EXPORT DIVERSITY AND REGIONAL GROWTH IN A DEVELOPING COUNTRY CONTEXT: EMPIRICAL EVIDENCE

By

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ABSTRACT

This paper provides empirical evidence on the relationship between exports, and in particular export diversity, and spatial inequality in a developing country context. Using export data from19 sectors within 354 sub-national (magisterial) districts of South Africa, various measures of sub-national export diversity are constructed. It is found that it is not only important how much is exported, but that it is also important what it is that is exported. Regions with less specialisation and more diversified exports generally experienced higher economic growth rates, and contributed more to overall exports from South Africa. It is also found that distance (and thus domestic transport costs) from a port is inversely related to the degree of export diversity. Estimating a cubic-spline density function for the Herfindahl-index measure of export diversity, it is found that export diversity declines as the distance from a port (export hub) increases. Most magisterial districts with high export diversity values are located within 100 km of the nearest port. Furthermore, comparing the cubic-spline density functions for 2004 with those of 1996 shows that distance (domestic transport costs) has become more important since 1996 (under greater openness) with magisterial districts located further than 100 km from the ports being less diverse in 2004 than in 1996. One possible explanation for this changing pattern of export diversity may be the impact of greater foreign direct investment (FDI) in South Africa since 1996.

Keywords: exports, export diversification, export variety, regional growth, new economic geography

JEL classification codes: F14 and R11

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1 Introduction

Unequal spatial development is a feature of most countries. Recent years have seen a burgeoning literature focusing on the nature, determinants and consequences of spatial inequality on development (see e.g. Kanbur and Venables, 2005). It is recognised that the spatial agglomeration of a country's economic activity is a key determinant of that country's economic development pattern (Puga and Venables, 1999:292). Despite this interest in spatial inequality in developing countries, relatively little attention has been focused on trade, and specifically exports, as a determinant of spatial inequality in developing countries. This lack of attention to exports and spatial development is in contrast with some recent work in the growing field of new economic geography (NEG) where the theoretical basis for the relationship between exports and spatial development has been put forward (see e.g. Venables, 2005) and where a small, but growing, literature provides empirical evidence, albeit from developed regions such as the EU, on the role of exports in regional growth and on the determinants of regional exports (see e.g. Nicolini, 2003).

The relative lack of research on the role and determinants of exports in spatial development in developing countries is also in contrast to the rich literature on the general (cross-country) relationship between exports and growth which supports policy reforms aimed at trade liberalisation and the strengthening of a country's export performance as a means of boosting growth and development. Foster (2006:1058-1061) contains a recent summary of the literature on exports and growth and discusses the reasons why exports are good for growth[1] (none which, however, refers to the potential impact on spatial inequality). A number of notable studies find empirical evidence that exports are good for growth, such as Edwards (1997), Sala-i-Martin (1997), Sachs and Warner (1997), Elbadawi (1998) and others.

It is therefore a surprising omission in this literature that the potential role of exports in spatial inequality has not been studied in greater detail. Two possible explanations might be that, first, an appropriate theoretical basis has been lacking before the development of models with the NEG framework that could handle issues such as imperfect competition and transport costs[2] and, second, that sub-national (spatial) data on exports are generally difficult to come by in a developing country.

The contribution of this paper is to provide empirical evidence on the relationship between exports and spatial inequality in a developing country context. In particular, the authors builds on earlier work on the determinants of the location of export-oriented manufacturing firms in a developing country (Matthee and Naudé, 2007) and focus on the potential importance of export diversity (variety) for spatial economic growth and development. In this respect the paper will also contribute to the small recent literature that recognises that it is not only important how much is exported, but that it is also important what it is that is exported. For instance Hausmann, Hwang and Rodrik

[1]The benefits of exports are argued to come from (a) knowledge spillovers and knowledge diffusion, (b) the greater scope for economies of scale, (c) greater competition and efficiency and (d) the loosening of a country's foreign exchange constraint.

[2]In traditional explanations of trade patterns of trade between countries and regions depend on natural resources, skills and factors of production. It is assumed that trade takes place in a perfectly competitive and frictionless (pinpoint) world without transport costs.

(2005:2) point out that "*not all goods are alike in terms of their consequences for economic performance. Specializing in some products will bring higher growth than specializing in others*". Using export data from 19 sectors within 354 magisterial districts of South Africa, various methods are employed to measure the 'diversity' of exports from a particular region, including the recently proposed EXPY and PRODY measures proposed by Hausman *et al.* (2005). This is the first time, as far as the authors are aware, that these latter measures have been used to inform spatial growth issues.

The paper is structured as follows. In section provides the modelling approach. In section 2.1, a brief overview is provided of the literature on spatial development and export diversity, emphasising the importance of the diversity or composition of exports for spatial growth. Section 2.2 contains the hypothesis and the growth model. Section 3 explains the empirical investigation. Subsection 3.1 discusses the various measures of export diversity, and subsection 3.2 describes the data that will be used. Subsection 3.3 contains the results. It first describes the current patterns of export and export diversity from South Africa's various regions. Second, subsection 3.3 describes the relationship between export diversity and transport costs (distance) given that transport costs will influence the location of export firms (as set out in the NEG). Thereafter, subsection 3.3 presents regression results on the relationship between regional growth and export diversity, where the different measures of export diversity are used as explanatory variables in a Barro-type growth regression. The paper concludes with a summary and recommendations for further research.

2 Modelling Approach

This section explains the regional growth, and subsequently spatial inequalities, through the theory of new economic geography. It further links growth with export diversity by describing the various dimensions of export diversity. The section concludes with a theoretical model of the relationship between growth and export diversification, as well as the hypothesis to be tested. Lastly, an application to developing countries is provided.

2.1 Theoretical Background

2.1.1 Regional Growth

In traditional trade theories, spatial economic differences are ascribed to differences in factor endowments, technologies and policy regimes. These theories, however, fail to explain why similar regions have different economic activities and subsequently different economic growth rates (Ottaviano and Puga, 1997). The theory of new economic geography fills the gap left by traditional trade theories, as it describes the formation of economic agglomeration in geographical space (Fujita and Krugman, 2004). The rationale behind regional economic imparity is that agglomeration creates growth and certain regions experience forces that encourage agglomeration and others experience forces that achieve the opposite (Armstrong and Taylor, 2000; Fujita and Krugman, 2004). Centripetal forces include market-size effects, thick labour markets and pure external economies (such as knowledge spillovers). Centrifugal forces, on the other hand, include immobile factors of production, land rents and pure external diseconomies (such as

congestion) (Krugman, 1998; Fujita, Krugman and Venables, 2001; Fujita and Krugman, 2004).

