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Export Diversity and Regional Growth

Empirical Evidence from South Africa

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Abstract

This paper provides empirical evidence on the relationship between exports, and in particular export diversity, and regional growth in a developing country context. Using export data for 19 sectors from 354 subnational (magisterial) districts of South Africa, we construct various measures of subnational export diversity. We find that it is not only how much that is exported, but also important is what is exported. Regions with less specialization and more diversified exports generally experienced higher economic growth rates and contributed much more to overall exports from South Africa. We also find that distance (and thus transport costs) may matter for export diversity. Estimating a cubic-spline density function for the various measures of export diversity we find 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 shows that distance (transport costs) have become more important (under greater openness), with fewer diverse magisterial districts located further away from ports in 2004 than in 1996. One possible explanation for this changing pattern of export diversity may be due to the impact of greater foreign direct investment in South Africa since 1996.

Keywords: exports, export diversification, export variety, regional growth, new economic geography
JEL classification codes: R12, R49, F12, F14

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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. 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). Kanbur and Venables (2005: 89-114) report on a recent project to analyse spatial inequalities in over 50 developing countries. Despite this surge of interest in spatial inequality in developing countries, relatively little attention has been focused on trade, and specifically exports, as determinant of spatial inequality in developing countries. This lack of attention on 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 liberalization and the strengthening of a country's export performance as a means of boosting growth and development. Foster (2006: 1058-61) 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 growth and inequality). A number of notable studies indeed find empirical evidence that exports are good for growth namely Balassa (1978), Kavoussi (1984), Fosu (1990a, 1990b) and more recently Greenaway et al. (1999).

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 subnational (spatial) data on exports are generally difficult to come by in a developing country.

The contribution of this paper is to provide some empirical evidence on the relationship between exports and spatial inequality in a developing country context. In particular we will build on our earlier work on the determinants of the location of export-oriented manufacturing firms in a developing country (Naudé and Matthee 2007) and focus on the potential importance of export diversity (variety) for spatial economic growth and

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.

development. In this respect our paper will also contribute to the small recent literature that recognizes that it is not only how much that is exported, but that it is also important what it is that is exported. For instance Hausmann et al. (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 for 19 sectors from 354 magisterial districts of South Africa, we will employ various methods to measure the diversity of exports from a particular region, including the recently proposed EXPY and PRODY measures proposed by Hausmann et al. (2005). This is the first time, as far as we are aware, that these latter measures are used to inform spatial growth issues.

The paper is structured as follows. In Section 2 we provide a brief overview of the literature on exports and spatial development, emphasising the importance of the diversity or composition of exports for spatial growth. In Section 3 we provide the empirical evidence from South Africa. Subsection 3.1 discusses the various measures of export diversity, and Subsection 3.2 describes the data that will be used. Subsection 3.3 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 Literature overview

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: 437; 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 et al. 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 it affects the development of agglomeration or causes 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 large precisely where the majority of manufacturers choose to locate. The result is agglomeration at the core and trade with the periphery (Krugman 1991; Brakman et al. 2001: 350; 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 localization economies or urbanization 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 specialization of economic activity, which is advocated by the Marshall-Arrow-Romer theory as well as by Porter (1990). Glaeser et al. (1992) describe these spillovers as knowledge that is transferred between firms in the same industry. Once an industry shares knowledge in specialization, innovation and growth occur at a faster rate. Lall et al. (2003) adds 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 specialization of economic activity include Duranton and Puga (1999), Midelfart-Knarvik et al. (2000) and Mukkala (2004). Urbanization economies describe benefits or spillovers due to the agglomeration of different economic activities (Economic Geography Glossary 2006). According to Jacobs (1969: 268) knowledge spillovers have a larger impact on local growth if 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 et al. (1997) conclude that urbanization is positively related to regional economic growth. Examples of empirical work on the diversification of economic activity include Glaeser et al. (1992), Harrison et al. (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 specialization 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).

Economic growth through export growth has been recognized to be important for developing countries (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 lead by export-oriented growth has, in the face of globalization, 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 (2004) find that a 10 per cent increase in export variety in a country’s industries raises a country’s productivity with 1.3 per cent. 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. Dependency on a few sectors may in fact hamper growth if they experience fluctuations in say, demand or prices (Al-Marhubi 2000). Furthermore, if there is instability in these industries, investment may be withdrawn and this negatively affects growth (Dawe 1996). Horizontal diversification implies stabilization (Al-Marhubi 2000). Vertical diversification occurs when the composition of exports shift from primary products to manufacturing products. The production of primary exports does not result in as many spillovers as the production of manufacturing 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). Hausmann et al. (2005) conclude that in addition the overall beneficial effects of export volumes on growth, the composition of a country's exports also matter. Countries that produce higher productivity goods experience greater export performance and are subsequently able to benefit more from the gains of globalization.

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 (including South Africa) have liberalized 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 differences in regional growth rates (and thus 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 becomes 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 Traistaru et al. 2002: 2; Osborne 1997; Overman et al. 2001; Roper and Love 2001). More pertinently, research on subnational 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, 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, despite the fact that South Africa has been liberalizing its trade since 1994, with substantial export success, there is little evidence of any significant convergence in per capita incomes between the country's regions (Naudé and Krugell 2003: 2006).

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, so as to determine whether greater (or lesser) spatial inequality is associated with changes in the exports (such as in level and/or composition) from different subnational regions.

