An augmented gravity model of South Africa's exports of motor vehicles, parts and accessories

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Abstract

The study applies an "augmented" gravity model to South Africa's exports of motor vehicles, parts and accessories to 71 countries over the period 1994 to 2004. A static panel data model is specified and estimated. Several conclusions are drawn from the study. First, a number of variables, namely, importer income, distance, level of import tariffs, government effectiveness, regulatory quality, use of right-hand drive vehicles are important determinants of bilateral trade flows for motor vehicles, parts and accessories. Second, solving the gravity model deterministically, we show that export potential exists in a number of countries like Malawi, Zambia, Kenya and Malaysia. A number of barriers hinder the members of the National Association of Automobile Manufacturers of South Africa (NAAMSA) from exploiting these export markets. These include very high import tariffs, lack of South Africa's diplomatic mission in the trading partner and the uncertainty regarding what happens at the expiry of the Motor Industry Development Programme (MIDP) in 2012. Finally, the export potential identified by the gravity model should be regarded only as an indication since it is sensitive to the model specification and sample of countries.

Key words: Gravity equation, MIDP, export potential, motor vehicles, parts and accessories, panel data

JEL E33, E52

1 Introduction

South Africa's automotive industry, which includes manufacturing, distributing and servicing of vehicles and components, contributes about 7 per cent to the gross domestic product (GDP). In 2005, it employed slightly more than 300 000 workers in manufacturing vehicle and automotive components, the tyre industry and distribution and servicing in the motor trade (Table 2). South Africa is ranked 19th in the world in vehicle production, accounting for about 0.7 per cent of the world's vehicle output in 2004 (NAAMSA, 2005). Vehicle production is the second largest industry in South Africa's manufacturing sector, and one of the fastest growing. The contribution of exports of motor vehicle parts and accessories and other transport equipment to South Africa's merchandise exports to the rest of the world grew from 2.8 per cent in 1994 to 9.2 per cent in 2004.

South Africa's car assembly plants emerged during the 1920s and aimed at mainly servicing the needs of the local market. As the demand grew, the motor industry developed very small plants producing at very high unit costs. Cars were mainly assembled locally from imported components with about 20 per cent local content. During this period, the industrial policy was built around import substitution with high import tariffs.

South Africa's automotive industry has experienced major policy reforms over the last four decades, which were aimed at improving competitiveness, increasing domestic value addition and promoting exports. During the period 1961-95 automotive manufacturers were obliged to observe local content requirements, which led to the emergence of the Original Equipment Manufacturers (OEM). However, in spite of the reforms, the pre-1995 automotive industry was characterised by many small assembly plants producing too many models at economically low volumes (NAAMSA, 2005). The dissatisfaction with the earlier reforms led to the introduction of the Motor Industry Development Programme (MIDP) in 1995, which complied with the General Agreement on Trade and Tariffs (GATT) and the World Trade Organisation (WTO).

The structural changes have led to a significant increase in exports of automotive products. Vehicle exports as a percentage of domestic production increased from 4 per cent in 1995 to 27 per cent in 2005 (Table 2). Exports of component parts increased from 12.6 billion rands in 2000 to 21.7 billion rands in 2004 (Table 3). The main export destinations are, among others, Germany, the United Kingdom, United States, Japan and Australia (Table 3). According to NAAMSA (2005), components accounted for 55 per cent while build-up vehicles contributed 45 per cent of the total automotive export revenues in 2004.

Black (2003) shows that rapid export expansion, considerable foreign investment and productivity improvements in the motor industry have been strongly influenced by the MIDP programme. As pointed out by Franse (2006), export expansion remains crucial to the future sustainability of South Africa's automotive industry since the size of the domestic market is relatively limited. Indeed, Chenery and Shrinivasen (1988) argue that exports generate greater growth as a result of greater capacity utilisation; greater horizontal specialisation as firms concentrate on narrower range of products; increasing familiarity with new technologies; greater learning by doing and the stimulative effect of the need to achieve greater internationally acceptable quality standards.

Despite the reforms, South Africa's share of the world's trade in motor vehicles remains small. The industry also remains a net user of foreign exchange. There is therefore a clear need to enhance the volume of South Africa's exports of motor vehicles. Two sets of factors play a role in stimulating exports: demand-side and supply-side factors. The MIDP to a great extent focuses on the supply-side. This paper focuses to a great extent on the demand side factors due to data limitations. The main questions to be answered are as follows;

(a) Which countries has South Africa exploited with its automobile export potential?

(b) Which countries has South Africa not reached with its export potential?

(c) Are there barriers to exploiting the export markets?

We attempt to answer these questions using a gravity model of trade. In its basic form, a gravity model expresses that the amount of trade between South Africa and its trading partners increases with their size as measured by national incomes and diminishes with the cost of transportation between them, proxied by the distance between their economic centres.

We further employ the gravity model to predict *within-sample* potential export trade flows for motor vehicles, parts and accessories (SIC 381-383) given certain conditions. A gravity model has been constructed by the International Trade Centre (ITC) called *TradeSim* (International Trade Centre, 2003). It estimates bilateral trade flows of developing countries with any of their partner countries. With regard to South Africa, *TradeSim* shows that there is untapped trade potential in the United States for motor vehicles and other transport equipment.

The novelty of our paper lies in three areas. First, we employ a static two-way error component panel data model, which includes both time-specific fixed effects and cross-section specific fixed effects. Second, we solve the baseline gravity model deterministically and compute export potential for 71 countries. Finally, we attempt to identify some of the factors that tend to inhibit NAAMSA members from exploiting the identified unexploited export markets.

The rest of the paper is organised as follows. Section 2 presents the background of the South Africa's automotive industry as well as the gravity model. Section 3 presents the model, estimation framework and the data. Section 4 focuses on the results and estimation of export potential. The last section deals with the conclusions.

2
Background of South Africa's automotive industry

Table 1 outlines some key automotive industrial policy periods and key instruments. South Africa's automotive industry started with car assembly plants in 1920s, which mainly served the needs of the local market. The motor industry developed very small plants producing different models and in some cases different makes at very high unit costs (Black, 1994). Cars were mainly assembled locally from imported components with about 20 per cent local content. During this period, South Africa followed an import substitution industrial policy, which entailed imposing heavy tariffs that increased with value-added (Barnes, Kaplinsky and Morris, 2004).

South Africa's isolation under the apartheid regime led to trade boycotts and sanctions, which had negative effects on foreign exchange earnings especially in the 1960s and the 1980s following the infamous Rubicon speech in 1985. The government responded by introducing local content requirements, which the local assemblers were supposed to observe.

The Local Content Programme (LCP) evolved over six phases from 1961-1995. During phases I to V, the LCP was based on weight, which varied from 15 per cent in 1961 to 66 per cent in 1980 (Franse, 2006). South African assemblers not meeting the local content requirements were subjected to prohibitively high import tariffs. This led to the emergence of a domestic components industry (Black & Mitchell, 2002).

In 1989, the South African government started to move away from import substitution towards an industrial policy promoting export. Local content requirement was reduced from 66 per cent to 50 per cent. The aim of the policy was to expand the size of the market for firms and thus force them to rationalise the completely built-up (CBU) vehicles and component markets. This led to an increase in exports of component markets with limited change in CBUs.

