UNITED NATIONS UNIVERSITY

UNU-WIDER
World Institute for Development Economics Research

Research Paper No. 2007/09

The Geographical Location of Manufacturing Exporters in South Africa

Wim Naudé[1] and Marianne Matthee[2]

February 2007

Abstract

This paper provides empirical evidence on the location of export-oriented manufacturing firms in Africa (South Africa), and on how the patterns of location has changed over the past decade after the country embarked on trade liberalization. It is found that (a) the proximity to a port is an important consideration in most export-oriented manufacturing firms' location, with more than 70 per cent of manufacturing exports in South Africa originating from a band of 100 km from a port; and (b) there is a second band of location of these firms at a distance of between 200 and 400 km from the port. Between 1996 and 2004, manufactured exports in the band between 200 and 400 km from the nearest port increased. Various possible explanations for this dispersion of export location are discussed. These include (a) changes in international and domestic transport costs; (b) an increase in manufactured exports that depend on natural resources due to demand factors; and/or (c) inflation in land-rents or wage rates in the vicinity of hubs; and/or (d) the increasing productivity of export plants due to scale effects.

Keywords: geographical economics, manufacturing exports, domestic transport costs, South Africa
JEL classification: R0, R4, F14

[1]UNU-WIDER, Helsinki; [2]North-West University, Potchefstroom.

This study has been prepared within the UNU-WIDER project on New Directions in Development Economics directed by Augustin Fosu.

UNU-WIDER acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development).

ISSN 1810-2611 ISBN 92-9190-948-3 ISBN 13 978-92-9190-948-3

Acknowledgements

We are grateful to Augustin Fosu, Thomas Gries, and Waldo Krugell for comments on an earlier draft. The usual disclaimer applies.

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by Lorraine Telfer-Taivainen at UNU-WIDER

1 Introduction

Growth in developing country exports has been significant over the recent past, and is generally seen as one of the main contributors towards the greater prosperity that a large number of these countries have achieved.[1] As documented by Dollar and Kraay (2004: F23), the top one-third of developing countries in terms of trade to GDP over the past twenty years saw a doubling of trade from 16 to 33 per cent of GDP. Export-led growth is widely acknowledged to have been responsible for economic growth in many countries in Asia over the past two decades.

An exception to this success-story is sub-Saharan Africa (apart from Mauritius; see Teal 1999). Africa's poor performance in exporting, especially of manufactured goods, is a cause for concern (see e.g., Bloom and Sachs 1998; Easterly and Levine 1997; Jenkins and Thomas 1999; Temple 1999). The continent's share of world manufactured exports remained roughly constant at 0.8 per cent over the period 1980-2000 (Lawrence 2005: 1121).

Various aspects or causes of this poor manufacturing performance in general and export performance in particular, have received attention in the research literature in recent years. These aspects include firm size (Naudé and Serumaga-Zake 2003), foreign ownerships, and educational attainment (Rankin et al. 2006; Bigsten et al. 1999; 2000a); contract flexibility and credit constraints (Bigsten et al. 2000b, 2003) macroeconomic competitiveness (Fosu et al. 2001) and improvements in infrastructure and administration (Lawrence 2005: 1137). Van Biesebroeck (2005a; b) confirms that exports are associated with higher productivity in Africa, and that scale (firm size) matters for exports. Foster (2006) also confirms that there exist a positive relationship between exports and economic growth in Africa.

One aspect however, that has been neglected, is the changes in the location and geographical concentration in African manufacturing export industries, due to the greater openness of these economies. This may be an important omission, as knowledge of the location of African manufacturing export industries and its dynamics over time will reflect the relative strengths and importance of various ultimate determinants of firms' export behaviour. These may include transport costs (Ellison and Glaeser 1994), density of transport infrastructure and networks (Martin and Rogers 1995), proximity to a port and port efficiency (Fujita and Mori 1996), resource endowments (Head et al. 1995), spillovers (Audretsch and Feldman 1996), inter-industry linkages and agglomeration benefits of large home markets (e.g. Davis and Weinstein 2002; 2003). The ubiquitous finding that scale matters in Africa for exporting is consistent with the interaction between home market size and firm location (market access), as for instance described in the model of Holmes and Stevens (2005) where goods with low increasing returns are not traded. Hanson's (2005) work in this regards implies that the size of a

1 There is wide support for the notion that exporting manufactured goods is good for economic growth and development (see e.g. Venables 1996; Edwards 1997; Sala-i-Martin 1997; Sachs and Warner 1997; Elbadawi 1998). The Commission for Africa (2005) recent stated its support for export-led growth strategies for Africa, the world's poorest continent.

home market, and thus the concentration of export-oriented firms, will depend on that location's access to markets for its goods.

Although they did not focus on the inland location of African manufacturing exporters relative to a port per se, Elbadawi et al. (2006) recently stressed that the physical distance that African firms are from export markets and suppliers are a significant factor limiting African manufacturing exports. For the case of South Africa, Edwards and Alves (2006: 496) recently found that manufacturing exports are being limited by declining investment in transport infrastructure. We believe that the physical distance that African firms are from ports may just as well be limiting African manufacturing exports, and not just for landlocked African countries.[2]

Neglecting changes in the location and geographical concentration of African manufacturing export industries may furthermore be limiting our understanding of the degree to which different subnational regions within a country benefits – or suffers – from export-oriented growth strategies. The unequal spatial impact of greater openness to trade has been recognised in the literature (see Traistaru et al. 2002; Overman et al. 2001), although relatively little empirical work,[3] at least none in Africa, has so far focused on the importance of location for exporters.