Agglomeration is not, however, only influenced by these forces. Transport costs also play a major role in the formation of spatial balances and regional growth in that they affect the development of agglomeration or cause dispersion of economic activities (Lopes, 2003). If transport costs were high, trade between regions would not take place, as it is too costly - exports and imports are so expensive that only home production is possible. Production will be spread out to be close to where demand is. If transport costs were low, there would also be no trade or agglomeration since the regions would be *ex ante* identical and neither would have the forces, such as a thick labour market or inter-industry linkages, which create the propensity for agglomeration. Thus, it is in an intermediate range that transport costs matter for trade and agglomeration. Below this threshold level of transport costs, manufacturers choose the location with large local demand. Local demand will be larger where the majority of manufacturers choose to locate. The result is agglomeration at the core and trade with the periphery (Krugman, 1991; Brakman Garretsen and Van Marrewijk 2001; Fujita *et al.*, 2001).

Economies of scale create agglomeration, which in turn leads to growth. The activities in an agglomerated setting generate externalities or spillovers. The externalities or spillovers depend on whether one considers localisation economies or urbanisation economies (Brakman *et al.*, 2001). The former is described as a 'geographical concentration of the same or similar industries that form an agglomeration' (Economic Geography Glossary, 2006). Externalities created here result from specialisation of economic activity, which is advocated by the Marshall-Arrow-Romer theory as well as by Porter (1990). Glaeser, Kallal, Scheinkman and Schleifer (1992) describe these spillovers as knowledge that is transferred between firms in the same industry. Once an industry shares knowledge in specialisation, innovation and growth occur at a faster rate. Lall, Koo and Chakravorty (2003) add that, in addition to knowledge being shared, firms also share sector-specific inputs, skilled labour and technologies which enhance the productivity levels of all firms in that industry. Examples of empirical work on the specialisation of economic activity include Duranton and Puga (1999), Midelfart-Knarvik, Overman, Redding and Venables (2000) and Mukkala (2004).

Urbanisation economies, on the other hand, describe benefits or spillovers due to the agglomeration of different economic activities (Economic Geography Glossary, 2006). Jacobs (1969) states that knowledge spillovers have a larger impact on local growth, provided that knowledge is shared between firms of different industries. Lall *et al.* (2003) describe that firms in a diverse area have access to a wide range of services that support their business. Once a variety of output is produced, it leads to external economies of scale for both producers and consumers (Rivera-Batiz, 1988). Bostik, Gans and Stern (1997) conclude that urbanisation is positively related to regional economic growth. Examples of empirical work on the diversification of economic activity include Glaeser *et al.* (1992), Harrison, Kelly and Grant (1996) and Kelley and Helper (1999). Duranton and Puga (2001) observe that diversified agglomerated areas, or so-called 'nursery cities', promote the development of new products, especially in the early stages of the product life-cycle. They find, however, that specialisation alongside diversification is important in the efficient functioning of an economic system. For developing countries diversity in economic activity has a stronger impact on regional growth, as they have abundant labour but low skill levels and wages (Lall *et al.*, 2003).

2.1.2 Export Diversity and Regional Growth

The previous section summarised regional growth through the theory of new economic geography where an agglomeration of diversified economic activities creates externalities that leads to growth. Not all regions, however, have centripetal forces and spatial inequalities occur. This paper, however, contemplates how the economic activity in the shape of diversified exports creates growth.

Dennis and Shepherd (2007) define export diversification as widening the range of products that a country exports. Why is it beneficial for a country to diversify exports? According to Ali, Alwang and Siegel (1991), a broad export base lowers instability. Dependency on a few sectors may hamper growth if they experience fluctuations in, say, demand or prices (Al-Marhubi, 2000). If a wider range of sectors contribute to exports, then export earnings remain constant. Those products whose prices decrease are offset by those products that experience prices increases. Also, products with declining prices can be replaced with those that have a positive growth trend (Ali *et al.*, 1991). Furthermore, if there are only a small number of export-oriented industries, and they become unstable, then investment in them may be withdrawn and this negatively affects growth (Dawe, 1996).

The concept of export diversification seems to contradict trade theory, especially Ricardo's theory of comparative advantage where a country should specialise (Salvatore, 1998). Ali *et al.* (1991) argue that specialisation in a narrow group of exports can lead to export instability if, for instance, demand for those products decrease. The stability that diversification brings, is perhaps achieved at the expense of the benefits of effective resource allocation associated with specialisation (Ali *et al.*, 1991).

Export diversification has different dimensions and can be analysed at different levels (Ali *et al.*, 1991). Herzer and Nowak-Lehnmann (2006) explain that export diversification can occur either horizontally or vertically. Horizontal export diversification implies that the number of export sectors has increased. This reduces the dependency on a few sectors to lead export-oriented growth. Horizontal diversification brings forth stabilisation in export earnings (Al-Marhubi, 2000). If growth is to be achieved though horizontal export diversification, a country can either enlarge the share of products with increasing growth rates in export earnings, or it can add new products based on the growth rates of world prices (Ali *et al.*, 1991).

Vertical diversification occurs when the composition of exports shift from primary products to manufactured products. The production of primary exports does not result in as many spillovers as the production of manufactured exports. In the latter, externalities on, for example, knowledge and new technologies are created. These externalities benefit other economic activities (possibly creating horizontal diversification) and improve the ability of all industries to compete internationally (Chuang, 1998; Al-Marhubi, 2000; Herzer and Nowak-Lehnmann, 2006). Vertical export diversification also contributes to stabilisation in export earnings, as the prices of manufactured exports do not fluctuate as much as those of primary exports (Ali *et al.*, 1991). If growth is to be achieved though vertical export diversification, a country can either introduce or expand value-added activities, or it can choose new products based on their value-added potential (Ali *et al.*, 1991).

Hausmann *et al.* (2005) conclude that the composition of a country's exports matter, as countries that produce higher productivity goods experience greater export performance and are subsequently able to benefit more from the gains of globalisation.

2.2 Growth Model

The economic growth of developing countries has been a much discussed topic in recent years. The topic of export growth in these countries been discussed even more (De Piñeres and Ferrantino, 1997). It has been shown that there is a positive link between economic growth and export diversification (or export variety) (Al-Marhubi, 2000; Funke and Ruhwedel, 2005). The pattern of economic development led by export-oriented growth has, in the face of globalisation, experienced restructuring in terms of the composition of exports. For example, there has been a declining trend in the terms of trade in primary products (Athukorola, 2000). Those developing countries that were able to diversify their exports experienced accelerated growth (De Piñeres and Ferrantino, 1997; Herzer and Nowak-Lehnmann, 2006). Feenstra and Kee (2005) find that a 10 per cent increase in export variety of a country's industries raises the productivity level of that country by 1.3 per cent.