Table 1
Development of automotive policy in South Africa

Period	Automotive policy	Key instruments
June 1961– February 1989	Phases I-V Local content programme	• Varying local content level based on weight • Excise duty rebate scheme
March 1989– August 1995	Phase VI Structural adjustment programme	• Local content scheme adjusted for value targets • Import-export complementation (IEC) scheme introduced
September 1995– June 2000	Phase I of MIDP	• Local content regulations abolished • Tariff phase-down for imported models and components (imported vehicles 40% and components 30% by 2002) • Export credits increased • Duty free allowance (DFA) and small vehicle incentive (SVI) scheme implemented

July 2000-2007	Phase II of MIDP	• Tariff phase-down to continue until 2007 (imported vehicles 30% and components 25%) • IEC phase-down from 2003-2007 • Introduction of new production-based duty free allowance in 2000 • Introduction of production asset allowance (PAA) but to be discontinued by 2007
2007-2012	Phase III of MIDP	• Tariff phase-down to continue until 2012 (imported vehicles 25% and components 20%)

Source: The Department of Trade and Industry (DTI), 2004

In 1995 the government introduced the MIDP with a view to helping the motor industry adjust to South Africa's reintegration into the global economy (Flatters, 2005). The objectives of MIDP were to improve the international competitiveness of South Africa's automotive and associated industries; improve vehicle affordability in the domestic market; encourage growth in the vehicle market and in the component manufacturing industry particularly in the field of exports; stabilise employment levels in the automotive industry; and create a better balance between the industry's foreign exchange usage and foreign exchange earnings. There were four key features of the MIDP;

(a) Reduce tariffs on light vehicles and components, with tariffs being phased down faster than required by the WTO obligations;

(b) Removal of local content requirements;

(c) Duty free import of components up to 27 per cent of the wholesale value of the vehicle; and

(d) Duty-rebate credits to be earned on exports of vehicles and components and to be used for duty-free imports of vehicles and components. Thus, the MIDP grants a production-asset allowance to vehicle manufacturers that invest in new plants and equipment, giving them 20 per cent of their capital expenditure back in form of import duty credits over a period of 5 years.

Table 2

Selected indicators of South Africa's automotive industry

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Market for Cars, Light Commercial Vehicles, Medium and Heavy Trucks and Buses											
Domestic Sales of Domestically Produced Vehicles	373 712	374 758	342 535	286 159	266 349	289 333	297 856	279 135	294 674	344 545	387 700
Exports	15 764	11 553	19 569	25 896	59 716	68 031	108 293	125 308	126 661	110 507	143 400
Total Domestic Production	389 476	386 311	362 104	312 055	326 065	357 364	406 149	404 443	421 335	455 052	531 100
Exports as % of Domestic Production	4	3	5	8	18	19	27	31	30	24	27
Imports	26 255	46 318	56 740	65 351	59 426	65 299	84 673	84 049	87 926	136 975	219 200
Total Local Market (Including Imports)	399 967	421 076	399 275	351 510	325 775	354 632	382 529	363 184	382 600	481 520	606 900
Imports as % of Local Market	7	11	14	19	18	18	22	23	23	28	36
Component Exports (Million Rands)						12 640	18 595	23 183	21 270	21 736	
Industry Employment Levels											
Vehicle Manufacturing Industry					32 000	32 300	32 700	32 370	31 700	31 800	33 825
Automotive Components					67 200	69 500	72 100	74 100	75 000	74 500	78 000
Tyre Industry					6 670	6 575	6 300	6 000	6 000	6 000	6 000
Motor Trade, Distribution and Servicing					175 000	180 000	182 000	185 000	191 000	194 000	195 000
Total Employment					**280 870**	**288 375**	**293 100**	**297 470**	**303 700**	**306 300**	**312 825**

Source: The National Association of Automobile Manufacturers of South Africa (NAAMSA) Annual Reports of 2004 and 2005.

The MIDP has given the OEMs the opportunity to scale down on the number of models produced locally and to import models, which were less economically viable to produce. The MIDP has allowed auto makers to concentrate on manufacturing certain vehicles or components for export while importing other models. Since its inception, the MIDP has been subjected to two reviews: 1999 and in 2002. Phase I of MIDP was operational from September 1995 to June 2000. The first review extended the programme from July 2000 to 2007 while the second review extended it to 2012.

Table 3

South Africa's exports to some selected Countries

		Ranking			
Country	Total (1988-2004)	(1988-1993)	Total (1994-2004)	1988-2004	Deviation(pre vs post 1994)
Germany	4 229 626 840	1	1	1	0
United States	3 007 962 528	2	2	2	0
United Kingdom	2 701 416 405	6	3	3	3
Japan	2 557 029 910	10	4	4	6
Australia	1 739 649 515	13	5	5	8
Zimbabwe	1 150 697 337	3	6	6	-3
Belgium	747 775 669	7	7	7	0
China	670 380 911	4	9	8	-5
Mozambique	639 703 073	8	8	9	0
Zambia	572 340 017	5	11	10	-6
Netherlands	493 645 754	11	10	11	1
Malawi	441 910 508	9	12	12	-3
Spain	270 694 274	15	14	13	1
Singapore	269 636 136	24	13	14	11
Italy	181 809 392	14	16	15	-2
Hong Kong Special Administrative Region of China	175 160 143	16	15	16	1
Kenya	161 039 673	21	17	17	4
France	148 270 573	17	18	18	-1
New Zealand	122 846 986	34	19	19	15
Brazil	113 155 325	18	20	20	-2
Mauritius	94 483 467	20	22	21	-2
United Republic of Tanzania	91 829 263	29	21	22	8
Angola	87 975 245	23	23	23	0
India	77 302 554	36	24	24	12
Republic of Korea	71 223 532	38	25	25	13
Democratic Republic of the Congo	61 991 500	12	34	26	-22
Ghana	57 901 643	59	26	27	33
Malaysia	52 401 659	44	27	28	17
Thailand	47 855 829	54	28	29	26
Sweden	40 902 554	58	29	30	29
Canada	40 620 110	32	30	31	2
Nigeria	36 734 211	65	31	32	34
United Arab Emirates	36 652 862	46	32	33	14
Uganda	33 026 629	52	33	34	19
Portugal	30 904 752	19	19	35	0
Mexico	29 258 765	30	35	36	-5
Cameroon	26 782 704	22	41	37	-19
Madagascar	25 870 407	50	36	38	14
Israel	25 241 477	26	40	39	-14
Russian Federation	24 785 874	104	37	40	67
Greece	24 228 945	27	39	41	-12
Argentina	18 913 406	31	42	42	-11
Switzerland	15 929 559	33	46	43	-13
Gabon	14 213 641	67	43	44	24
Indonesia	13 952 519	86	44	45	42
Antigua and Barbuda	13 723 421	84	45	46	39
Saudi Arabia	13 107 612	25	58	47	-33
Seychelles	12 976 308	41	49	48	-8
Turkey	12 450 734	61	47	49	14
Cte	12 062 098	60	48	50	12

Source: Computed using exports data collected from Quantec research (http://ts.easydata.co.za). Date accessed 21st August 2005

2.1 Automotive industry export performance

South Africa's export of motor vehicles and components has increased substantially since the introduction of the MIDP in 1995 (tables 2 and 3). Table 3 presents data on South Africa's export of motor vehicle, parts and accessories over the period 1988-2004. Column 2 of Table 3 shows the total exports over the period 1988 to 2004 in US dollars. Columns 3, 4 and 5 of Table 3 present rankings of export destinations using total exports as a criterion for ranking. Three different rankings are presented; the period 1988-1993, 1994-2004 and the average over the period 1988-2004.