In this paper, we provide an attempt to start to rectify this omission of neglecting changes in the location and geographical concentration on African manufacturing export industries, by providing empirical evidence on the geographical location of manufacturing exporters in South Africa. We also note the changes in geographical location that has taken place between 1996 and 2004, a period characterized by substantial trade liberalization and a fall in international transport costs (see Naudé 2005; Chasomeris 2006). The paper is structured as follows. In the next section we briefly discuss the focus on South Africa and describe the contribution of the paper. In Section 3 we provide a basic description of the country's spatial patterns of export location. Section 4 presents and discusses the methodology used, namely cubic-spline density functions that will be fitted to export data on the level of 354 magisterial districts in South Africa for 1996 and 2004. Section 5 reports the results from the estimated cubic-spline density functions. Section 6 provides a discussion of the results, and Section 7 concludes.

2 Motivation and contribution

South Africa is a good example of an African economy where the potential importance of understanding the location of export-oriented manufacturing firms, and the changes in such location over time, can be illustrated. This is for three reasons.

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2 Limão and Venables (2001) determined that the average landlocked country faces transport costs 50 per cent higher and trade volumes 60 per cent lower than the average coastal country.

3 An exception is Roper and Love (2001: 12) who, using a panel of manufacturing firms in Ireland, have found that the location of a firm is a significant and important determinant of its export propensity.

First, the country has adopted an outward-oriented macroeconomic strategy, which explicitly aims to raise the exports of its manufacturing sector. Consistent with this strategy the country has taken significant trade liberalization measures since 1994 (see Coetzee et al. 1997; Naudé and Coetzee 2004). This comes after decades of import substitution policies which had skewed the nature and location decisions of manufacturing firms (Suleman and Naudé 2003). Our paper contributes to the analysis of the changes introduced since 1994, by considering how the location of export-oriented manufacturing firms has changed between 1996 and 2004.

Second, the country has a notably unequal spatial economy. Around 70 per cent of the country's GDP is produced in only 19 of the urban areas (Naudé and Krugell 2006). Part of this is no doubt a legacy of apartheid-era policies,[4] such as the Regional Industrial Development Programme (RIDP) and Industrial Decentralization Policy (IDP). Thus, changes in the location of export-oriented manufacturing since 1994 could reflect the effects of the abandonment of these policies, as well as new policies of the new democratic government, such as Spatial Development Initiatives (SDIs), Industrial Development Zones (IDZs) (Kleynhans et al. 2003; Naudé 2006) and the significant devolution of power to local municipalities (Naudé 2003).[5] Moreover, following similar concerns elsewhere, the suspicion has been raised that the internationalization of the South African economy since 1994 may have increased the degree of regional specialization and geographic concentration of industrial activity, and thus has exacerbated spatial inequality (Rogerson 1998). However, despite the particular nature of South Africa's spatial economy and fears that greater openness may have increased the geographical concentration of manufacturing firms, only very few concerns have so far been raised that geographical factors (such as those mentioned in Section 1, namely transport costs, transport infrastructure, port efficiency, agglomerations, etc.) might adversely impact on the success of South Africa's exports[6] (e.g. by Dehlen 1993; Pretorius 1997; Naudé 2001; Naudé and Krugell 2003). In the broader scientific literature, a small but growing number of studies are pointing out to the importance of geography – in particular through location and distance from markets – in determining exports (Radelet and Sachs 1998; Hummels 1999a; b; Limão and Venables 2001). This paper therefore makes a further contribution in adding to this literature.

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4 Apartheid contributed to spatial inequality through racial segregation, with resulting inefficient land use, high transport costs, and under-investment in transport infrastructure, telecommunications and electric power (Naudé and Krugell 2003). The long-run, deeper spatial inequalities in the South African economy stems however from the climate (which is more habitable towards the eastern seaboard) and the country's endowment of natural resources. For instance, the discovery of diamonds in Kimberley in 1867 and the discovery of gold in the Witwatersrand (Johannesburg) in 1886 lead to rapid inland urbanization and accompanying industrialization to service the mines and the growing domestic markets. The role of port cities such as Durban and Cape Town became important as they handled exports of diamonds and gold.

5 A discussion of industrial location and industrial location policy in South Africa falls outside the scope of this paper. The interested reader is referred to Drewes and Bos (1995), Suleman and Naudé (2003) and Naudé (2006) for overviews.

6 Naudé (2001) estimated an export supply equation for South Africa, using quarterly data over the period 1975 to 1998. He found that international transport costs have a significant negative effect on South African exports. Recent work by Chasomeris (2005; 2006) also expresses concerns over the potential impact of international transport costs (shipping costs) on exports from Africa.

Third, South Africa has the largest manufacturing sector on the African continent and well developed transport infrastructure.[7] Whilst this may make South Africa atypical of the average African situation, the manner in which South Africa's manufacturing adjust under liberalization, and the locational patterns of its exporting firms, will have important indicative effects for other African countries (Naudé et al. 2002, 2005). Also, given that South Africa has a fairly good transport infrastructure compared to many other African countries, the distance of location of manufacturing exporters from a port may be a good proxy for the effect of domestic transport costs on exports (and on the concentration of economic activity as per the analysis of Hanson 2005). The latter is an aspect on which reliable and accessible data in Africa is scarce.

In a much quoted paper, Limão and Venables (2001: 460) state that 'distance may fail to explain a significant part of transport costs' with transport infrastructure being a very important part of transport costs. We believe this to be true for many developing countries, and for most of Africa, with South Africa being the exception. Indeed, Naudé (2001) states that domestic transport costs in South Africa cannot be claimed to be high in comparison to other countries. Micco and Perez (2001) confirm that distance is the main determinant of transport costs once a certain level of transport infrastructure is in place. Therefore, by considering how far manufacturing exporters tend to locate from South Africa's ports, we would be able to get an indirect measure of the potential importance of domestic transport costs in manufacturing exports, something which would be less straightforward in other African settings.

3 Spatial profile of manufacturing exports in South Africa

In the previous section it was mentioned that the South African economy is characterized by significant spatial inequalities. Changes in the country's internationalization since 1994 might have acerbated these inequalities. For instance, Naudé and Krugell (2006) find no evidence of convergence in per capita incomes since 1996 between the various subnational (magisterial) districts.