Based on the notion that exports are good for economic growth (through the channels mentioned in the introduction - see footnote 1), a large number of countries have liberalised trade and embarked on outward-oriented development strategies. Whilst the literature has extensively studied the linkages and causality between exports and growth, and noted the various idiosyncrasies in country approaches and experiences (and identified the controversies that remain) (Foster, 2006), the literature is less clear on the impact of trade on spatial inequality. On the one hand, the basic core-periphery model of the NEG predicts that generally, more open economies will have less spatial inequality (Ades and Glaeser, 1995; Krugman and Livas, 1996; Venables, 2005). This is because, in a more open economy with firms being able to export more, local firms become less reliant on the local market with a subsequent reduction in the forces of agglomeration.

On the other hand, it is feared that not all regions will share equally from the gains from increasing exports and that geography (locational factors) might determine the export propensity of firms (see Osborne, 1997; Overman *et al.*, 2001; Roper and Love, 2001; Traistaru, Iara and Paura, 2002:2). More pertinently, research on sub-national convergence in per capita incomes has failed so far to find significant evidence of convergence between regions, with one of the world's most successful export-led growth cases, that of China, being characterised by increasing spatial inequality (Kanbur and Zhang, 2005). In Mexico, regional income convergence 'broke down' after the country joined NAFTA (North American Free Trade Agreement), with states endowed with higher levels of human and physical capital and better infrastructure growing faster than those without after joining NAFTA (Chiquiar, 2005:257). Also, in a developing country such as South Africa, which has been liberalising its trade since 1994 with substantial export success, little evidence exist of significant convergence in per capita incomes between the country's regions (Naudé and Krugell, 2003; 2006).

As discussed earlier, unequal spatial development exist in most countries. The reason for the inequality may be attributed to different economic activities and growth patterns in a country's regions. Export diversification contributes to growth in a country (Herzer and Nowak-Lehnmann, 2006) and many studies have proven so on a country level. The link, however, between regional growth (and inequality) and export diversity has not yet been made. Therefore, can spatial inequalities be attributed to the composition of a region's exports?

To determine the relationship between growth and regional export diversification is stated in the following equation, which is a modified version of that used by Al-Marhubi (2000):

$$\Delta Y_i = \alpha + X\beta + Z\gamma + \varepsilon_i \quad (1)$$

where ΔY is the mean growth rate of output for region *i*, X is a matrix of standard control variables for cross-region growth equations, Z is a matrix of the variable(s) of interest, and ε_i represents region-specific error terms (Al-Marhubi, 2000).

The above cited literature has focused on the relationship between a country's aggregate exports and spatial development and, as such, does not provide for a wholly satisfactory direct test of the different hypotheses. To do so, one would ideally require disaggregated data on exports to determine whether greater (or lesser) spatial inequality is associated with changes in the exports (such as in level and/or composition) from different sub-national regions.

3 Empirical Investigation

In the previous section, it is indicated that the current literature tends to expose the importance of exports for growth, and that greater openness ought to lead to less spatial inequality within a country. However, in practice greater export growth has not generally been accompanied by less spatial inequality. This might imply that different sub-national regions have different characteristics which determine their ability to export. Moreover, it is being recognised that what a sub-national region exports may matter. In this regard, analyses on country levels tend to be in agreement that export diversity and diversification may be important for economic growth. In this section data from South African sub-national regions are used to test whether such a relationship might hold. If so, it might explain why spatial inequality tends to persist despite the fact that the country's overall growth in exports has been significant since the late 1990s.

In this section therefore (subsection 3.3) the regression results on the relationship between various measures of export diversity and economic growth across 354 sub-national regions (magisterial districts) in South Africa is reported. First, however, in subsection 3.1, the various measures of export diversity used, including the recently proposed PRODY and EXPY measures of Hausmann *et al.* (2005) is explained. Thereafter, in section 3.2, the data used is discussed, before setting out the results.

3.1 Measures of Export Diversity

The export diversity of the various regions is measured using four types of indices. The first diversity index is the Herfindahl-index which examines trends in export revenue or specialisation of the regions. Petersson (2005) defines this measure of specialisation as follows:

$$SPEC_{jt} = \sum_i \left(\frac{E_{jit}}{\sum_j E_{jit}}\right)^2 \quad (2)$$

where E_{ijt} represents the exports of a region *j* of a particular industry (or export sector) *i* in a given year *t*. An index value approaching 1 indicates a high degree of export concentration (or specialisation), whereas a value approaching 0 signifies a high degree of export diversification (Petersson, 2005). This index is numbered (1) in the regression results.

The second diversification index was developed by Al-Marhubi (2000). This measure is the absolute deviation of the region's share of the country's total exports. Al-Marhubi (2000) calculates this measure as follows:

$$S_{jt} = \frac{\sum_i \left|h_{ijt}\right| - \left|h_{it}\right|}{2} \tag{3}$$

where h_{ijt} is the share of industry *i* in total exports of region *j* and h_{it} is the share of industry *i* in total country exports in a given year *t*. Again this measure ranges from 0 to 1 where 1 represents total concentration and 0 total diversification (Al-Marhubi, 2000). This index is numbered (2) in the regression results.

The third measure is the normalised-Hirschmann index, which is a concentration index. This index also provides values between 0 and 1. According to Al-Marhubi (2000) and Naqvi and Morimune (2005), the normalised-Hirschmann index for a region is defined by the following formula:

$$H_{jt} = \frac{\sqrt{\sum_{i=1}^{n}\left(\frac{x_{it}}{X_{jt}}\right)^2} - \sqrt{\frac{1}{n}}}{1 - \sqrt{\frac{1}{n}}} \tag{4}$$

where x_{it} is the value of exports of industry *i* located in region *j* and X_{jt} is the total exports of region *j* in a given year *t*. The number of industries is indicated by *n*. An index value nearer to 1 indicates extreme concentration. Likewise, a value closer to 0 signifies a more diverse combination of exports (Al-Marhubi, 2000; Naqvi & Morimune, 2005). This index is numbered (3) in the regression results.