The ranking for the period 1988-1993 reflects South Africa's motor vehicle trade during the apartheid era. The countries that were important are Germany, United States, Zimbabwe, Zambia and United Kingdom, among others. During the post-apartheid era (1994-2004) the situation changed marginally with the emergence of Japan and the United Kingdom as major trading partners. The last column compares the ranking in the period 1988-1993 and 1994-2004. Positive figures indicate improvement in terms of ranking for that country. For instance Japan's ranking improved from 10 during the apartheid era to number 4 during the period 1994-2004.

2.2 The gravity model

The gravity model, first applied to international trade by Tinbergen (1962) and Pöyhönen (1963), has been used in the social sciences since the latter half of the nineteenth century to explain migration and other social flows in terms of the "gravitational forces of human interaction".

The basic form of the gravity model, true to its namesake, is analogous to the Newton's 1687 "Law of Universal Gravitation". The law holds that the gravitational force between two physical bodies (F_{ij} in Newtons) is proportional to the product of each body's mass (M_i and M_j in kilograms) divided by the square of the distance between the respective centres of gravity (D^2 in metres);

$$F_{ij} = G\frac{M_i M_j}{D_{ij}^2} \qquad (1)$$

In 1962 Jan Tinbergen proposed that roughly the same functional form could be applied to international trade flows. Since then it has been applied to a whole range of "social interactions" including migration, tourism and investment with a lot of empirical success. The gravity law of social interaction can be expressed roughly in the same notation as equation 1 except that M_i and M_j are redefined as the economic sizes of the two locations.

The gravity model has gone from a theoretical orphan to being the favoured child of all main theories of international trade. Despite its use in many early studies of international trade by Tinbergen (1962), Pöyhönen (1963) and Linnemann (1966), the gravity model was considered suspect because it had no theoretical foundation.

Leamer and Stern (1970) provided the first foundation with the "potluck assumption", that argues that nations produce their goods and throw them all into a pot; then each nation draws its consumption out of the pot in proportion to its income. They conclude that the expected value of nation *i*'s consumption produced by nation *j* will equal nation *i*'s share of world GDP times nation *j*'s share of world GDP.

Anderson (1979) was the first to provide a clear microfoundation but rested on an assumption that was viewed as ad hoc at that time, namely that each nation produced a unique good that was only imperfectly substitutable with another nation's goods.

Although, the gravity model fell into disrepute in the 1970s and early 1980s, an attempt was initiated by Bergrstrand (1985) to give it a sound microeconomic foundation. He developed a theoretical connection between the factor endowments theory and bilateral trade. However, he did not manage to reduce the complicated price terms to an empirically implementable equation.

A simple gravity model for South Africa's exports of motor products is

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} \prod_{m=1}^{k} (z_{ij}^m)^{\beta_m} e^{\left(\sum_{w=1}^{r} \lambda_w L_{ij}^w\right) + \varepsilon_{ij}} \qquad (2)$$

Where

X_{ij} the value of bilateral exports of automobile products from South Africa to nation *j*.

In line with practice, i refers to origin country (South Africa) and j to destination nation

Y_i, Y_j South Africa and importer incomes

$\prod_{m=1}^{k}(z_{ij}^{m})^{\beta_m}$ A set of measures impacting either negatively or positively on trade flows from South Africa to country j but are positive so that logarithmic transformation can be applied

$\sum_{w=1}^{r}(\lambda_{ij}^{w} L_{ij}^{w})$ A set of measures impacting either negatively or positively on trade flows from South Africa to country j but logarithmic transformation cannot be applied e.g. dummy variabales.

ε_{ij} the random error term

In this model four assumptions are made. Firstly, all goods are differentiated by place of origin (Armington Assumption). In other words automobile products from South Africa are distinguishable from others. Secondly, each country is specialised in the production of only one good. Thirdly, the supply of each good is fixed. Finally, preferences of consumers are homothetic (approximated through a constant elasticity of substitution utility function).

Equation 3 is generated by performing logarithmic transformation on Equation 2.

$$\ln X_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \sum_{m=1}^{k} \beta_m \ln z_{ij}^{m} + \sum_{w=1}^{r} \lambda_w L_{ij}^{w} + \varepsilon_{ij} \quad (3)$$

2.2.1 *Remoteness variable approach*

Bilateral trade between South Africa and country j depends on the bilateral trade barrier, t_{ij}, relative to all other partners. As pointed out by Anderson (1979), bilateral trade flows are a function of the bilateral trade barrier relative to the average barrier of the two countries with all their partners after controlling for country size. Consequently a remoteness variable is included in Equation 2 to proxy for this average trade barrier. Remoteness of country i is usually computed as in Anderson and van Wincoop (2003: 173);

$$\mathrm{R}\,EM_i = \sum_{m \neq j}^{m} \left(\frac{d_{im}}{y_m} \right) \quad (4)$$

Where d_{im} is the distance of country i. This variable is intended to reflect the average distance of country i from all trading partners other than j.

However, as argued by Anderson and van Wincoop (2003), this approach, which relies solely on distance, does not capture the entire range of factors impeding bilateral trade flows. Therefore the gravity model in Equation 3 suffers from omitted variable bias.

2.2.2 *Multilateral (price) resistance terms approach using price indices*

Anderson and van Wincoop (2003) suggest a theoretical gravity specification based on the approaches of Anderson (1979), Bergstrand (1989) and Deardorff (1998), which explicitly takes into account "multilateral (price) resistance" terms. These multilateral resistance terms consist of country specific price indices, p_i and p_j. Consequently, bilateral trade between country i and country j is dependent on the following;

$$\left(\frac{t_{ij}}{p_i p_j} \right)^{1-\sigma} \quad (5)$$

Where σ is the elasticity of substitution between all goods.

Unfortunately, the multilateral trade barriers suggested in equation 5 are unobservable. However, it is possible to use a fixed effects model as suggested by Anderson and Van Wincoop (2003).

Equation 6 is an "augmented gravity model" of trade, which has been modified to include the multilateral terms.

$$\ln X_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + (1-\sigma)\,\rho \ln d_{ij} + \sum_{m=3}^{k} \beta_m \ln z_{ij}^{m} + \sum_{w=1}^{r} \lambda_w L_{ij}^{w} + (1-\sigma) \ln p_i + (1-\sigma) \ln p_j + \varepsilon_{ij} \quad (6)$$

3 The Model

3.1 Model specification

The gravity model has traditionally been estimated using cross-section data. However, this has been shown to generate biased results since typically heterogeneity among the countries is not appropriately controlled for. With heterogeneity, South Africa may export different amounts to two different countries, even though the two export markets have the same GDPs and are equidistant from the South Africa.