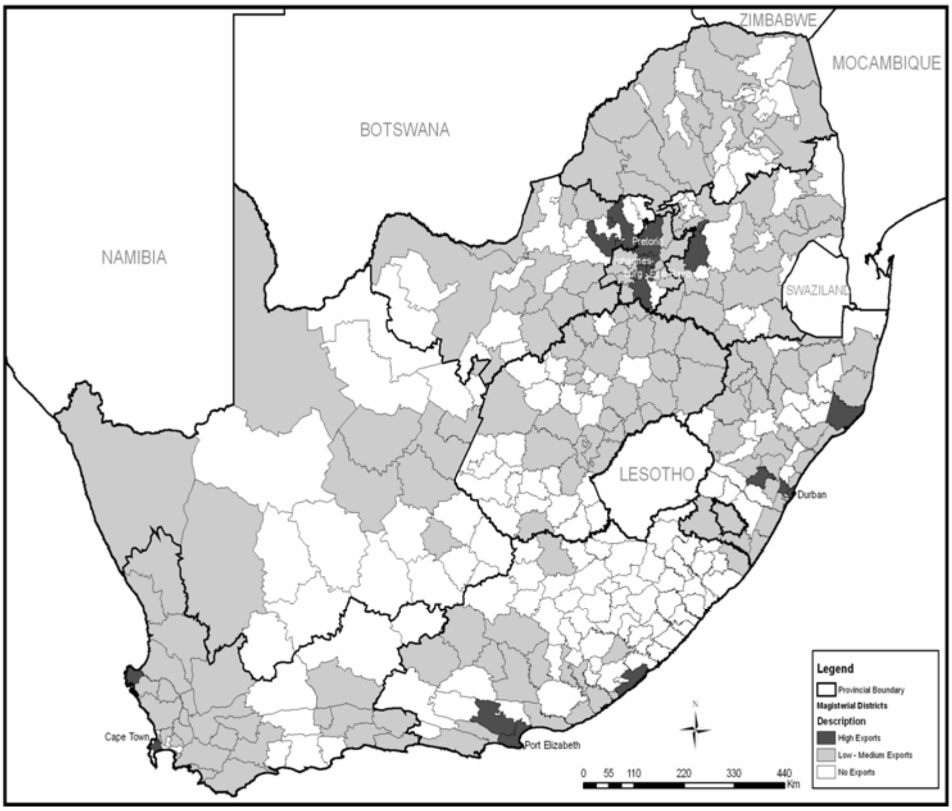
As far as the location of export-oriented firms are concerned, subnational data from a magisterial district levels suggests that around 22 of the 354 magisterial districts produced 84 per cent of the total manufacturing exports in 2002. South Africa's skew spatial distribution is clearly evident here, as 40 per cent of all manufactured exports originate from the central Johannesburg-Pretoria region. The other large agglomerations that export manufactures are Durban-Pietermaritzburg (11.32 per cent), Pretoria-Brits (7.9 per cent) and Cape Town-Bellville (5.98 per cent) (see Naudé and Krugell 2006; Gries and Naudé 2007).

Figure 1 depicts the spatial location of the magisterial districts that export manufactured goods. The shaded districts are those that have positive manufactured exports. The relative volume of exports is indicated according to the percentage of exports from a particular district. For instance, the areas shaded black are areas where the district contributes more than 1 per cent of total manufactured exports and the areas shaded

[7] Despite this, much of most recent work on manufacturing exports from Africa omits South Africa, the exceptions being Naudé et al. (2002, 2005) and Edwards and Alves (2006).

grey between 0.1 and 0.99 per cent. It is evident that the majority of manufactured exports originate in districts in or close to one of the major export hubs, namely City Deep (situated in Johannesburg), Durban harbour (situated in KwaZulu-Natal), Port Elizabeth (situated in the Eastern Cape) and Cape Town harbour (situated in the Western Cape). City Deep is an inland container port situated in Johannesburg constructed to cope with container traffic originating from Gauteng. Durban is the largest general cargo port in South Africa and also the best-equipped container terminal. Port Elizabeth is situated midway between the ports of Durban and Cape Town. This port specialises in cargoes for the vehicle manufacturing and vehicle components industries. Cape Town's container terminal is a well-located hub for exports and handles high value and time-sensitive cargoes (ITRISA 2005; Transnet 2006).

Figure 1: Manufactured exports per magisterial district in South Africa, 2004



Source: Data from South African Customs and Excise Data and Global Insight Southern Africa. Map drawn for the authors by GISCOE.

4 Empirical analysis

4.1 Methodology

In South Africa, manufactured exports clearly originate from a relatively few regions, as was seen from the discussion in the previous section and was depicted in Figure 1. There is clearly some for of "clustering" of manufacturing exporters taking place in the country. Whether this is clustering as is normally understood in the industrial clustering literature (see e.g. Nadvi and Schmitz 1999) remains to be investigated,[8] since the current level of analysis is on the level of district, not a firm. Nevertheless, the tentative conclusion from this paper is that there is indeed some form of industrial clustering (at least agglomeration) occurring with exports of certain sectors having distinct spatial locations (we show below that export of electronic components for instance, originate almost exclusively within a 100 km radius of an export hub). The evidence comes first from the sectoral analysis of the location of manufacturing exporters presented below (see the discussion around Table 1). Second, there exists a growing literature on the location of foreign direct investment (FDI), and on the relationship between the location and export decisions of such multinational firms. For present purposes, this literature has established that first, multinational firms tend to locate closer to export hubs such as ports (Ma 2006), second that multinational firms have a higher probability of exporting (Poddar 2004), and third that the presence of multinational firms are associated (through positive spillover effects) with higher exports by domestic firms (Greenaway et al. 2003). These three aspects could for instance partly explain[9] the pattern of spatial manufactured exports evident in Figure 1 and would suggest that at least in some cases, such as automobiles, the clustering may go beyond mere agglomerations to include complexes and networks (as described in Gordon and McCann 2000).

