchange rate is positive which indicate an increase in exports. As the exchange rate depreciated over the sample period, it is expected that exports will increase, which is consistent with theory. Two other variables were also tested but later discarded. South African population has a negative coefficient which means that South Africa exports less chemical products when its population grows. This may be because domestic consumption increases as a result of a bigger population. However, the coefficient is statistically insignificant and was thus discarded from the model. The effect of import tariffs was also tested but found to have the correct sign but was insignificant and also discarded. This may be due to tariffs being increasingly less important in international trade. The dataset comprises 310 observations, including 10 annual observations for 31 countries and the adjusted R-square is 0,974.

Country specific effects estimates from the first estimation are presented in Table A1 of the Appendix. The country or cross-section specific effects show the effect of factors that are unique to each country but not included in the estimation of the model. It shows that trade in chemical products between South Africa and its trading partners differ from country to country, given the unique feature of each country. Table A1 shows that there are features in some countries that promotes exports of chemical products from South Africa to Angola, Belgium, Cyprus, Denmark, Ireland, Luxemburg, Malawi, Mauritius, Mozambique, Netherlands, Seychelles, Zambia and Zimbabwe. However, it is also shown that there are unobservable country characteristics that discourage South Africa’s exports of chemical products to certain countries (countries with negative signs). It is important from a policy perspective, to analyse these export inhibiting factors which discourage exports of chemical products from South Africa.

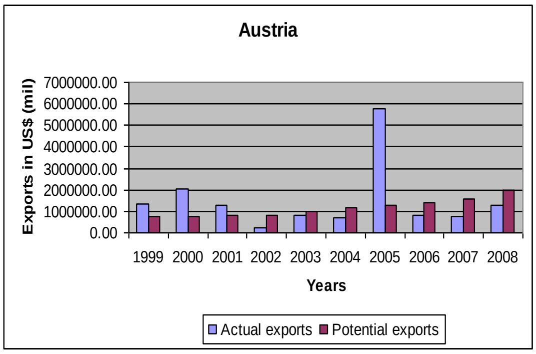
The second stage regression includes some factors which may explain some of these unobservable country characteristics (fixed effects) in Table A1. Table 3 presents the results of the second stage regression and show that all variables are significant and aligned with theory. Table 3 shows that distance has a small negative effect on chemical product exports. Countries where English is the official language are associated with an increase in South African exports of chemical products. Membership of the EU and being a country on the African continent is also associated with increased exports of chemical products from South Africa.

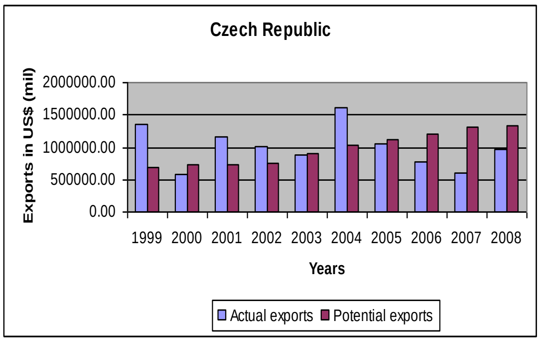
Table 3: Second stage regression: fixed effects regressed on dummies

Independent Variables	**Coefficient (t-statistics)**
Constant	-1,046 (-5,916)***
Distance	-0,0001 (-5,991)***
English Language	1,180 (7,960)***
European Union	1,511 (37,349)***
African continent	2,564 (11,162)***
Adjusted R-squared	0,986

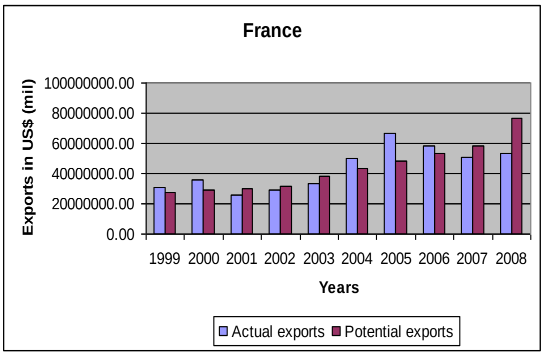
Notes: ***/**/* significant at 1%/5%/10% level.
The t-statistics of all variables are in parentheses

To determine the within potential exports of chemical products, the estimated fixed effects of Equation (3) is simulated. The estimated export potential are then compared to actual exports in order to see if there is unexploited trade potential among countries. The results are presented in Figure 1 and shows that Austria, Czech, Finland, France, Greece, Hungary, Japan, Malawi, Mauritius, Spain, Tanzania, United Kingdom, United States and Zimbabwe have unexploited trade potential at least in 2008. For these countries, potential exports exceed actual exports. It is important to promote exports to these countries in order to benefit from this unexploited trade potential. However, a further analysis of the all these countries is important in order to determine and identify possible factors that may inhibit the promotion of actual exports, given the unexploited potential. Furthermore, the results also show that the DRC, India, Italy, Luxembourg, Mozambique and Seychelles had unexploited trade potential from 2004 up until 2007. In 2008 the actual trade have now surpassed the potential exports in these countries, which may indicate that improved export strategies to these countries were implemented.