The panel data approach attempts to solve the problem by permitting more general types of heterogeneity. Our study follows the panel data analysis approach. The basic static gravity model is specified as follows;

$$\ln X_{ijt} = \beta_0 + \phi \ln X_{ijt-1} + \beta_1 \ln(Y_{it}) + \beta_2 \ln(Y_{jt}) + \beta_3 \ln d_{ij} + \beta_4 \ln p_{it} + \beta_5 \ln p_{jt} + \beta_6 \ln\_tar_{jt} +$$
$$\lambda_1 ge_{jt} + \lambda_2 rq_{jt} + \lambda_3 cc_{jt} + \lambda_4 lang_j + \lambda_5 AFR_j + \lambda_6 SADC_j + \lambda_7 EU_j + \lambda_8 NAFTA_j + \lambda_9 ASIA_j +$$
$$\lambda_{10} ME_j + \lambda_{11} MERC + \lambda_{12} Drive_j + \varepsilon_{ijt} \quad (7)$$

Where:

X_{ijt}: Foreign price value (e.g. US dollars) of exports of goods by South Africa to country *i*;

Y_i: South Africa's GDP in US dollars;

d_{ij}: The geographical distance between South Africa's economic centre of gravity (capital city-Pretoria) and the trading partner's economic centre of gravity (capital city);

p_i: South Africa's price index using the GDP deflator;

p_j: Importer's price index using the GDP deflator;

tar_i: Most favoured nation (MFN) import tariffs applied on motor equipment by the trading partner. This is a normal non-discriminatory tariff charged on imports (excludes preferential tariffs under free trade agreements and other schemes or tariffs charged inside quotas);

ge_j: Index of government effectiveness in the trading partner;

rq_j: Index of regulatory quality in the trading partner;

cc_j: Index for control of corruption by the trading partner;

$Lang_j$: English language dummy. Trading partners, whose official language is English, are coded 1 and otherwise 0;

AFR_j: African countries dummy (African countries coded 1 and otherwise 0);

$SADC_j$: SADC member state dummy (SADC countries coded 1 and otherwise 0);

EU_j: European Union dummy (EU members coded 1 and otherwise 0);

$NAFTA_j$: North American Free Trade Agreement dummy (NAFTA members coded 1 and otherwise 0);

$ASIA_j$: Asian countries dummy (Asian countries coded 1 and otherwise 0);

ME_j: Middle East dummy (Middle East countries coded 1 and otherwise 0);

$MERC_j$: MERCOSUR FTA dummy (MERCOSUR members coded 1 and otherwise 0);

$Drive_j$: Keep left driving dummy (Countries where vehicles keep left are coded 1 and otherwise 0). In South Africa drivers are expected to keep left, which implies that production plants are designed to manufacture right hand-driven vehicles and components to be fitted on the same; and

ε_{ijt}: captures all the factors that influence exports but not included in equation 6.

i = Trading partners (See column 1 of tables 6a and 6b)

t = 1994, 1995, …, 2004

Expectation: $\phi><0, \beta_1>0, \beta_2>0, \beta_3<0, \beta_4<0, \beta_5<0, \beta_6<0, \lambda_1>0, \lambda_2>0, \lambda_3>0, \lambda_4>0, \lambda_5>0, \lambda_6>0, \lambda_7><0, \lambda_8><0, \lambda_9><0, \lambda_{10}><0, \lambda_{11}><0, \lambda_{12}>0,$

The error term, ε_{ijt}, is decomposed as a two-way error component model i.e. $\varepsilon_{ijt} = \mu_i + \lambda_t + \nu_{ijt}$. Where μ_i is the country-specific effects, λ_t is time specific effects and ν_{ijt} is the remainder white noise stochastic error term, which varies with countries and time.

The country-specific fixed effects (μ_i) are time-invariant characteristics of the different countries. These include;

(i) The *unobservable* socio-political environment in each of the countries

(ii) Trading partner's love for "South African attributes" embedded in motor vehicles and component exports. For instance, South Africa has several unique technologies, such as differential locks for off-road vehicles, aluminium welding technology for radiators, and the ability to design components such as air cleaners and air conditioners that are able to cope with the higher temperatures and dust levels in Africa

(iii) The unobservable contribution of the state of international relations between South Africa and the trading partner. It could also capture the unobservable contribution of the trade officers and other officials in South Africa's diplomatic missions abroad (Consulates, embassies and high commissions).

The use of unobservable country specific fixed effects is predicated on the need to incorporate their effects in the model despite the difficulty to explicitly model them. The difficulties emanate from lack of knowledge regarding the actual factors or lack of data.

The time-specific fixed effects (λ_t) are cross-section invariant and capture the various policy interventions, motor vehicle trade liberalisation policies, changes in product quality owing to innovations in South Africa. It may include;

(i) Product innovations that change the attributes of South African motor vehicles and components;

(ii) The country-invariant effect of the introduction of the MIDP in 1995;

(iii) The different phases of MIDP;

(iv) The effect of the government of national unity in South Africa since 1994;

(v) The Asian crisis of 1997;

(vi) Argentina/Mexican/Russian crisis of 1998-99; and

(vii) The rand collapse in 2001

Equation 7 can now be re-specified as follows;

$$\ln X_{ijt} = \beta_0 + \mu_j + \lambda_t + \beta_1 \ln(Y_{it}) + \beta_2 \ln(Y_{jt}) + \beta_3 \ln d_{ij} + \beta_4 \ln p_{it} + \beta_5 \ln p_{jt} + \beta_6 \ln\_tar_{jt} + \lambda_1 ge_{jt} + \lambda_2 rq_{jt} + \lambda_3 cc_{jt} + \lambda_4 lang_j + \lambda_5 AFR_j + \lambda_6 SADC_j + \lambda_7 EU_j + \lambda_8 NAFTA_j + \lambda_9 ASIA_j + \lambda_{10} ME_j + \lambda_{11} MERC + \lambda_{12} Drive_j + \nu_{ijt} \quad (8)$$

3.2 Estimation framework

In using the panel data approach, a number of challenges must be addressed. These include zero trade, estimating country fixed effects and time-invariant regressors, and endogeneity.

3.2.1 Dealing with zero trade flows

The log-linearised model in equation 8 is not defined for observations with zero trade. There are various approaches to handle the presence of zeros. These include discarding the zeros from the sample, adding a constant factor to each observation on the dependent variable,

estimating the gravity in nonlinear form using the fixed effects Poisson maximum likelihood estimator and the use of unbalanced panel estimation techniques.

3.2.2 Heteroscedasticity and serial correlation

The log-linearised model in equation 8 may be both biased and inefficient in the presence of heteroscedasticity. This is corrected by using cross-section and period weights in the estimation. To avoid serial correlation, one of the models in Table 5 is estimated in dynamic form.

3.2.3 Estimating effects and time-invariant regressors simultaneously

The effects of time-invariant regressors like distance, language, etc. can be estimated using a random effects model (REM). REM assumes that the effects are randomly distributed across the different countries. However, the random effects coefficients cannot be interpreted since they cannot be attributed to a specific trading partner.

The alternative is to estimate country-specific fixed effects model (FEM), using WITHIN estimation (demeaning before OLS) in which the coefficients are interpreted as the unobserved effects of each country. The problem with estimating country-specific fixed effects and time-invariant regressors simultaneously is perfect multicollinearity. The problem emanates from the fact that both country-specific fixed effects and the time-invariant factors are captured by using dummy variables.