The fourth measure is an index that ranks exports in terms of their implied productivity: In other words, it shows the quality of the exports (what a region exports, matters). Hausmann *et al.* (2005) developed a formula to generate an income/productivity level for each industry or export sector. This level (called PRODY) reflects the weighted average of the per capita GDP of the regions that host the exporting industries. Using this level, a measure (called EXPY) can be calculated for the productivity level associated with a country's specialisation pattern. EXPY reflects the income/productivity level that corresponds to a region's export basket (this is done by calculating the export-weighted average of the PRODY for that region) (Hausmann *et al.*, 2005). Hausmann *et al.* (2005) define PRODY as follows:

$$PRODY_{it} = \sum_j \frac{x_{jit} / X_{jt}}{\sum_j \left(x_{jit} / X_{jt} \right)} Y_{jt} \quad (5)$$

where x_{jit} / X_{jt} is the share of industry *i*'s exports located in region *j* in the region's overall export basket in a given year *t*. Y_{jt} is the real per capital GDP of region *j* in year *t*. EXPY in turn is calculated as:

$$EXPY_{jt} = \sum_i \left(\frac{x_{jit}}{X_{jt}} \right) PRODY_i \quad (6)$$

3.2 Data

Data on sub-national exports from 19 industries were obtained from South African Revenue Services (Department of Customs and Excise) for the period 1996. Other sub-national data corresponding to the 354 magisterial districts in South Africa, such as data on openness (openness is calculated as the share of total exports to nominal GDP), contribution of manufacturing exports to total exports, population growth, real GDP growth, real GDP per capita and human capital were obtained from Global Insight Southern Africa's Regional Economic Explorer, which is based on a number of official Statistics South Africa sources (Global Insight Southern Africa, 2006; Regional Economic Focus Database, 2006). Human capital is proxied by education levels higher than grade 12, following Fedderke (2001) and also by the education levels higher than grade 12 in 1996 (following Al-Mahrubi, 2000).

The distance variable used in this study is the actual distance (in kilometres) between the magisterial districts and the major export hubs in South Africa. The export hubs are: City Deep (a dry port for containers situated in Gauteng), Durban harbour (in KwaZulu-Natal), Port Elizabeth harbour (in the Eastern Cape) and Cape Town harbour (situated in the Western Cape). The reason for including only these ports is that that majority of exports move through them as they are equipped to handle containers and higher value products. These hubs are also situated on one or more of the three main freight corridors namely Gauteng to Durban, Gauteng to Cape Town and Gauteng to Port Elizabeth. Around 62 per cent of all imports and exports are moved through one or more of these corridors (DoT, 2005). In terms of the data, the shortest distance from each magisterial district to one of these hubs was chosen as the distance variable, as it is assumed that exporters strive to minimise their transport costs. The internet service Shell Geostar (www.shellgeostar.co.za) was used to obtain these distances. Shell Geostar is a mapping service that provides detailed maps and distances between any two locations in South Africa.

3.3 Results

A brief discussion on South Africa's spatial inequality is warranted, as it explains the type of geography that this paper refers to. The spatial distribution of South Africa's inland economic activity was caused by the discovery of diamonds in Kimberley in 1867 and the

discovery of gold in the Witwatersrand in 1886 (its first nature geography). Johannesburg and the surrounding areas subsequently experienced rapid urbanisation. The role of ports became important as they handled exports of diamonds and gold. During the decades that followed, several factors led to changes in the political situation that caused the exclusion of South Africa from the international community. This was the result of Apartheid (Naudé *et al.*, 2000; Naudé and Krugell, 2005).

Apartheid was a territorial, social and political segregation between different race groups (Naudé *et al.*, 2000). While economic activity during the 19th century was clustered, the Apartheid era had the opposite effect by causing unequal development of economic activity through various policies. Inefficient land use, high transport costs, and under-investment in transport infrastructure, telecommunications and electric power fuelled this inequality (Naudé and Krugell, 2005).

The economy continued to deteriorate under Apartheid until the 1990s when liberalisation began to take place, which led to the lifting of sanctions against South Africa. This transition from a closed to an open economy again changed the spatial structure of economic activity within South Africa (Naudé *et al.*, 2000). South African industries were now exposed to international competition. Subsequently, industries that could not cope with increased levels of competition closed down (for example, the textile industries in the Western Cape). Other industries that were able to move into new markets thrived (for example, the motor industry in the Eastern Cape) (Naudé *et al.*, 2000).

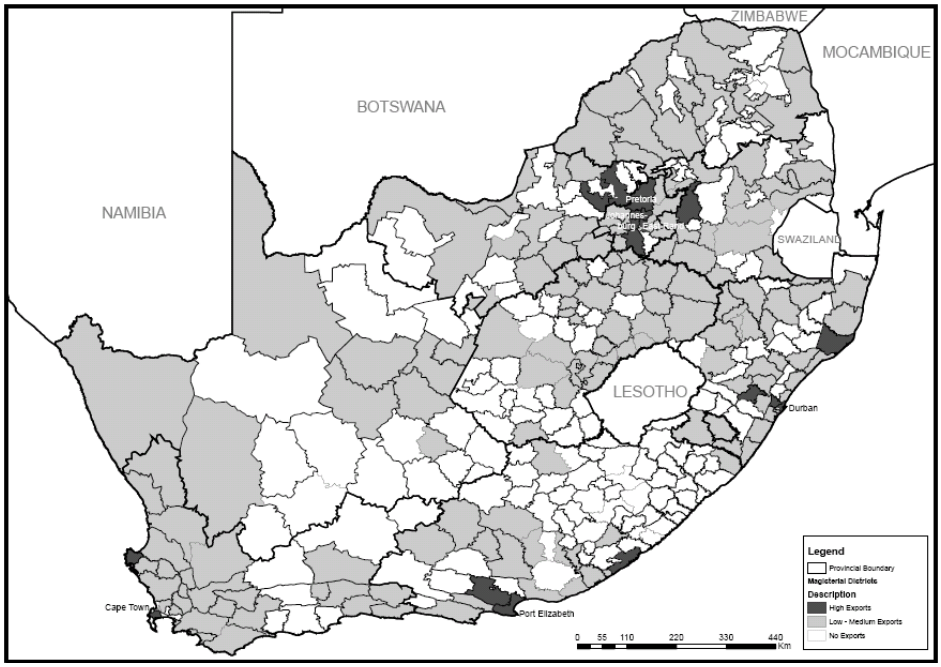
The current situation is that South Africa's spatial distribution of economic activity is still highly skewed. Around 70 per cent of the country's GDP is produced in only 19 of the urban areas (Naudé and Krugell, 2005). Around 22 of the 354 magisterial districts produced 84 per cent of the total manufacturing exports in 2002. South Africa's skew spatial distribution is clearly evident here, as Gauteng (Johannesburg, Randburg, Boksburg, Germiston and Kempton Park) produce 33 per cent of that percentage. The other large agglomerations that export manufactures are Durban-Pietermaritzburg (11 per cent), Pretoria-Brits (8 per cent) and Cape Town-Bellville (6 per cent) (Naudé and Gries, 2004; Naudé and Krugell, 2005). Economic activity is also skewed in the sense that the cities located near ports are smaller than those situated inland (Krugell, 2005).