Finland
Exports in US$ (mil)
700000.00
600000.00
500000.00
400000.00
300000.00
200000.00
100000.00
0.00
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Years
Actual exports
Potential exports


France
Exports in US$ (mil)
100000000.00
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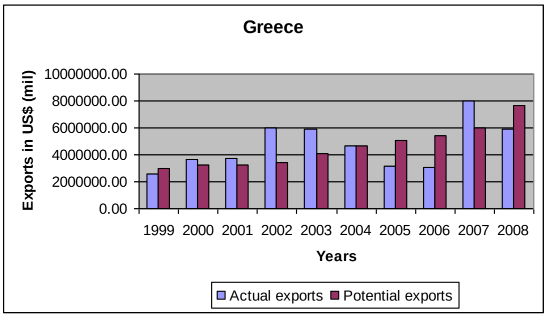
Actual exports
Potential exports


Greece
Exports in US$ (mil)
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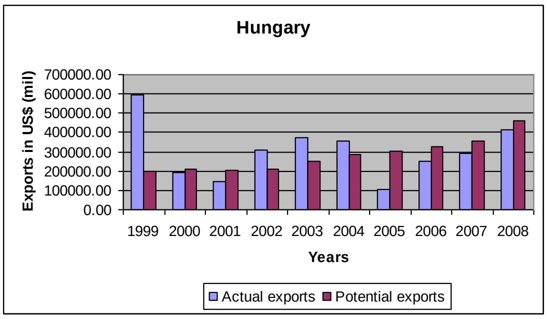
Hungary
Exports in US$ (mil)
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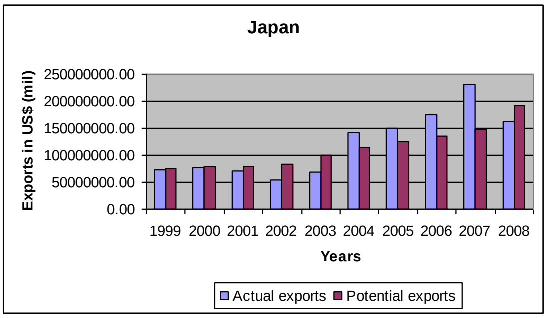
600000.00
500000.00
400000.00
300000.00
200000.00
100000.00
0.00
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Years
Actual exports
Potential exports


Japan
Exports in US$ (mil)
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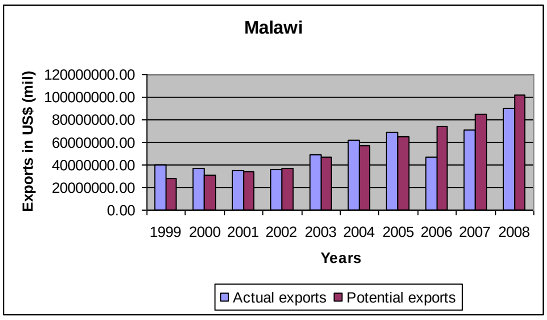
200000000.00
150000000.00
100000000.00
50000000.00
0.00
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Years
Actual exports
Potential exports


Malawi
Exports in US$ (mil)
120000000.00
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80000000.00
60000000.00
40000000.00
20000000.00
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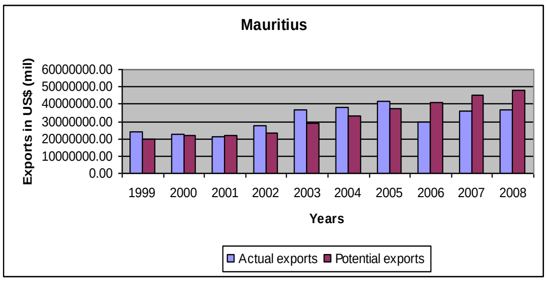
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Years
Actual exports
Potential exports