The study follows the approach of Cheng and Wall (2005). This approach uses two steps. The first step entails estimating a modified form of Equation 8 excluding the time-invariant variables. The country-specific fixed effects ($\hat{\mu}_j$) are regressed on other time-invariant variables as follows;

$$\hat{\mu}_j = \theta_0 + \theta_1 \ln d_{ij} + \theta_2 lang_j + \theta_3 AFR_j + \theta_4 SADC_j + \theta_5 EU_j + \theta_6 NAFTA_j + \theta_7 ASIA_j + \theta_8 ME_j + \theta_9 MERC_j + \theta_{10} Drive_j + \eta_{ijt} \quad (9)$$

3.3 Data descriptions

Sample of countries: 71 countries are selected on the basis of importance to South Africa's automotive exports as well as availability of data for variables described in equations 8 and 9.

Exports: Standard industrial classification (SIC) level 2 exports data in nominal US dollars, are collected from Quantec Research (http://ts.easydata.co.za). Date accessed 21st August 2005. The exports data cover motor vehicles, parts and accessories (SIC 381-383).

Distance: Distance captures both export transaction costs and costs of searching and finding information regarding export markets (economic reports, country risk reports, foreign market demand reports, etc.). Data in kilometres are collected from http://www.indo.com/distance/.

GDP, Population: Collected from International Monetary Fund's International Financial Statistics.

Language: An English language dummy variable (0 or 1) is created, which takes into account common national language (official or not). The assumption here is that the official language in South Africa is English. It is imperative to note that there are 9 official languages in South Africa. However, the main commercial languages are English and Afrikaans.

Import tariffs: Most favoured nation (MFN) import tariffs applied (percentage) on transport equipment by the trading partner. These are normal non-discriminatory tariffs charged on imports (excluding preferential tariffs under free trade agreements and other schemes or tariffs charged inside quotas). http://stat.wto.org/TariffProfile. Accessed in August 2007. One limitation is that the tariffs are for a much broader category (transport equipment).

Government effectiveness: This index describes the ability of governments to effectively deliver public services and make policy. The index ranges from –2.5 (worst governance) and 2.5 (best governance). The data is collected from

http://www.govindicators.org. Date accessed 30th December 2005.

Regulatory quality: This is a measure of the ability of the government to formulate and implement sound policies and regulations and promote private sector development. The index ranges from –2.5 (worst governance) and 2.5 (best governance). The data is collected from http://www.govindicators.org . Date accessed 30th December 2005.

Control of corruption: This measures the extent to which public power is exercised for private gain, including petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. The data is collected from http://www.govindicators.org. Date accessed 30th December 2005.

European Union (EU) dummy: Europe is South Africa's biggest source of investment, accounting for almost half of South Africa's total foreign trade. In 1999 South Africa concluded a trade agreement with the EU called the Trade, Development and Co-operation Agreement (TDCA). The Afrikaans community has a cultural link with the EU since they originated from Netherlands. EU dummy is created by coding EU members with 1 and otherwise 0.

North American Free Trade Agreement (NAFTA) dummy: NAFTA is the trade bloc in North America created on January 1, 1994. South Africa is beneficiary of the US's Generalised System of Preferences (GSP) which grants duty-free status to some 4 650 goods. NAFTA members are coded 1 and otherwise 0.

African dummy: A number of local communities in South Africa originated in Southern, Eastern and Central Africa. South Africa is a member of the African Union (AU) and hosts Pan African Parliament and the New Partnership for Africa's Development (NEPAD) secretariat. South Africa has access to the African continent since it is perceived as the "big brother" by a number of countries. The African dummy is created by coding African countries with 1 and otherwise 0.

Asian dummy (excluding Middle East): Asia is the world's largest and most populous continent. Since 1994, South Africa has continued to strengthen its relations with Asia through increases in two-way trade and finalising co-operation agreements involving scientific and technological exchange, technology transfer, investments and overseas development assistance. Asian countries are coded 1 and otherwise 0.

Middle East dummy: The Middle East is becoming an important trade zone for South Africa. It holds great potential for South Africa as an export market, and serves as a potential strategic source of foreign direct investment. Middle East countries are coded 1 and 0 otherwise.

South America (MERCOSUR): The Mercosur is a trading bloc created by Argentina, Brazil, Paraguay and Uruguay in 1991, and later joined by Mexico and Venezuela. Bolivia, Chile and Peru are associate members. In December 2000, a framework agreement for the creation of a free trade agreement was signed by South Africa and MERCOSUR. MERCOSUR FTA dummy is created by coding MERCOSUR members as 1 and otherwise 0.

Drive on left side dummy: About a quarter of the world, including South Africa, drives on the left. There are also countries in the sample whose inhabitants drive on the right-hand side of the road. A list of countries that keep left and right on the road is collected from http://users.pandora.be/worldstandards/driving%20on%20the%20left.htm. The drive on left side dummy variable is created by coding those countries using right hand-drive vehicles as 1 and otherwise 0.

Importer price index: The study uses GDP deflators as a proxy for import price index. The import price index, p_j, captures a number of multilateral resistance variables $p_j = \left[\sum_i \left(\frac{t_{ij}}{\Pi_i}\right)^{1-\sigma} \phi_i\right]^{\frac{1}{1-\sigma}}$. t_{ij} are all the factors that restrict trade, σ is the elasticity of substitution between automotive products, ϕ_i is the share of South Africa's GDP in world GDP, $\Pi_i = p_i = \left[\sum_j \left(\frac{t_{ij}}{p_j}\right)^{1-\sigma} \phi_j\right]^{\frac{1}{1-\sigma}}$ and ϕ_j is the share of importer GDP in world GDP. The data is collected from the International Financial Statistics of the IMF.

4
Estimation results

4.1 Regression results and discussions

Table 5 presents the estimation results from equations 8 and 9. The first, is the pooled model in which homogeneity in terms of cross-section and time is assumed. With adjusted R-squared above 0.6, the gravity equation explains more than half of the bilateral export trade of motor vehicles, parts and accessories. The low Durbin-Watson statistic shows that the models suffer from a problem of serial correlation. .

The following emerges from the results. First, the importer GDP has the expected positive and significant effect in all the models. The magnitude of the coefficient is close to unity in all models, which is consistent with the findings in McCallum (1995) and Anderson and Wincoop (2003). The high income elasticity indicates that South Africa's automobile exports could rise significantly if her trading partners maintain strong economic growth.

Second, distance has the expected negative and significant effect on South Africa's exports of motor vehicles, parts and accessories. It means that South Africa exports less to countries that are far off. Grossman (1998) reckons that if shipping costs are at the order of 5 per cent of the value of traded goods, the trade-distance elasticity should be around -0.03, which is much lower than the trade-distance elasticity in our study. Since distance is a proxy for transport costs, any policy that reduces costs for exporting will enhance exports of motor vehicles, parts and accessories.

Second, importer price index has the expected negative and significant effect on trade. This is not surprising since the importer price index captures a number of trade restricting factors.

Third, motor equipment MFN tariff has the expected negative sign but statistically insignificant in the pooled model. An attempt to include it in other models created perfect multicollinearity.

Fourth, importer government effectiveness, regulatory quality and control of corruption have the expected positive and significant effect. This indicates that governance issues in the importer country have a significant effect on South Africa's exports of automobile products.

Fifth, South Africa tends to export more motor vehicles, parts and accessories to English-speaking countries. Having the English language in common between South Africa and trading partner nations helps to build networks of trust. Institutions are also shared by increasing the degree of common cultural, literary and educational material, and by increasing the probability of migration. This affects the language policy in South Africa.