Therefore, the large inland agglomerations (or the second nature geography) are a result of the location of South Africa's first nature geography. Spatial inequality exists because the second nature geography did not develop equally throughout the country.

3.3.1 Export diversity in South Africa

This section provides a descriptive overview of export diversity in South Africa. Firstly, how much is exported in South African by its regions? Figure 1 provides an illustration of the 354 magisterial districts (which comprise the 9 provinces) in South Africa. The shaded districts in figure 1 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 grey between 0.1 per cent and 0.99 per cent. The determinants of these sub-national exports are analysed in Matthee and Naudé (2007).

Figure 1: Exports per magisterial district

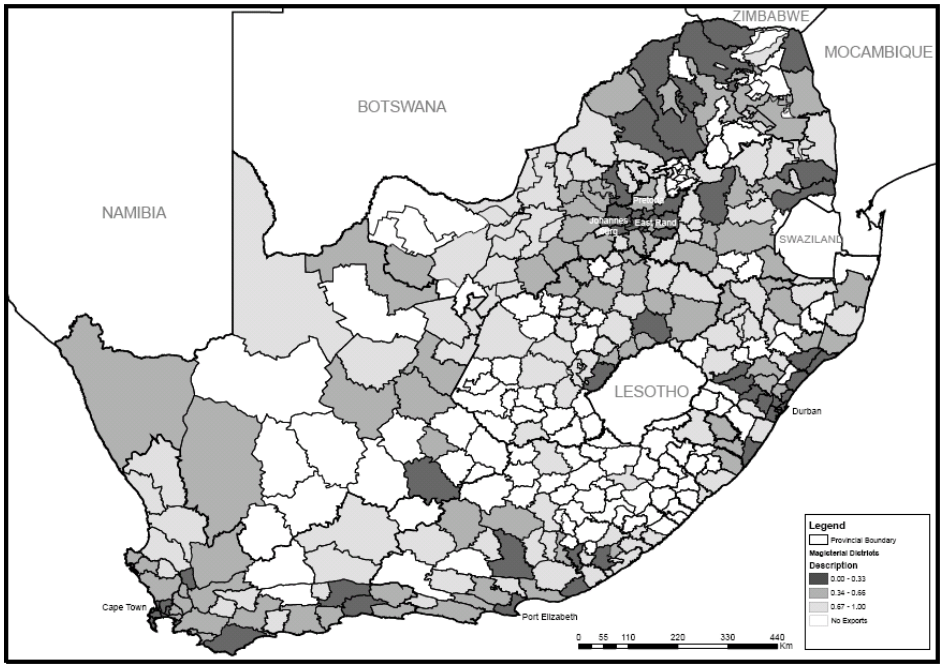


Source: Authors' own calculations (MAP drawn by GISCOE)

Second, what is being exported in terms of diversity? Figure 2 illustrates the regions' diversity of exports as calculated by the Herfindahl-index in 2004. Here total exports are taken into account. The shaded areas reveal whether a region's exports are diversified or concentrated. The black magisterial districts' Herfindahl-index is nearer to 0, which indicates diversity. The light grey districts' index value is closer to 1 (i.e. exports are more specialised). The white areas do not export and therefore do not have an index value.

The magisterial districts with an index value greater than 0.90 in 2004 experienced an average annual real GDP per capita growth rate below the average for all exporting magisterial districts in 2004. Moreover, these districts contributed only 1.29 per cent of total exports in 2004. For the magisterial districts with an index value of below 0.20, the opposite is true. Their average annual GDP per capital growth rate is above average (for all exporting magisterial districts in 2004). The contribution made to total exports in 2004 is 32.9 per cent. The calculation of the normalised-Hirschmann index requires the number of export producing sectors of each region. On average (in 2004), the more diversified districts produce exports in 17 of the 19 sectors, whereas the more concentrated districts produce exports only in 3 sectors (with little or no exports in the manufacturing sector).

Figure 2: Export diversity or concentration



Source: Authors' own calculations (MAP drawn by GISCOE)

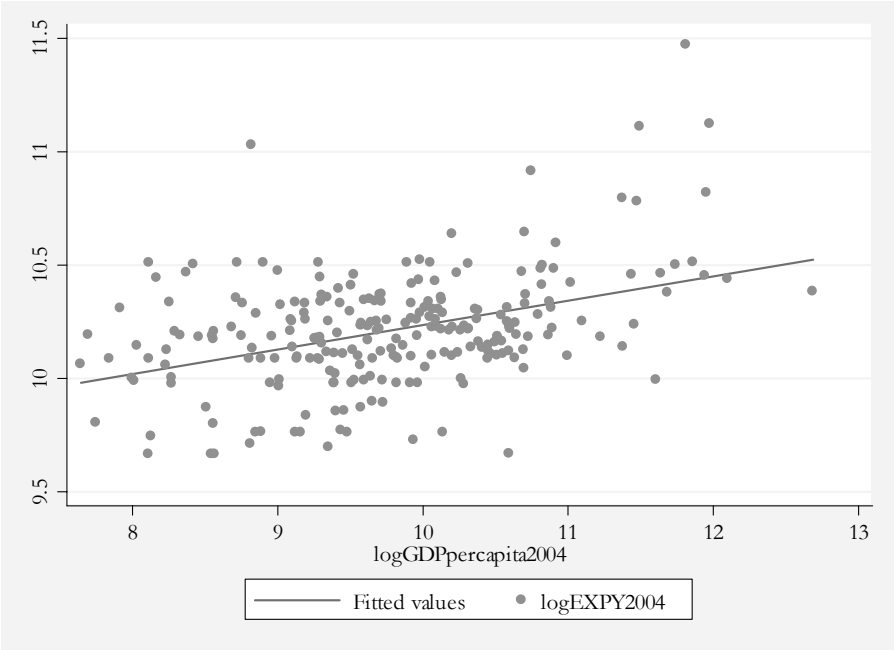
The type of sector in which a region produces also matters. As explained above, Hausmann *et al.* (2005) construct an index (PRODY) that represents the income level associated with that sector. This index is basically the weighted average of per capita GDP of all regions producing in that export sector. Table 1 provides the PRODY values for each of 19 export sectors in South Africa, as well as the increase in the income level in the sectors over the period 1996 to 2004. In contrast to the findings of Hausmann *et al.* (2005), the sectors with low PRODY values are not in the primary sector. The forestry and logging sector (classified in the primary sector), wood and wood products sector as well as the furniture sector (classified in the manufacturing sector) have the lowest increase in PRODY values. The sectors with the highest increase in PRODY values are electrical machinery and apparatus and electronic, sound/vision and other appliances. Production in these two sectors mainly takes place in one of the metropolitan areas. This makes sense, as these regions tend to have higher per capita GDPs than the rural regions.