In this paper we do not focus on measures of industrial concentration such as those used in the industrial clustering literature (see e.g. Gordon and McCann, 2000), or used in investigating issues of industry location (see Duranton and Overman 2005; Marcon and Puech 2003). Rather, due to the nature of our data (see Section 4.2), we are forced to see manufacturing exports as taking on various densities in different locations, and as such we use the technique of fitting cubic-spline functions to our data. Essentially this entails the use of a standard methodology used often in population density and urban concentration studies, in a novel context.

Cubic splines are piecewise functions whose 'pieces' are polynomials of degree less than or equal to three, joined together to form a smooth function (Poirier 1973). The reason for the development of spline functions was to overcome the problems experienced with piecewise linear regression functions (Suits et al. 1978). Piecewise linear regression functions suffer from discontinuity in their derivatives. This discontinuity at the kinks of the linear regression makes it difficult to analyse, for example, shifts in elasticities and marginals, (Suits et al. 1978). Cubic spline functions have been applied to various study disciplines, one of which is, as remarked, urban studies. In a seminal study Anderson (1982; 1985) applied cubic spline functions to determine the urban population density (or spatial structure) of a metropolitan area (see also Alperovich 1995, and more recently Muñiz et al. 2003).

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8 A 'cluster' can be defined as a sectoral and spatial concentration of firms (Nadvi and Schmitz 1999: 1503). Further work on the potential clustering of export-oriented manufacturing firms in South Africa can make a useful contribution to the relevantly scant literature on African industrial clusters**.**

9 For instance, multinational firms in the automobile industry, of which South Africa is a significant exporter, are located in or near the port cities of Port Elizabeth/Uitenhage and Durban, and around the Pretoria metropolitan area (Rosslyn). One could thus argue on this basis that particular industrial clusters exist in the South African automotive industry. See also Meyn (2004) on the export performance of the South African automotive industry.

We assume that what matters for exports is access to a port (export hub). As such, any location in the country can be expressed as a distance from the export hub (defined as a sea-port or dry-port). For this purpose, magisterial tract data on exports is used to determine the density of exports at various distances from the closest hub (port) (Zheng, 1991). The density-distance relationship is estimated by using piecewise, continuous polynomials (Zheng 1991). Suits et al. (1978) initially developed a spline density function where the density variable regresses into three polynomial expressions of the distance variable (Skaburskis 1989). The function is as follows:

$$\begin{aligned} T = {} & [\alpha_1 + \beta_1(K - K_0) + \chi_1(K - K_0)^2 + \delta_1(K - K_0)^3]Y_1 + \\ & [\alpha_2 + \beta_2(K - K_1) + \chi_2(K - K_1)^2 + \delta_2(K - K_1)^3]Y_2 + \\ & [\alpha_3 + \beta_3(K - K_2) + \chi_3(K - K_2)^2 + \delta_3(K - K_2)^3]Y_3 + \nu \end{aligned} \quad (1)$$

Where K is the distance from the magisterial district to the closest hub, K_0 is the distance of the closest tract, K_1 is the first interior knot and K_2 is the second interior knot. Y_1, Y_2 and Y_3 are dummy variables defined on the various intervals on the X-axis. In other words they locate each tract in its segment along the distance variable (Y_i, where i = 1, 2, 3…). The parameters α, β, χ and δ describe the spline and υ is a normally distributed disturbance term with a zero mean and constant variance (Anderson 1982; Skaburskis 1989). In equation (1), there is, however, no guarantee that the function is continuous at knots K_0, K_1 and K_2. A further problem is that the derivatives are also discontinuous at these knots. It is for this reason that Suits et al. (1978) improved their function by adding constraints to the coefficients. The constraints make the function continuous and guarantee continuity of the first and second derivatives. The improved density function can be written as:

$$\begin{aligned} T = {} & \alpha_1 + \beta_1(K - K_0) + \chi(K - K_0)^2 + \delta_1(K - K_0)^3 + \\ & (\delta_2 - \delta_1)(K - K_1)^3 Y_1 * + (\delta_3 - \delta_2)(K - K_2)^3 Y_2 * \end{aligned} \quad (2)$$

$Y_i* = 1$ if, and only if, $K \geq K_i$. That is, $Y_i* = 0$ until K reaches K_i, then $Y_i* = 1$ thereafter (Anderson 1982). Zheng (1991) has modified the spline density function by omitting the second dummy term and adding an error term. His version of the spline density function (used here) is written as:

$$\begin{aligned} M_r = {} & \alpha + \beta(K_r - K_0) + \chi(K_r - K_0)^2 + \delta_i(K_r - K_0)^3 + \\ & \sum_{i=1}^{n-1}(\delta_{i+1} - \delta_i)(K_r - K_i)^3 Y_i + \mu_r \end{aligned}$$

$Y_i = 0$ if $K_r \geq K_i$

$Y_i = 0$ otherwise (3)

It should be noted that this is not a behavioural equation specifying the determinants of exports, as for instance in Rankin et al. (2006). Rather, it relates exports to distance, and provides a prediction of average manufactured exports at various distances from the export hub. As far as we are aware there has not been any study that uses the cubic-spline density function to estimate the location of manufactured exports.

4.2 Data

Data on exports of manufactured goods were obtained from Global Insight's Southern Africa's Regional Economic Focus database. This database is compiled from data supplied by the South African Revenue Services and the Department of Customs and Excise. The documentation required from exporters by the Department of Customs and Excise captures their postal codes or street addresses. This data per postal code is mapped to one of the 354 magisterial districts to provide information on exports from each magisterial district. The magisterial allocations are then compared to the national totals as contained in the *South African Reserve Bank Quarterly Bulletin*. A weakness of the data is that exports are measured at current world prices. In other words, taxes and subsidies are not included in value added. This causes a peculiarity in the export share measure, as some of the magisterial districts have an export share greater than 100 per cent (Gries and Naudé 2007). Data from two of the dependent variables are used, namely manufactured exports and gross value added.