Sixth, being a member of the EU enhances South Africa's exports of automobile products to that country. This may be attributed to the positive effect of the *EU-South Africa Trade Co-operation and Development Agreement of 1999* and the cultural heritage of South Africa with Europe.

Seventh, the fact that a country is a member of NAFTA enhances its imports of automobile products from South Africa. In other words there are some unobservable factors that enhance South Africa's exports of motor vehicles and parts to the United States, Canada and Mexico.

Eighth, belonging to the African continent tends to enhance South Africa's exports of automobile products to that country. This is to be expected since South Africa is perceived by many African states as the "big brother". It has played an important role in the African Union (currently hosting the African Parliament), NEPAD, solving conflicts and being the technological leader in the continent.

Ninth, membership to SADC tends to reduce trade barriers of South Africa's exports of automotive products. This is to be expected since South Africa is a key member of SADC, which implies that her exports of automotive products face preferential tariffs/treatment in member states. Additionally, some of the members within SADC belong to the South African Customs Union (SACU) and Southern Africa Monetary Union.

Tenth, membership in MERCOSUR enhances South Africa's trade in automobile products. Although trade relations between South Africa and MERCOSUR have been small, they have picked up in the recent past. South Africa signed

a framework agreement with MERCOSUR in 2000, comprising Argentina, Paraguay, and Brazil (with Bolivia, Chile and Colombia, Ecuador, Peru and Venezueala as associate members) with the aim of forming an FTA. The agreement was eventually signed between SACU and MERCOSUR in 2004.

Eleventh, membership in Middle East and Asia has had a positive effect on South Africa's exports of automotive products. This shows that South Africa should attempt to enhance her trading relations with countries in the Middle East and Asia.

Twelfth, South Africa's export of motor vehicles, parts and accessories designed for vehicles driving on the left are obviously preferred by trading partners that drive on the left hand side.

Thirteenth, the positive (negative) effects show that these are unobservable characteristics that tend to enhance (inhibit) South Africa's exports of motor vehicles, parts and accessories to the countries in the sample. These time-specfic fixed effects reflect that initially the industry tended to struggle with high production costs. However, after 2001 the MIDP programme contributed to the sector's export performance.

Table 5

Estimation for motor vehicles, parts and accessories (SIC 381-383)

	Pooled model		Time-specific model		Cheng-Wall two-step estimation			
					Stage 1 Results		Stage 2 results	
Variables	*Coefficient*	*t-value*	*Coefficient*	*t-value*	*Coefficient*	*t-value*	*Coefficient*	*t-value*
Intercept	-10.78	-0.88	0.27	0.19	-10.19**	-2.08	4.67***	19.59
Log of exports lagged once					0.28**	2.67		
log of importer GDP	1.02***	25.51	1.05***	18.76	0.73**	2.71		
log of South Africa GDP	0.12	0.25			0.004	0.03		
Log of distance	-1.36***	-11.64	-1.56***	-13.76			-0.72***	-26.57
Log of importer price index	-0.09**	-3.05	-0.09**	-2.09	-0.04**	-2.22		
Log of South Africa price index	1.57***	5.24			0.54**	2.19		
Motor equipment tariff	-0.005	-0.84						
Importer country's government effectiveness index	0.73***	12.75	0.80***	14.07			0.33***	8.66
Importer country's regulatory quality index							0.19***	8.76
Importer country's control of corruption index							0.11***	3.68
English language dummy	0.42***	4.1	0.48***	3.33			0.35***	16.9
EU member state dummy	0.65***	5.17	0.54**	3.09			0.48***	16.82
NAFTA member state dummy	0.35***	3.79	0.2	1.31			0.35***	8.15
African continent dummy	2.67***	14.36	2.70***	11.01			2.40***	73.73
SADC dummy	1.97***	18.54	1.65***	13.37			1.66***	54.12
Asian member state dummy	0.45**	3.01	0.34	1.52			0.45***	14.44
Middle East member state dummy	0.30	1.31	0.29	1.52			0.26***	9.51
MERCOSUR member state dummy	0.71***	4.87	0.71***	4.14			0.53***	9.9
"Keep left" countries dummy	1.09***	10.12	1.14***	7.06			0.66***	23.37
Time Fixed Effects								
1994								
1995			-0.81					
1996			-0.44					
1997			0.18					
1998			-0.24					
1999			-0.26					
2000			0.08					
2001			0.44					
2002			0.29					
2003			0.34					
2004			0.41					
Diagnostic statistics								
Adjusted R-squared	0.80513		0.628642		0.920454		0.951771	
Instrument rank	17		23		78			
Durbin-Watson	0.75271		0.613353		2.031169		0.074179	
Type of panel data used	Unbalanced		Unbalanced		Unbalanced		Unbalanced	
Number of observations	709		709		635		769	
Method used to control for heteroscedasticity	Cross-section weights		Period weights		Cross-section weights		Cross-section weights	

Notes: (i) Country-specific effects from stage 1 of Cheng-Wall model are presented in tables 6a and 6b

(ii) ***, ** and * refer to significance at 1%, 5% and 10% respectively

(iii) White cross-section standard errors used to correct for heteroscedasticity

Finally, the estimates for country-specific effects are presented in column 7 of tables 6a and 6b. On the one hand, the positive coefficients indicate that there are unobservable characteristics in those countries (column 1 of tables 6a and 6b), which enhance South Africa's exports of motor vehicles, parts and accessories to those countries. Examples include Mozambique, Congo and United Kingdom. On the other hand, there are unobservable country-specific characteristics that tend to inhibit South Africa's exports of motor vehicles, parts and accessories to countries like Italy, Peru and Kuwait. From a policy perspective, it is imperative to conduct a survey on motor vehicle exporters to determine the other factors that may hamper trade to the countries that have negative country-specific effects.

4.2 Potential exports

There are basically two approaches to computing trade potential. The first approach obtains *within-sample* trade potential as the difference between estimated trade from actual trade relations between countries. The second approach derives *out-of-sample* trade potential estimates (e.g. Brülhart & Kelly, 1999). In this approach, gravity model parameters are estimated and applied to forecast "natural" trade relations between countries. The difference between the observed and predicted trade flows represent the unexhausted trade potential.

Whichever approach is used, the finding of untapped trade potential calls for proactive export promotion policies e.g. bilateral and multilateral agreements, trade facilitation etc. To the contrary, finding actual trade exceeding potential trade (successful partnership) implies that trade has reached its potential level and no social cost is anticipated from future integrations.

A model is constructed from stage 1 results of the Cheng-Wall model in Table 5 and solved deterministically to determine *within-sample* potential exports of motor vehicles, parts and accessories. The choice of this model is predicated by the fact that it addresses many of the problems in the gravity equation. These entailed calculating the predicted values of exports, $\hat{X}_{Sit}$ i.e. export potential is equivalent to the within-sample predictions.

It is imperative to note that the export potentials are dependent on the nature of the sample specification employed in this study. This means that our potential exports should be understood in the context of the specified model we have used. Different specification and sample selection may lead to different results.