Table 1: PRODY values of each export sector

Export Sector	**1996**	**2004**	**% increase**
Agriculture and hunting	12303	23797	8
Forestry and logging	18413	22853	2
Fishing, operation of fish farms	24440	54552	9
Mining of coal and lignite	26410	69789	11
Mining of gold and uranium ore	56312	134779	10
Mining of metal ores	27027	71823	11
Other mining and quarrying	12390	28555	10
Food, beverages and leather goods	15450	27588	7
Wood and wood products	14071	16842	2
Textiles, clothing and leather goods	9621	15198	5
Fuel, petroleum, chemical and rubber products	19955	37046	7
Other non-metallic mineral products	14828	29150	8
Metal products, machinery and household appliances	18359	30727	6
Electrical machinery and apparatus	10797	37276	15
Electronic, sound/vision, medical and other appliances	17851	69432	16
Transport equipment	14217	26189	7
Furniture and other items NEC and recycling	15294	21264	4
Electricity, gas, steam and hot water supply	35217	84427	10
Other unclassified good	15651	27949	7

Hausmann *et al.* (2005) develop the productivity level further to determine the productivity level associated with a region's export basket (EXPY). Figure 3 illustrates the relationship between the fitted values of EXPY in 2004 and the real GDP per capita in that year.

Figure 3: Fitted values of EXPY in 2004



There appears to be a positive relationship between these two variables (a piecewise correlation indicates correlation at the 5 per cent significance level). According to Hausmann *et al.* (2005), such a correlation indicates that rich (poor) regions export products that tend to be exported by other rich (poor) regions.

3.3.2 Export Diversity and Transport Costs

Transport costs are increasingly recognised as having important and significant impacts on trade patterns and globalised production (Hoffmann, 2002). Referring to the role of transport and transport infrastructure in theories of regional development and the NEG, Bruisma *et al.* (2000:260) remark that "*In this long theoretical debate transport infrastructure has always played a - more or less - eminent significant role*". Limão and Venables (2001) state that transport and other costs of conducting business on an international level are key determinants of a country's ability to participate fully in the world economy, and especially to grow exports. Porto (2005) finds that for low-income countries, transport costs are amongst the most important of trade barriers. Empirical studies support theoretical views by providing the relevant evidence of the significance of transport costs for trade. The general consensus is that international transport costs negatively affect a country's trade volumes. Evidence from Limão and Venables (2001) indicate that if transport costs increased by 10 per cent, trade volume would be reduced by 20 per cent. For developing countries, this effect is much more severe, as they tend to be landlocked. Landlocked countries' transport costs are higher (approximately 50 per cent) and have lower trade volumes (around 60 per cent) than coastal countries (Radelet and Sachs, 1998; Limão and Venables, 2001). On the matter of domestic transport costs, Elbadawi, Mengistae and Zeufack (2001) find that domestic transport costs act as an even stronger constraint on exports than international transport costs. Exporting regions' growth is more constrained, as domestic transport costs affect the competitiveness of their exports.

As the focus here is on export diversity, and empirical evidence shows that domestic transport costs matter, one needs to establish the impact of these costs on the

level of a region's export diversity. Matthee, Naudé and Krugell (2006) use cubic-spline density functions to determine the significance of domestic transport costs for the spatial location of manufactured exporters. They find that the proximity to a port is an important consideration in most export-oriented manufacturing firms' location decisions. The issue here is whether or not domestic transport costs are important for export diversity. Dennis and Shepherd (2007) find that international transport costs impact negatively on export diversification of developing countries. When examining domestic transport costs, cubic-spline density functions are used to determine the relationship between domestic transport costs (proxied by distance to the nearest export hub) and the Herfindahl-index. 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). Zheng (1991) formulates the cubic-spline density function as:

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

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

$Y_i = 0$ otherwise. (7)

Figure 4 provides the relationship between distance and the Herfindahl-index values for 2004. It appears that those magisterial districts with a diverse range of exports are located within around 100 km from the nearest export hub. Those with high Herfindahl-index values are located further at 400 km. The outliers on the right-hand side of the graph specialises in agriculture, with the exceptions of Prieska (whose production lies in food processing), Namaqualand (in metal products) and Hay (in furniture).

Figure 4: Cubic-spline density function for Herfindahl--ndex values in 2004

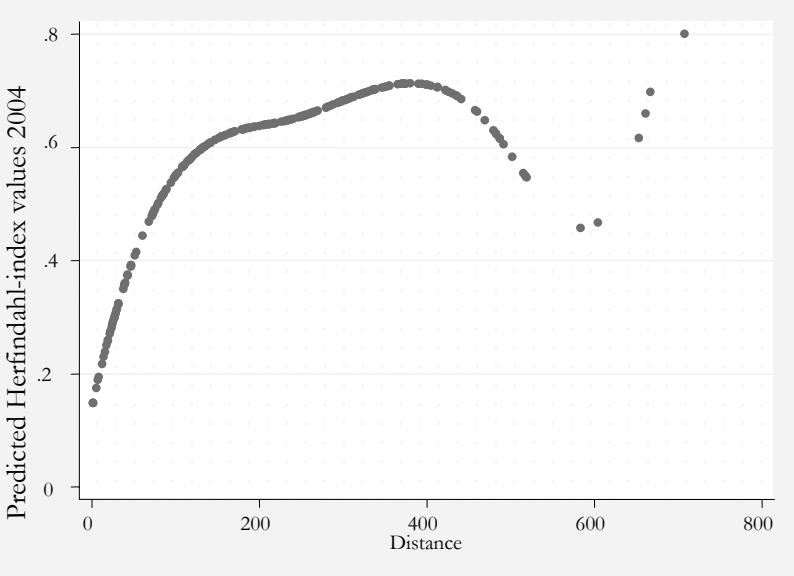
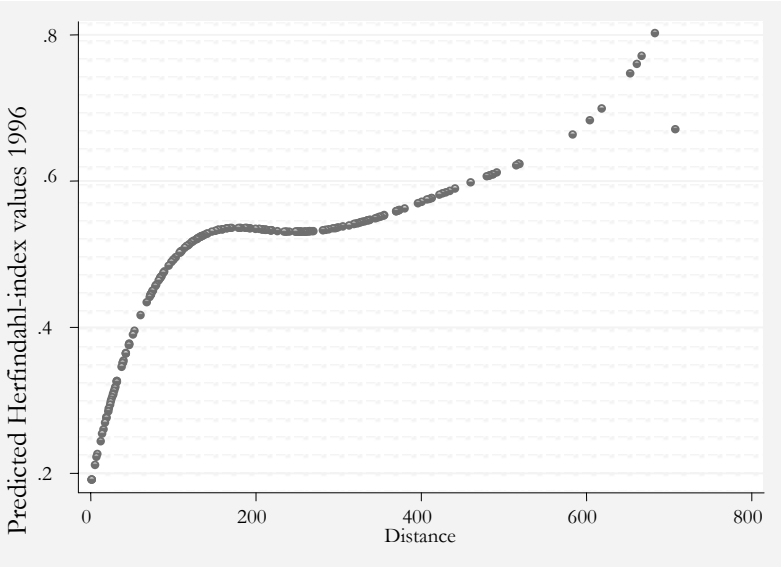