The only other variable for which data were obtained is distance. In most urban spline density studies in the literature, actual distances are not used, and distance is calculated by the 'great circle' formula in which distance is measured directly (in other words, 'as the crow flies'). In this paper, actual road distances in kilometres are used. The internet service Shell Geostar[10] was used to obtain the shortest route in kilometres, from each of the magisterial districts to each of the major export hubs in South Africa, as in 2006 (the routes are unlikely to have changed since 1996). The hubs used were Cape Town harbour, Port Elizabeth harbour, Durban harbour, and City Deep.[11] The shortest distance to one of these hubs were chosen as the actual distance, as it is assumed that exporters strive to minimise their transport costs.

4.3 Results

Cubic-spline density functions were applied to different sets of data, using STATA 9. The data sets included the eight-year average of manufactured exports from 1996 to 2004 and manufactured exports in 1996 and 2004 respectively. In the cubic-spline density functions, the furthest distance in kilometres in 2004 of manufactured exports from a hub was used to calculate the knots. Cubic-spline density functions were developed for three, four and five knots for each of the data sets. The results indicated that three knots seemed to provide the best fit to the data. Appendix 1 contains the results of the cubic-spline density functions for all of the data sets using three knots. Appendix 2 contains the results of the cubic-spline density functions for all of the data sets using four knots and Appendix 3 illustrates the results using five knots.

Location of manufacturers

In order to obtain a description of the location of manufactured exports relative to their closest export hubs, we firstly estimated cubic-spline density functions for the eight-year average of manufactured exports from a district over the period 1996 to 2004. The

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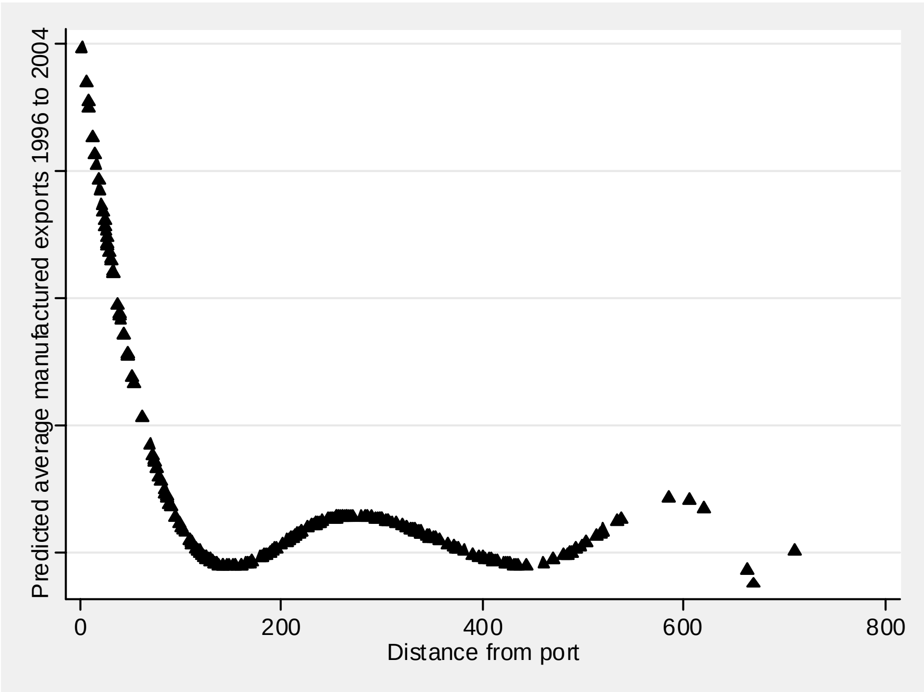
10 www.shellgeostar.co.za.

11 Other export hubs in South Africa were excluded, due to the fact that the use of these hubs would lessen the degrees of freedom in the cubic-spline density functions. These export hubs are however, the most important in South Africa, handling the bulk of all exports (Chasomeris 2006).

number of magisterial districts with positive exported manufactures during this period is 267. Figure 2 illustrates the results (regression results contained in Appendix 1). From Figure 2, it is clear that for the overall period 1996-2004 the largest volumes of manufactured exports originated within 100 km of the export hub/port. The coefficient on distance from the port (β) is negative and significant (see Appendix 1). This suggests that proximity to a port (hub) is an important consideration in most export-oriented manufacturing firms' location. To the extent that distance implies transport costs, it would suggest that domestic transport costs matter for manufactured exports.

It is also noticeable from Figure 2 that there is not a unidirectional decrease in export-orientation as the distance from the port/hub increases. In fact, in South Africa, there appears to be a second band of location of export-oriented manufacturing firms at a distance of between 200 and 400 km from the nearest hub. A third band occurs at around 600 km from the nearest hub. As will be shown below the manufactured exports that originate from this band tend to be resource-based.