Column 1 of Table 6 presents the countries in the sample. Column 2 presents the export potential in US dollars, which is computed as follows;

$$Potential = predicted - actual \quad (10)$$

Where *predicted* and *actual* represents the predicted and actual exports of motor vehicles, parts and accessories, respectively. Column 3 is the ranking of the countries on the basis of unexploited export potential. On the basis of this ranking, Mozambique has the highest untapped export potential that South Africa should explore ways of taking advantage of. The finding of untapped export in Table 6 calls for proactive export promotion policies e.g. bilateral and multilateral agreements, trade facilitation etc. To the contrary, if actual trade exceeds potential trade (successful partnership) it implies that trade has reached its potential level and no social cost is anticipated from future integrations.

Column 4 shows the ranking of the countries on the basis of actual exports. For instance despite the fact that Mozambique has the highest export potential, it is ranked number 8 in terms of importance to South Africa. Columns 7-12 present some important characteristics regarding the trading partners in question. The point is that even though export potential exists in a particular country, the characteristics presented in columns 7-12 could make it difficult for the National Association of Automobile Manufacturers of South Africa (NAAMSA) members to exploit that opportunity.

Column 7 indicates whether a trading partner is a WTO member state or not. If a country is a member of the WTO, it is obliged to observe some specific rules and principles such as most favoured nation (MFN), national treatment,

reciprocity, transparency etc. For instance under the MFN principle, a product made in one member state should be treated no less favourably than a "like" good that originates in any other country.

Column 8 presents the average applied MFN tariffs for motor equipment. High tariffs imposed by trading partners increase the final price of the motor vehicles or components from South Africa.

Column 10 presents the rule of law. South Africa exports to countries with good rule of law. These include Japan, the US, UK etc. The point is that NAAMSA members may be limited in exploiting business opportunities due to unreliable rule of law in the trading partners. Examples include the Russian Federation, Togo, Pakistan etc.

Column 11 presents trading agreements signed bilaterally or multilaterally with South Africa. The agreements are the African Union (African countries), South African Customs Union (SACU), Southern African Development Community (SADC), SA-EU Free Trade Agreement, AGOA, SACU-MERCOSUR.

The final column presents the state of international relations between South Africa and the trading partners. NAAMSA members could utilise South African diplomatic missions abroad in breaking into these markets. There are, however, some countries where there are no diplomatic missions such as Togo, Fiji, New Zealand, Colombia, Cyprus, Sierra Leone, and Lebanon.

Table 6a

Potential exports and other selected indicators

Country	Potential exports (US$ 000's)	Ranking	Total exports (1994-2004)	Ranking	Country-specific fixed effects	WTO member?	MFN average applied tariff	Driving side	Rule of Law	Agreement	Diplomatic relations with South Africa
Mozambique	8727.16	1	523 880 225	8	4.25	Yes	9.4	Left	-0.60	SADC, African Union	High commission-Maputo
Belgium	6897.44	2	608 916 138	7	1.23	Yes	4.1	Right	1.47	EU-SA FTA	Embassy-Brussels
Malawi	6880.80	3	328 121 770	12	4.38	Yes	14.4	Left	-0.29	SADC, African Union	High commission-Lilongwe
Zambia	3929.67	4	415 115 338	11	4.18	Yes	10.8	Left	-0.54	SADC, African Union	High commission-Lusaka
Kenya	3133.28	5	151 432 545	17	2.42	Yes	6.7	Left	-0.98	African Union	High commission-Nairobi
Italy	1940.30	6	151 542 758	16	-1.06	Yes	4.1	Right	0.74	EU-SA FTA	Embassy-Rome,Consulate-Milano
Malaysia	1897.98	7	51 224 587	27	0.18	Yes	11.5	Left	0.52		High commission-Kuala Lumpur
Netherlands	1285.35	8	425 523 431	10	0.73	Yes	4.1	Right	1.78	EU-SA FTA	Embassy-Hague
Thailand	839.61	9	47 534 991	28	-0.54	Yes	20.7	Left	-0.05		Embassy-Bangkok
Portugal	733.33	10	20 124 815	37	-0.78	Yes	4.1	Right	1.16	EU-SA FTA	Embassy-Lisbon
Israel	608.19	11	19 550 319	39	-0.68	Yes	3.3	Right	0.77		Embassy-Tel Aviv
Democratic Republic of the Congo	392.38	12	29 100 308	34	1.98	Yes	8.8	Right	-1.74	SADC, African Union	Embassy-Kinshasa, consular general-Lubumbashi
Tanzania	318.75	13	88 151 438	21	-0.05	Yes	6.7	Left	-0.49	SADC, African Union	High commission-Dar-Es-Salaam
Gabon	292.60	14	14 130 899	42	1.74	Yes	15.5	Right	-0.51	African Union	Embassy-Libreville
Sri Lanka	289.34	15	9 778 989	46	0.30	Yes	9.9	Left	-0.03		High commission-Colombo
Egypt	176.25	16	8 141 562	48	-1.14	Yes	12.9	Right	-0.02	African Union	Embassy-Cairo
Canada	120.94	17	37 245 760	30	-1.44	Yes	5.8	Right	1.75	Trade & Investment Co-operation of 1998	High commission-Ottawa
China	111.91	18	476 010 729	9	-0.90	Yes	11.6	Right	-0.47		Embassy-Beijing,Consular general-Shanghai
Argentina	35.99	19	15 427 720	41	-1.22	Yes	13.9	Right	-0.71	SACU-MERCOSUR PTA (2004)	Embassy-Buenos Aires
Ireland	34.77	20	8 119 891	49	0.66	Yes	4.1	Left	1.62		Embassy-Dublin
Congo	24.72	21	5 781 401	53	1.28	Yes	16.8	Right	-1.18	African Union	Embassy-Brazaville
Peru	0.27	22	242 071	71	-3.55	Yes	6	Right	-0.63		Embassy-Lima
Fiji	-4.90	23	341 549	70	-2.63	Yes	23.4	Left	-0.19		
Lebanon	-11.53	24	1 492 467	67	-1.45	No	4	Right	-0.32		
Finland	-13.76	25	1 629 863	66	-2.52	Yes	4.1	Right	1.97	EU-SA FTA	Embassy-Helsinki
Sierra Leone	-15.75	26	2 969 227	58	1.17	Yes	8.1	Right	-1.53	African Union	
Cyprus	-18.99	27	2 850 590	59	-0.38	Yes	4.1	Left	0.85	EU-SA FTA	
Colombia	-19.60	28	8 155 260	47	-1.65	Yes	13.7	Right	-0.70		Embassy in Caracas (Venezuela) responsible
Pakistan	-46.11	29	2 044 369	62	-3.00	Yes	28	Left	-0.78		High commission-Islamabad
Philippines	-76.23	30	2 452 042	61	-1.86	Yes	8.6	Right	-0.62		Embassy-Manila
Togo	-98.02	31	627 697	69	-1.48	Yes	8.7	Right	-1.01	African Union	
Republic of Korea	-123.16	32	69 155 791	25	-0.65	Yes	5.4	Right	0.67		Embassy-Seoul
Mali	-140.57	33	7 110 105	52	1.31	Yes	8.7	Right	-0.34	African Union	Embassy-Bamako
Rwanda	-161.54	34	2 830 687	60	0.92	Yes	22	Right	-0.90	African Union	Embassy-Kigali
Kuwait	-196.18	35	2 029 446	63	-2.18	Yes	4	Right	0.65		Embassy-Kuwait