Mauritius
Exports in US$ (mil)
60000000.00
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Years
Actual exports
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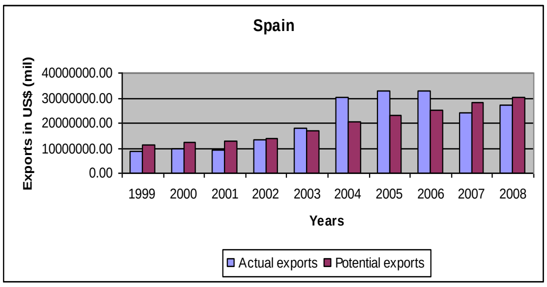
Spain
Exports in US$ (mil)
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30000000.00
20000000.00
10000000.00
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1999 2000 2001 2002 2003 2004 2005 2006 2007 2008
Years
Actual exports
Potential exports

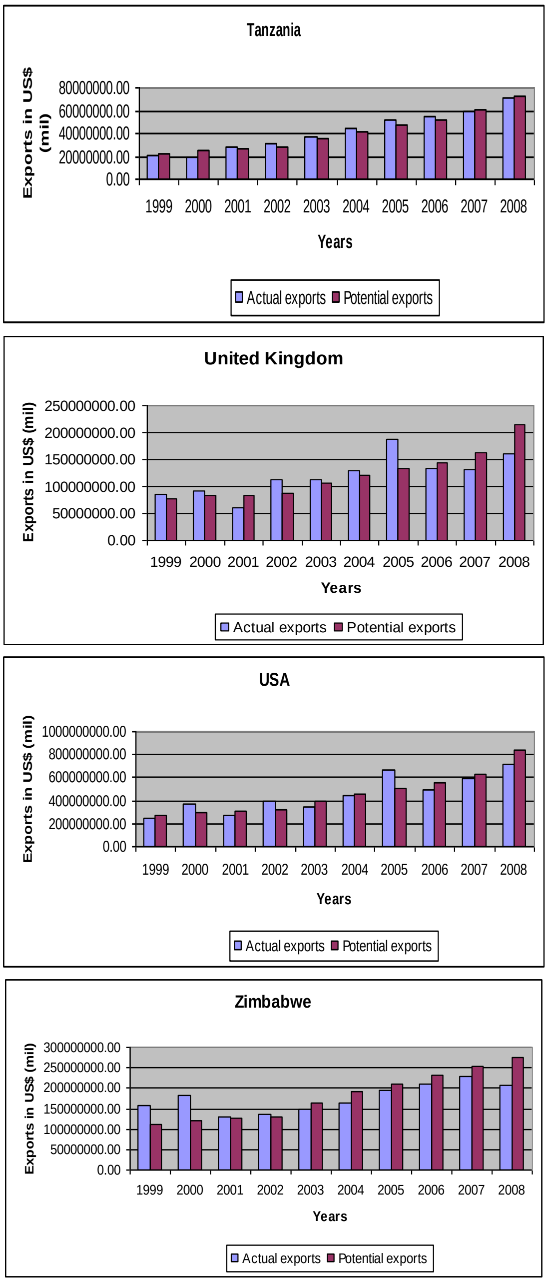

Figure 1: Actual and potential exports of South Africa's chemical products (US$)

6.1 Variability of potential trade

Although the countries with unexploited trade potential have now been identified, it is also important to determine which of them are in fact stable and reliable export destinations. Stability of export flows in a specific sector is of utmost importance as job security and revenue generation depends on it. From the estimation, the paper also determines the stable destinations by using the coefficient of variation (CV) computed from the stochastically solved model. It can be computed in percentage as follows:

%CV = (Standard deviation/Mean) x 100

The coefficient of variation provides an indication of the South African trade partners in the chemical sector which can be classified as stable or not. The lower the CV, the more stable and reliable the trading partner and the higher the CV, the less stable and reliable the trading partner. From the group of countries included in the study, Figure 2 shows South Africa's 12 most stable and reliable export destinations within the chemical sector. This information is important from a policy perspective as export promotion policies should be directed towards the more stable trade destinations. Adjusted policies directed towards improving the predictability of trade to the less stable countries with a high CV should also be pursued.