Figure 2: Average manufactured exports from 1996 to 2004

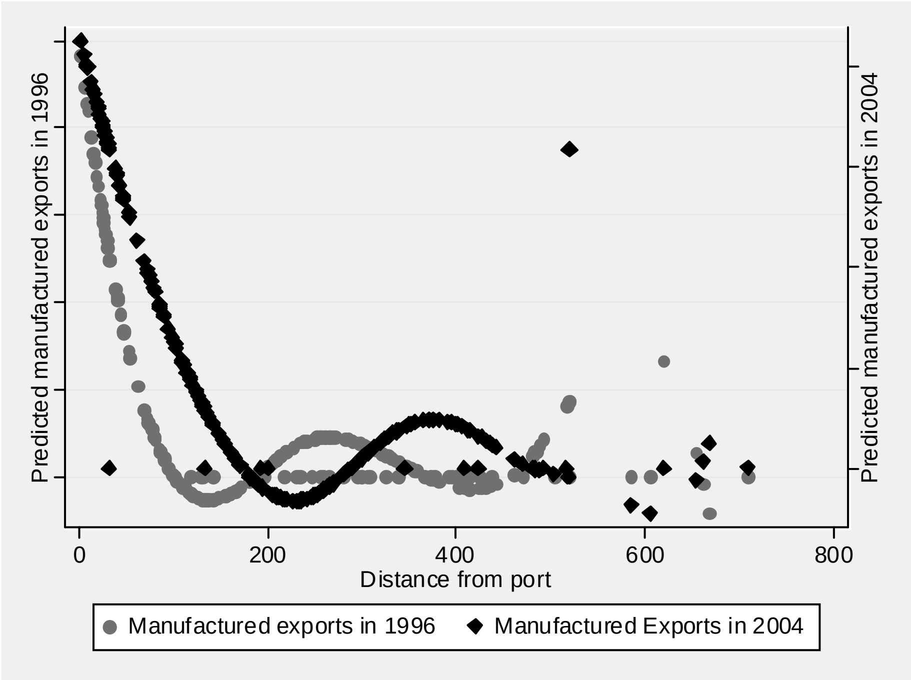


The period 1996-2004 saw significant trade liberalization taking place in South Africa, with an accompanying increase in total manufactured exports and a decrease in real international transport costs between South Africa and the EU (see e.g. Naudé 2005; Chasomeris 2006). It might therefore be instructive to compare changes in the location of manufactured exports between 1996 and 2004.

Figure 3 compares the density functions for the value of manufacturing exports in 1996 and 2004. In 1996 only 193 of the 354 magisterial districts hosted exported manufactures, whilst in 2004 the number rose to 223, a 15 per cent increase. The general increase in manufacturing exports from all locations is evident in the rightward shift of the density function in Figure 3. It can also be seen that the amplitude of the

2004 density function in the band between 200 and 400 km from the hub increased, suggesting greater exports from locations rather further away from the hub.

Figure 3: Manufactured exports in 1996 and 2004



Discussion

In all instances where cubic-spline density functions were applied to the various data sets, the results indicated that distance is negatively related to the level of manufactured exports (see Appendixes 1, 2, and 3). The majority of exporters of manufactured goods are located within 100 km of the nearest export hub. A second 'zone' of export density occurs between 200 and 400 km of the nearest export hub.

Table 1 provides information on the location of the manufacturers of the nine sectors of manufactured exports. The majority (in excess of 70 per cent) of manufactured exports are produced within 100 km of the nearest export hub. For certain goods, such as electronics, about 98 per cent of manufacturing takes place within 100 km of an export hub. This is consistent with our earlier discussion on the role on multinationals in manufactured exports (see Section 3) and in light of the finding by Woodward and Rolfe (1993: 122) that 'export assembly platforms figure increasingly in international production strategies of multinational corporations', particularly in electronics.

Table 1: Percentage exports per sector by distance

Sector	Distance (in km) from nearest export hub							
	0-100	101-200	201-300	301-400	401-500	501-600	601+	Total %
Food, beverages and tobacco products	84.28	8.14	4.25	2.76	0.50	0.05	0.02	100
Textiles, clothing and leather goods	79.15	1.50	12.50	6.59	0.25	0.01	0.00	100
Wood and wood products	82.39	16.62	0.47	0.39	0.12	0.00	0.00	100
Fuel, petroleum, chemical and rubber products	78.60	14.34	1.38	2.12	3.56	0.01	0.00	100
Other non-metallic mineral products	94.21	2.74	2.19	0.74	0.09	0.02	0.00	100
Metal products, machinery and household appliances	75.75	20.12	0.84	2.43	0.52	0.01	0.33	100
Electrical machinery and apparatus	92.74	0.97	6.05	0.12	0.08	0.02	0.01	100
Electronic, sound/vision, medical and other appliances	98.79	0.64	0.32	0.10	0.13	0.01	0.00	100
Transport equipment	81.28	3.92	14.36	0.26	0.11	0.06	0.00	100
Furniture and other items NEC and recycling	71.53	2.47	1.94	0.82	23.23	0.00	0.01	100

Source: Calculated by authors using data from SA Customs and Excise as contained in the Regional Economic Explorer, Global Insight Southern Africa.

Further away from an export hub in South Africa (in excess of 100 km) one tends to find furniture, textiles, and metal products. These goods tend to be produced largely for the domestic market, and are relatively more intensive in natural resources such as wood, plants and mineral ores. The differential location of electronic and furniture manufacturers may also reflect the fact that the former is more dependent on imported intermediate inputs and higher skilled labour in production, than the latter. If one compares the location of manufacturing exporters over time, i.e. compare the level and location of manufactured exports in 1996 and in 2004, two structures are evident (see Figure 3). First, exporters seem to have located further away from the hub within the first 100 km. Second, the level of manufactured exports in the second ‘band’ (originating around 400 km from the hub) has increased significantly from 1996 to 2004.

There are a number of possible, though not mutually exclusive, explanations for these changes in location density of manufactured exports in South Africa. These explanations reflect the interplay between distance and agglomeration in the location decisions of manufacturing firms as discussed earlier. In this paper, we do not, due to data limitations, empirically discriminate between these, but discuss the possible explanations broadly, so as to support possible future research (once data limitations are overcome) and also to argue that tentative evidence would suggest that all of the major dispersal forces noted here, might in fact be relevant in an African country such as South Africa at present.