Source: Compiled from various sources

Table 6b

Potential exports and other selected indicators

Country	Potential exports (US$ 000's)	Ranking	Total exports (1994-2004)	Ranking	Country-specific fixed effects	WTO member?	MFN average applied tariff	Driving side	Rule of Law	Agreement	Diplomatic relations with South Africa
Burundi	-197.77	36	1 779 317	65	0.94	Yes	11.6	Right	-1.50	African Union	Embassy-Bujumbura
Morocco	-198.04	37	3 962 311	55	-1.22	Yes	18.7	Right	-0.05		Rep Office-Rabat
Ethiopia	-221.87	38	1 865 195	64	-0.80	No	11.3	Right	-1.00	African Union	Embassy-Addis Ababa
Switzerland	-246.11	39	13 314 714	44	-2.48	Yes	4.1	Right	1.98	EU-SA FTA	Embassy-Bern,Consulate-Geneva
Czech Republic	-275.27	40	3 295 369	57	-1.90	Yes	4.1	Right	0.69	EU-SA FTA	Embassy-Prague
Indonesia	-318.02	41	13 944 167	43	-1.62	Yes	12.3	Left	-0.91		Embassy-Jakarta
Turkey	-420.31	42	12 327 366	45	2.03	Yes	4.1	Right	0.04	EU-SA FTA	Embassy-Ankara
Austria	-451.47	43	7 194 403	51	-1.90	Yes	4.1	Right	1.76	EU-SA FTA	Embassy-Vienna
Sweden	-453.88	44	40 728 223	29	-0.49	Yes	4.1	Right	1.85	EU-SA FTA	Embassy-stockholm
Saudi Arabia	-461.27	45	7 259 523	50	-1.98	Yes	4	Right	0.20		Embassy-Riyadh
Cameroon	-491.36	46	18 151 552	40	1.24	Yes	15.5	Right	-1.00	African Union	High commission-Yaounde
Poland	-583.92	47	3 519 189	56	-3.38	Yes	4.1	Right	0.51	African Union	Embassy-Warsaw
India	-768.23	48	74 725 492	24	-0.54	Yes	24.8	Left	-0.09		High commission-New Delhi
Greece	-854.50	49	19 722 845	38	-1.01	Yes	4.1	Right	0.75	EU-SA FTA	Embassy-Athens
Madagascar	-919.08	50	25 254 488	36	1.90	Yes	11.1	Right	-0.30	SADC, African Union	Rep office-Antananarivo
New Zealand	-973.04	51	120 232 708	19	1.11	Yes	4.6	Left	1.93		
Mexico	-978.61	52	25 603 613	35	-1.49	Yes	17.3	Right	-0.26		Embassy-Mexico city
United Arab Emirates	-1100.02	53	35 568 517	32	1.01	Yes	4	Right	0.85		Consular general-Dubai,representative office-Abu Dhabi
Brazil	-1194.45	54	97 152 760	20	-0.68	Yes	18.1	Right	-0.21	SACU-MERCOSUR PTA (2004)	Embassy-Brasilia,Consulate-Sao Paulo
Uganda	-1270.76	55	32 531 761	33	0.15	Yes	6.7	Left	-0.79	African Union	Embassy-Kampala
Mauritius	-1379.06	56	84 357 997	22	2.86	Yes	5.1	Left	0.84	SADC, African Union	High commission-Port Louis
Ghana	-1709.69	57	57 747 793	26	2.38	Yes	32.1	Right	-0.16	African Union	High commission-Accra
Angola	-1992.32	58	81 032 818	23	2.32	Yes	3.4	Right	-1.33	SADC, African Union	Embassy-Luanda
France	-2337.73	59	131 099 366	18	-1.09	Yes	4.1	Right	1.33	EU-SA FTA	Embassy-Paris
Russian Federation	-4589.92	60	975 638	68	-3.17	No	11	Right	-0.70		Embassy-Moscow
Singapore	-7274.77	61	263 187 709	13	1.51	Yes	0	Left	1.82		High comission-Singapore
Nigeria	-7799.12	62	36 643 414	31	0.58	Yes	8.6	Right	-1.44	African Union	High commission-Abuja,rep office-Lagos
Spain	-8620.68	63	245 892 873	14	-0.17	Yes	4.1	Right	1.12	EU-SA FTA	Embassy-Madrid, General consulate-Bilbao
Zimbabwe	-9122.60	64	921 670 329	6	4.43	Yes	13.6	Left	-1.53	SADC, African Union	High commission-Zimbabwe
Hong Kong-China	-15803.17	65	154 657 200	15	0.38	Yes	0	Left	1.42		Consulate-Hongkong
Chile	-49071.66	66	4 796 991	54	-1.30	Yes	5.5	Right	1.16	MOU to solve issues of mutual interest	Embassy-Santiago
Germany	-68691.42	67	3 655 635 646	1	1.02	Yes	4.1	Right	1.66	EU-SA FTA	Embassy-Berlin
Australia	-107194.16	68	1 708 347 537	5	1.65	Yes	6.2	Left	1.82	Chairs the Cairns group, Indian Ocean Rim Association for Regional Co-operation	High commission-Canberra
United Kingdom	-141325.97	69	2 546 662 594	3	2.39	Yes	4.1	Left	1.71	EU-SA FTA	High commission-London
United States	-148427.23	70	2 639 014 307	2	-0.32	Yes	3.1	Right	1.58	US-SACU FTA Negotiations, AGOA,GSP	Embassy-Washington,General consulate-Chicago,Los Angeles, New York
Japan	-378966.16	71	2 464 901 564	4	-0.40	Yes	0	Right	1.39		Embassy-Tokyo

Source: Compiled from various sources

5 Conclusion

This study applies an "augmented" gravity model to South Africa's annual bilateral exports of motor vehicles, parts and accessories (SIC 381-383) to 71 of its trading partners over the period 1994 to 2004. A static panel data model is utilised to estimate the coefficients. A number of results emerge from the study.

First, certain characteristics of the trading partners enhance South Africa's exports of motor vehicles and parts and accessories: GDP, government effectiveness, regulatory quality, English language, membership to EU, Africa, NAFTA, Asia, and MERCOSUR (South America) as well as whether drivers in a country keep left or not.

Second, geographical distance, import tariffs levied on motor equipment and the fact that a country is located in the Middle East tend to inhibit the exports of motor vehicles and parts and accessories. The negative effect of distance implies that high transport costs inhibit South Africa exports of motor vehicles and parts and accessories. This is not surprising given the fact that the automotive export products are bulky.

Third, there are country-specific fixed effects, which tend to inhibit South Africa's exports. There is therefore a need to conduct a survey to determine these factors.

Fourth, the positive time-specific effects after 2002 show that the MIDP has been effective in enhancing the performance of the automotive industry exports. The question that needs to be addressed is what happens after the expiry of the MIDP in 2012?

Fifth, the gravity model shows that there are a number of countries where there is export potential that South Africa can exploit. However, there are some difficulties that exporters may face in exploiting these export destinations (Tables 6a and 6b). These include, among others, very high import tariffs, lack of South Africa's diplomatic mission in the trading partner, country not being a member of the WTO, lack of trade agreement with the country. There is therefore a need for the Department of Trade and Industry (DTI) to work on these issues with a view to making it easy for NAAMSA members to export.

Finally, despite the appealing results, the gravity model results and trade potentials should be interpreted with caution. The gravity model is very sensitive to the sample selected and hence the export potential may change depending on the model specification.

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