Figure 5 provides the same relationship, only with those magisterial districts that had positive exports in 1996. Here it seems that the magisterial districts between 200 and 400 km were more diversified in 1996 than in 2004. The same outliers appear on the right-hand side, with less focus on agriculture. Fewer magisterial districts produced exports in 1996 than in 2004.

Figure 5: Cubic-spline density function for Herfindahl-index values in 1996



3.3.3 Export Diversity and Growth: Regression Results

Before the regression results are illustrated and explained, a detailed explanation of the growth variables is provided (the regressions run were only for the magisterial districts that had positive exports during the period 1996 to 2004). The dependent variable is the average annual growth rate of real GDP over the period 1996 to 2004. Human capital is proxied in two manners. The first proxy is the average value (between 1996 and 2004) of the proportion of population with an education level higher than grade 12. The second proxy is the proportion of population with an education level higher than grade 12 in 1996. Openness is the average share of total exports to nominal GDP of 1996 and 2004. The contribution of manufacturing exports is the average share of manufacturing exports to total exports of 1996 and 2004. Population growth is the average annual growth rate of the population over the period 1996 to 2004. The logarithm of the level of real GDP per capita in 1996 is used as the initial GDP per capita. Distance is as described in section 3.2. The indices (see section 3.1) are reported as the average value taken between 1996 and 2004.

Al-Marhubi (2000) includes both export structure (share of manufactured exports in total exports) and openness in his list of growth variables. Export structure is included to avoid export diversification from picking up the growth effects associated with the export structure, terms of trade changes and export instability. The reason is that the terms of trade changes and export instability are a consequence of the export structure. In our data, the share of manufactured exports in total exports and openness is highly correlated (the correlation is 0.8011, which indicates multicollinearity as it is higher than

the cut-off value of 0.80). This indicates that they cannot be included in the same model (the other variables were not highly correlated with one another). Models 1 and 2 use the variable average human capital (1996-2004) (see table 2) and models 3 and 4 use initial human capital (i.e. human capital of 1996) (see table 3). In the first and third model none of the variables are significant. In the second and fourth models, only share of manufactured exports in total exports is significant (it has a negative sign). If each of the variables is individually regressed with real GDP growth, openness, share of manufactured exports in total exports and initial human capital are significant.

Table 2: OLS regression results without the indices (using average human capital) (dependent variable real GDP growth, 1996-2004)

Model	**Model 1**		**Model 2**	
Variable	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**
Openness	-0.73	0.47 (0.126)		
Share of manufactured exports in total			-0.01	0.00 (-3.68)***
Log initial GDP	0.02	0.08 (0.832)	0.07	0.06 (1.22)
Average human capital	0.18	0.02 (0.337)	0.01	0.12 (0.74)
Distance	-0.00	0.00 (0.424)	-0.00	0.00 (-1.21)
Population growth	0.05	0.13 (0.705)	0.12	0.11 (1.12)
Constant	0.79	0.69 (0.251)	0.56	0.54 (1.03)

t-ratios in brackets

**** significant at the 1% level ** at the 5% level * at the 10% level*

Table 3: OLS regression results without the indices (using initial human capital) (dependent variable real GDP growth, 1996-2004)

Model	**Model 3**		**Model 4**	
Variable	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**
Openness	-0.64	0.46 (-1.39)		
Share of manufactured exports in total			-0.01	0.00 (-3.96)***
Log initial GDP	0.06	0.07 (0.81)	0.10	0.05 (1.87)
Initial human capital	0.02	0.12 (1.59)	0.02	0.01 (1.56)
Distance	-0.00	0.00 (-0.76)	-0.00	0.00 (-1.17)
Population growth	0.05	0.13 (0.36)	0.12	0.11 (1.09)
Constant	0.37	0.70 (0.53)	0.22	0.61 (0.36)

t-ratios in brackets

**** significant at the 1% level ** at the 5% level * at the 10% level*

A correlation matrix showed that the three export diversity indexes are highly correlated (more than the cut-off value of 0.80) with openness (correlation of 0.83 with index 1, 0.85 with index 2 and 0.83 with index 3) and share of manufactured exports in total exports (correlation of 0.95 with all three indices). Therefore, both these variables were omitted in the regressions. Model 1 uses the variable average human capital (see table 4) and model 2 uses initial human capital (i.e. human capital of 1996) (see table 5).

Table 4: OLS regression results with the indices (using average human capital) (dependent variable real GDP growth, 1996-2004)

Model 1	**Index (1)**		**Index (2)**		**Index (3)**	
Variable	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**
Index	-0.62	0.14 (-4.42)***	-0.46	0.11 (-4.16)***	-0.71	0.16 (-4.40)***
Log initial GDP	0.09	0.06 (1.62)	0.08	0.06 (1.41)	0.08	0.06 (1.50)
Average human capital	0.02	0.02 (0.91)	0.02	0.02 (0.91)	0.02	0.02 (0.92)
Distance	-0.00	0.00 (-1.22)	-0.00	0.00 (-1.10)	-0.00	0.00 (-1.23)
Population growth	0.13	0.10 (1.29)	0.13	0.10 (1.28)	0.12	0.10 (1.27)
Constant	0.41	0.53 (0.77)	0.41	0.54 (0.77)	0.47	0.51 (0.92)

t-ratios in brackets

**** significant at the 1% level ** at the 5% level * at the 10% level*

Table 4 reports the results of the various regressions run with the three indices. The indices are significant at the 1 per cent level. None of the other variables are significant. This may be that the manner in which the indices are constructed encompasses the effects of say, human capital and population growth. In table 5 (using initial human capital), the indices are again significant at the 1 per cent level. The only other significant variable is initial GDP (it is significant at the 10 per cent level). Distance, although negative, is not significant.