In the introduction to this paper we noted from the geographical economics literature a number of dispersal forces for inland location of manufactured exports. These included transport costs (Ellison and Glaeser 1994), density of transport infrastructure and networks (Martin and Rogers 1995), proximity to a port and port efficiency (Fujita and Mori 1996), resource endowments (Head et al. 1995), spillovers (Audretsch and Feldman 1996), inter-industry linkages and agglomeration benefits of large home markets (e.g. Davis and Weinstein 2002; 2003). In the remainder of this discussion below we will emphasize changes in transport costs, transport infrastructure, port efficiency, as well as natural resource endowments, as we believe that it is these factors that provide the most substantial explanation for the dispersal of export manufacturing observed in South Africa. However, we do note the potential importance of rising land rents and wages as further dispersal forces.

As far as transport costs are concerned, the apparent decline in the importance of distance from a hub/port for manufactured export density from South African magisterial districts could be due to an actual decline in transport costs over the period. It could be due to both declines in international as well as domestic transport costs. In a somewhat different setting (of large cities), Krugman and Livas Elizondo (1996) showed that greater internationalization could generate dispersal forces that lead to a decentralization of economic activity away from large cities (hubs). They use Mexico City as an example. The dispersal of manufactured exports documented in this paper is consistent with the decentralization of economic activity during greater international openness, experienced in South Africa since 1994, as modelled in Krugman and Livas Elizondo (1996). One channel is through a reduction in international transport costs. Chasomeris (2006) documents South Africa's international transport costs (shipping costs) and shows that after the ending of apartheid and the country's reintegration into the international community following years of international sanctions, that shipping costs to Europe indeed declined in real terms. A similar analysis has not been done for domestic transport costs, and direct measures of domestic transport costs (for instance freight costs via road or rail) remains difficult to come by. Nevertheless, it may very well be the case that structural improvements in the South African economy since 1994, such as greater competition in the road freight sector, improvements in transport infrastructure, and technological advances in freight management and handling have lowered domestic transport costs (CSIR 2001; Mitchell 2006).

Further research is required into domestic transport costs, not only in South Africa, but in Africa and developing countries in general. According to Porto (2005) transport costs are amongst the most important trade barriers facing exporters in developing countries. Numerous studies and various methods have been used to measure the impact of international transport costs on trade (see for example, Hummels 1999a; b; Limão and Venables 2001; Martínez-Zarzoso et al. 2003). The measurement of domestic transport costs has not been as popular a topic, with no commonly used method. In most cases, a proxy for domestic transport costs is applied (Elbadawi et al. 2001; Limão and Venables 2001; Combes and Lafourcade 2005). However, it is estimated that domestic transport costs may have a much stronger effect on exports than international transport costs. Despite this, the majority of studies have focused on international transport costs, with only a few studies (as cited above) focusing on domestic transport costs. Even fewer studies are available that investigate the importance of domestic transport costs in an African country.

The above discussion makes a case for changes in transport costs (international and domestic) as dispersal factors for manufactured exports within South Africa, and calls for further research into the role of domestic transport costs in Africa. In addition to transport costs, another dispersal factor that we need to note here is the increase the competitiveness of manufactured exports that depend on natural resources, in that they have a high share of primary commodity inputs in their value. These resources are not necessarily located close to an export hub/harbour. Examples here include the rapid growth in exports of commodity-based manufactures from South Africa (see Edwards and Lawrence 2006: 11). In South Africa, large multinational companies such as Lafarge has in recent years made significant investments in cement production plants, but in areas relatively distant from export hubs/ports (Cokayne 2005).

A further factor that could be driving the relative changes in location of manufacturing exports may involve the increases in land-rents and/or wage rates in the vicinity of hubs. As far as land prices and rents are concerned it is an established fact that property prices in general have be increasingly very substantially in South Africa since the late 1990s. Funke et al. (2006) recently noted that property prices in South Africa have increased by well over 100 per cent in real terms since 1999. Areas closer to the ports can be expected to have seen much higher rises than more remote areas.

As far as wage increases are concerned, more research is needed before conclusions can be made on the spatial incidence of wage increases. Burger and Yu (2006) do find that real wage earnings in South Africa have increased since 1994, but point out that these increases were mostly in the lower income, low skilled groups who are not necessarily concentrated around the port areas. Another channel through which the interaction of higher wage rates, the location of natural resources, and changes in international transport costs could have resulted in the dispersal observed is through the location of multinational firms (foreign direct investment). South Africa, since 1994, attracted a growing volume of FDI. Some of the FDI could be expected to be 'vertical' FDI. The latter is driven by differences in factor prices among countries, and will be stimulated by a reduction in transport costs. Vertical FDI often takes place to benefit from lower labour costs so that labour-intensive parts of the manufacturing process can be undertaken (Fujimara 2004: 8). This type of FDI would therefore prefer locations further away from ports where labour costs may be lower**.** Before such conclusions can be made however, further research on spatial changes in wages are needed.

Finally, we have to acknowledge that the possibility exists that due to a growing domestic market, some firms in outlying areas have been able to generate productivity gains from the larger home market, resulting in higher production for the export market also. However, such a possibility has to be evaluated against contrary evidence on the macro-level that South Africa's exports often rise when domestic demand falls, with exports acting as a type of 'vent-for-surplus' to use Adam Smith's terminology (see for example Naudé 2000, and also more recently Edwards and Alves 2006).

5 Conclusions

We started this paper by pointing out that, although there have been a number of recent papers dealing with Africa's manufacturing export performance, none have so far focused on the geographical location of African manufacturing export industries, or on the dynamics of the location decision of manufacturing exporters. We indicated that this may be an important omission, as knowledge of the location of African manufacturing export industries and its dynamics over time will reflect the relative strengths and importance of various ultimate determinants of firms' export behaviour.

Given that firms require moving their exports through ports (generally export hubs such as either sea ports or dry ports) we considered the density of manufacturing exports originating from various distances from South Africa's ports. Data on manufactured exports from 354 magisterial districts for the period 1996-2004 was obtained, and cubic-spline density functions estimated on the relationship between manufacturing exports and distance.