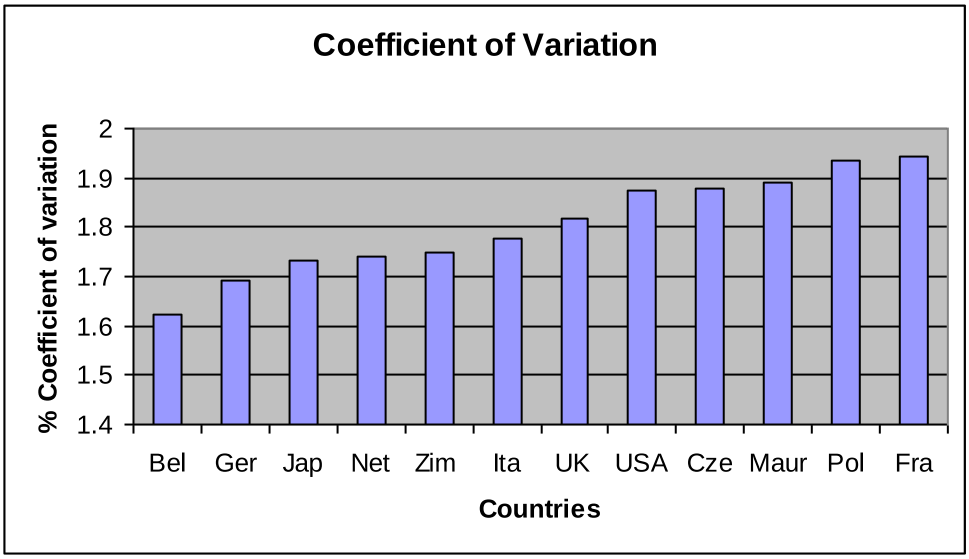

Figure 2: % CV of South Africa's 12 most stable and reliable export destinations in the Chemical sector

Countries which have unexploited trade potential and are among the most stable and reliable export destinations in the chemical sector include the Czech Republic, France, Japan, Mauritius, the UK, USA and Zimbabwe. Policy makers should pursue the correct policy mix with these countries as both unexploited trade potential is available and the countries are reliable export destinations. This may ensure a consistent flow of foreign currency revenue to South Africa and increased job creation possibilities.

7. Conclusion

This study estimated the determinants of South Africa's exports of chemical products for the period 1999 to 2008 using a gravity model approach. South Africa's GDP, the importer's population and the exchange rate all have positive effects on exports in the chemical sector. The importer's GDP has a small negative impact on chemical exports from South Africa. Distance has a very small negative effect on the exports, while membership of the EU and being part of the African continent are associated with an increase in exports. Countries where English is the official language tends to import more from South Africa.

The paper identified unexploited trade potential at least in 2008 in Austria, Czech Republic, Finland, France, Greece, Hungary, Japan, Malawi, Mauritius, Spain, Tanzania, United Kingdom, United States and Zimbabwe. From these 14 countries exhibiting unexploited trade potential, seven proves to be stable and reliable export destinations based on the coefficient of variation. These countries include the Czech Republic, France, Japan, Mauritius, the UK, USA and Zimbabwe.

The results of this study can provide important information on countries to guide policymakers in developing tailor made policies to ensure that the export potential is exploited in order to accelerate growth. The success rate can further be enhanced by focussing on reliable and stable export destinations as indicated by the coefficient of variation. Maintaining a strong and well developed upstream sector is eminent for growth. However, the results of this study may serve as an impetus to stimulate the underdeveloped downstream sector. It provides important avenues to be considered for enhancing the chemical industry's sustainable productivity, superior export flows and improved growth.

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APPENDIX

Table A1. Countries used in the estimation and their specific or fixed effects

Positive fixed effect:	
Angola	0.869989
Belgium	2.230536
Cyprus	3.367937
Denmark	0.999667
Ireland	1.870162
Luxemburg	2.68886
Malawi	1.374937
Mauritius	6.066961
Mozambique	0.721513
Netherlands	2.639782
Seychelles	9.979952
Zambia	2.701221
Zimbabwe	2.568711
Negative fixed effect:	
Austria	-1.139669
Czech Republic	-2.005901
Congo (DRC)	-2.282377
Finland	-1.703979
France	-1.870335
Germany	-1.797326
Greece	-0.417556
Hungary	-3.033728
India	-6.63764
Italy	-2.063174
Japan	-2.52982
Poland	-3.238022
Portugal	-0.670208
Spain	-2.139139
Sweden	-1.534152
United Kingdom	-0.827999
Tanzania	-1.23924
United States of America	-2.949961

Data description and sources

The study covers the period 1999 to 2008 using annual data. Thirty one main trading partners in the chemical (H16-H17) sector were included in the estimation. The data for exports, gdp, populations and exchange rate were obtained from Quantec website: www.quantec.co.za. The data on distance was obtained from http://www.timeandate.com, and they are computed as distance in kilometers between capital cities. The English language dummy variable was sourced from Silva and Tenreyro (2006).