The negative signs of the index coefficients in tables 4 and 5 are similar to Al-Marhubi's (2000) results. The negativity implies that, with other given factors, larger export diversification and lower concentration or specialisation contributes to real GDP growth. Therefore it matters what a magisterial district exports. The results in the above models illustrate that export diversity is significantly associated with real GDP growth, with all the indices significant at the 1 per cent level. However, which type of diversity, either horizontal or vertical, also matters.

Table 5: OLS regression results with the indices (using initial human capital) (dependent variable real GDP growth, 1996-2004)

Model 2	Index (1)		Index (2)		Index (3)	
Variable	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**	**Coefficient**	**Robust SE**
Index	-0.58	0.13 (-4.45)***	-0.43	0.11 (-4.06)***	-0.67	0.16 (-4.26)***
Log initial GDP	0.13	0.05 (2.36)*	0.12	0.05 (2.28)*	0.12	0.05 (2.45)*
Initial human capital	0.02	0.01 (1.28)	0.02	0.01 (1.35)	0.02	0.01 (1.28)
Distance	-0.00	0.00 (-1.18)	-0.00	0.00 (-1.06)	-0.00	0.00 (-1.18)
Population growth	0.13	0.10 (1.27)	0.12	0.10 (1.26)	0.12	0.10 (1.26)
Constant	0.05	0.60 (0.08)	0.05	0.58 (0.08)	0.10	0.56 (0.19)

t-ratios in brackets

**** significant at the 1% level ** at the 5% level * at the 10% level*

Table 6 provides the regression results that determine the nature of the magisterial districts' diversity. Two explanatory variables are used. The first variable is the Herfindahl-index values of manufacturing exports in terms of total exports and the second variable is primary exports as a percentage of total exports (again the average for 1996-2004 for both variables is used). The Herfindahl-index values of manufacturing exports serve as a proxy for horizontal diversity and the changes in the values of primary exports proxies vertical diversity (i.e. diversification of exports from primary to secondary products).

Table 6: OLS regression results for the horizontal/vertical diversity regression (dependent variable real GDP growth, 1996-2004)

Variable	**Coefficient**	**Robust SE**
Herfindahl-index for manufactured exports	-7.22e-07	3.66e-08 (-19.73)***
Primary exports as percentage of total exports	0.01	0.00 (1.63)
Constant	1.13	0.12 (9.69)***
No. observations		281
R^2		0.00262
Root MSE		1.6528

t-ratios in brackets

**** significant at the 1% level ** at the 5% level * at the 10% level*

From table 6, it can be concluded that vertical integration in South Africa is not a significant source of economic growth on the local level. Horizontal diversification (in

manufacturing), however, is associated with larger growth (the coefficient of the Herfindahl-index is significant at the 1 per cent level). Therefore, it is not important to merely diversify exports from primary to secondary products, but the type and diversity of secondary products produced and exported are what matter for growth.

4 Concluding Remarks

There is a widely shared belief that exports are good for economic growth, and that greater openness ought to lead to less spatial inequality within a country. However, in practice, greater export growth has, in general, not been accompanied by less spatial inequality. In this paper, one possible explanation for this was investigated, that different sub-national regions tend to export different products, and that it is the type and quality of products that are being exported that matter for economic growth. Research on the level of countries suggests that export diversity and diversification may be important for economic growth, but so far very little research has focused on the sub-national or regional level.

The contribution of this paper was, therefore, to provide empirical evidence on the relationship between exports and, in particular, export diversity and spatial inequality in a developing country context. Using export data from 19 sectors within 354 sub-national (magisterial) districts of South Africa, various measures of sub-national export diversity were constructed, including the recently proposed EXPY and PRODY measures proposed by Hausman, Hwang and Rodrik (2005). This is the first time, as far as the authors are aware, that these latter measures have been used to inform spatial growth issues.

The results showed that it is not only important how much is exported, but that it is also important what it is that is exported. Regions with less specialisation and more diversified exports generally experienced higher economic growth rates, as well as contributed more to overall exports from South Africa. For instance, in terms of the Herfindahl Index, sub-national regions (magisterial districts) with an index value of higher than 0.9 (high specialisation) experienced below average annual growth in GDP per capita between 1996 and 2004, whilst those with an index value below 0.20 (diversified exports) achieved an above average growth rate in GDP per capita over the period. Moreover, the magisterial districts with index value below 0.20 contributed 33% of South Africa's total exports in 2004. The positive relationship between export diversity and growth on a regional (sub-national) level is similar to the positive relationship Al-Marhubi (2000) found on a cross-country level, and the finding that on a sub-national level export sectors with low PRODY values are in resource-intensive and primary sectors (such as in forestry and related sectors) are consistent with the cross-country evidence of Hausmann *et al.* (2005).

It is also found that distance (and thus transport costs) may matter for export diversity. Estimating a cubic-spline density function for the various measures of export diversity, it is found that export diversity declines as the distance from a port (export hub) increases. Most magisterial districts with high export diversity values are located within 100 km of the nearest port. Furthermore, comparing the cubic-spline density functions for 2004 with that of 1996 allowed an indication of how the distance-export diversity relationship had changed over time (the period in question was characterised by significant trade liberalisation). This showed that distance (transport costs) has become more important since 1996 (under greater openness), with magisterial districts located

further than 100 km from the ports being less diverse in 2004 than in 1996. One possible explanation – which requires further research - may be the impact of greater foreign direct investment (FDI) in South Africa since 1996, following the opening up of the economy and the transition into democracy. In another context, Bruinsma *et al.* (2000) find that transport infrastructure, and therefore distance, are significant determinants of the locational decisions of 'footloose' multinational firms, and that these firms tend to locate in particular high-value added sectors in close proximity to a port (see for example the role of FDI in China's spatial development in Ma, 2006). In South Africa, tentative indications that may support this hypothesis was found in the fact that it is horizontal diversification and not vertical diversification *per se*, that is associated with higher economic growth, and that high-skill intensive sectors with integrated global markets (such as electronics) tend to be almost exclusively located within a small distance of ports. Further research is needed to clarify the relationship between export diversity, openness and foreign direct investment.

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