Our results showed that South Africa's manufactured exports tend to be spatially concentrated. Around 22 of the 354 magisterial districts produced 84 per cent of the total manufacturing exports. Distance (in kilometres) is negatively related to the density of manufactured exports, and statistically significant. Given that distance is the main determinant of transport cost, our results provided an indirect measure that domestic transport costs is important in manufacturing exports. Our results furthermore have shown that the largest volumes of manufactured exports are generated within 100 km of an export hub. For certain goods, such as electronics, about 98 per cent of manufacturing takes place within 100 km of an export hub. It was also found that the relationship between exports and distance from an export hub is not uniformly negative. We found a second band of location of export-oriented manufacturing firms at a distance of between 200 and 400 km from the nearest hub. A third band occurs at around 600 km. The manufactured exports that originate from this band tend to be low-skill intensive and resource based.

Comparison over time showed that the number of locations from which manufacturing exports occur in South Africa increased by 15 per cent during 1996-2004 and that manufactured increased in the band between 200 and 400 km from the nearest hub. We offered a number of explanations and emphasised that the evidence suggest that although a number of factors are simultaneously having a dispersal effect on manufactured exports, there is some evidence to suggest that declines in transport costs (both of shipping costs and domestic transport costs) played an important role in this dispersal. We did not however, due to data limitations, empirically discriminate between the various explanations for the dispersal of exports, and leaves this as a task for future research.

The policy implications from our findings can now be set out. For export promotion, more attention needs to be paid to the physical location of firms relatively to ports. This could suggest that African policy makers give more attention to improvements in domestic transport infrastructure and reductions in domestic transport costs, including improving the efficiency of export hubs, and even creating additional export hubs (e.g. through dry ports). Another, perhaps more speculative, but warranted policy implication given the discussion, is that openness to trade, if accompanied by declines in international transport costs, may contribute to a greater dispersal, or decentralization) of export manufacturers. This will have beneficial results for more peripheral regions, and may be important for local and regional development strategies in a continent where concerns over spatial inequalities have been raised (Kanbur and Venables 2003).

Appendix 1

3 knots	Total Hubs		
Parameter	Average	1996	2004
α	4.10e+09 (9.03)**	2.51e+09 (7.44)**	4.33e+09 (7.60)**
β	-6.96e+07 (-6.05)**	-4.66e+07 (-5.13)**	-3.79e+07 (-5.11)**
χ	366691.1 (4.75)**	260066.1 (4.13)**	73710.2 (3.39)**
δ_1	-598.3 (-4.09)**	-440.5 (-3.60)**	1.10e-06 (0.63)
$\delta_2 - \delta_1$	756.2 (3.20)**	606.2 (2.88)**	-1143.5 (-0.83)
$\delta_3 - \delta_4$	-539.4 (-1.08)	-684.1 (-1.36)	-2318.6 (-0.42)
$\delta_4 - \delta_5$	1.36e+09 (0.44)	1.81e+09 (0.77)	-2.72e+09 (-0.53)
SE	1.7e+09	1.2e+09	2.8e+09
Adj. R-bar squared	0.21	0.17	0.14
No. observations	267	193	223

Note: t-ratios in parenthesis: * significant at the 10% level; ** significant at the 5% level.
Source: Authors' own calculations.

Appendix 2

4 knots	Total Hubs		
Parameter	Average	1996	2004
α	3.58e+08 (0.69)	2.55e+09 (7.50)**	5.72e+09 (7.73)**
α	-1651511 (-0.12)	-4.89e+07 (-5.21)**	-8.25e+07 (-4.86)**
χ	23881.5 (0.25)	283058.6 (4.20)**	303994.4 (3.76)**
δ_1	-52.7 (-0.28)	-500.05 (-3.67)**	-0.00 (-2.73)**
$\delta_2 - \delta_1$	0.10 (0.15)	1.45 (2.89)**	20.22 (2.62)**
$\delta_3 - \delta_4$	0.57 (0.27)	-3.77 (-2.21)**	27.15 (3.07)**
$\delta_4 - \delta_5$	-16.93 (-0.95)	15.04 (1.02)	71.88 (1.57)
$\delta_6 - \delta_5$	8.90e+09 (1.12)	-2.67e+10 (-1.79)*	-6.66e+09 (-0.48)
$\delta_7 - \delta_6$	—	—	—
SE	1.9e+09	1.2e+09	2.8e+09
Adj. R-bar squared	0.02	0.18	0.18
No. observations	267	193	223

Note: t-ratios in parenthesis: * significant at the 10% level; ** significant at the 5% level.
Source: Authors' own calculations.

Appendix 3

5 knots	Total Hubs		
Parameter	Average	1996	2004
α	2.22e+08 (0.42)	2.63e+09 (7.63)**	5.50e+09 (7.71)**
β	4708666 (0.33)	-5.28e+07 (-5.36)**	-7.41e+07 (-4.87)**
χ	-34865.98 (-0.34)	320769.2 (4.36)**	252400.8 (3.70)**
δ_1	88.07821 (0.41)	-593.79 (-3.83)**	-0.0000113 (-2.38)**
$\delta_2 - \delta_1$	-0.0018079 (-0.85)	0.00 (2.91)**	0.0262125 (2.16)**
$\delta_3 - \delta_4$	0.0128365 (1.18)	-0.02 (-2.38)**	-0.0211681 (-1.18)
$\delta_4 - \delta_5$	-0.0736356 (-1.40)	0.07 (1.66)*	0.0696358 (0.84)
$\delta_6 - \delta_5$	1.217318 (1.11)	-0.86 (-1.11)	-0.5000189 (-0.31)
$d_7 - d_6$	-2.84e+10 (-0.84)	1.95e+10 (0.88)	1.13e+10 (0.22)
SE	1.9e+09	1.2e+09	2.8e+09
Adj. R-bar squared	0.02	0.18	0.17
No. observations	267	193	223

Note: t-ratios in parenthesis: * significant at the 10% level; ** significant at the 5% level.
Source: Authors' own calculations.

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