3 Empirical investigation

In the previous section we indicated that the current literature tends to espouse 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 subnational regions have different characteristics which determine their ability to export. Moreover, it is being recognised that what a subnational region export 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 we use data from South African subnational regions 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) we report our regression results on the relationship between various measures of export diversity and economic growth across 354 subnational regions (magisterial districts) in South Africa. First however, in Subsection 3.1, we discuss the various measures of export diversity used, including the recently proposed PRODY and EXPY measures of Hausmann et al. (2005). Thereafter in Section 3.2 we discuss the data used, 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 specialization of the regions. Petersson (2005) defines this measure of specialization as follows:

$$SPEC_{jt} = \sum_i \left(\frac{E_{jit}}{\sum_j E_{jit}}\right)^2 \qquad (1)$$

where E_{ijt} represents exports of a region j of a particular industry (or export sector) i in a given year t. An index value approaching one indicates a high degree of export concentration (or specialization), whereas a value approaching zero 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 regions' share of the country's total exports. Al-Marhubi (2000) calculates this measure as follows:

$$S_{jt} = \frac{\sum_i \left|h_{ijt}\right| - \left|h_{it}\right|}{2} \qquad (2)$$

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:

$$H_{jt} = \frac{\sqrt{\sum_{i=1}^{n}\left(\frac{x_{it}}{X_{jt}}\right)^2} - \sqrt{\frac{1}{n}}}{1-\sqrt{\frac{1}{n}}} \qquad (3)$$

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 and 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 specialization 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) defines PRODY as follows:

$$PRODY_{it} = \sum_j \frac{x_{jit}/X_{jt}}{\sum_j \left(x_{jit}/X_{jt}\right)} Y_{jt} \qquad (4)$$

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:

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

3.2 Data

We calculated five measures of export diversity for subnational regions of South Africa following the specifications set out in equations (1) to (5). Data on subnational exports from 19 industries were obtained from South African Revenue Services (Department of Customs and Excise) for the period 1996-2004. We describe the results in Subsection 3.3. We then use a cubic-spline density function to estimate the relationship between subnational export diversity and distance from a harbour (port), in order to determine

whether distance (which can proxy for transport costs) has had a significant association with the diversity of exports. The distance variable that we use 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. The results from this estimation are set out in Subsection 3.3.

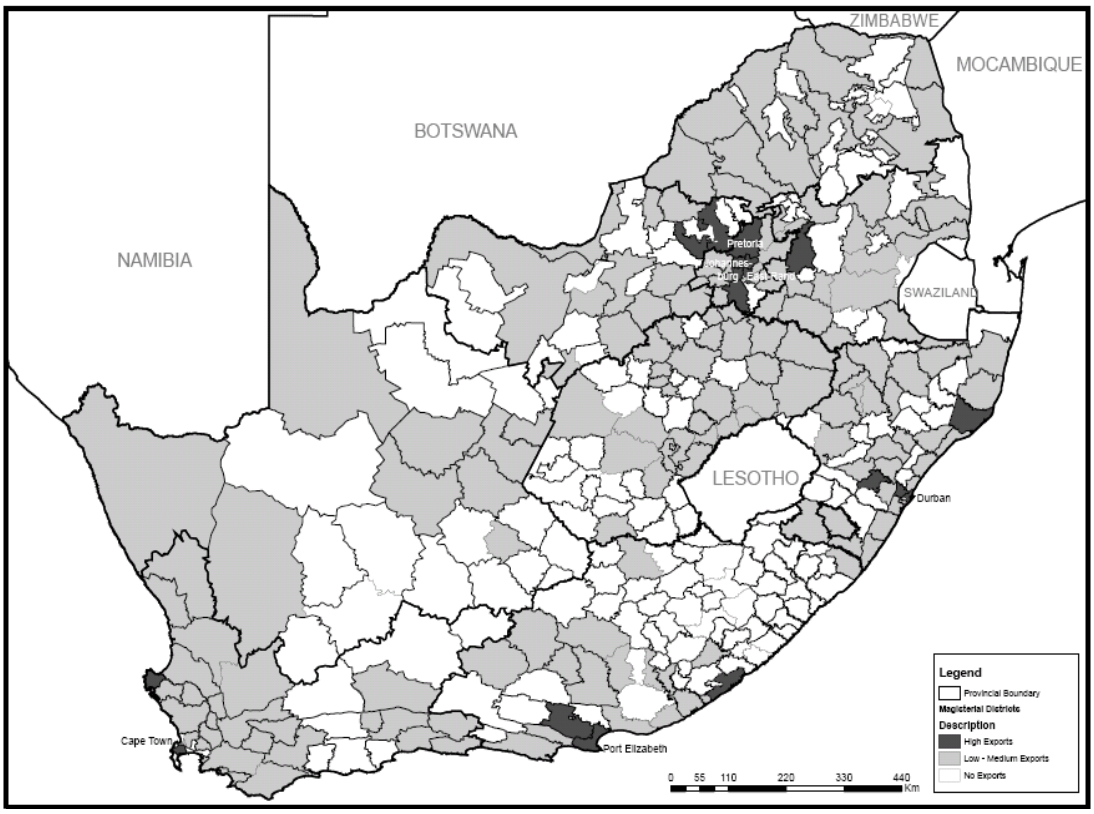
Finally, we use the various measures of export diversity as described in equations (1) to (5) to explore the relationship between export diversity and economic growth on subnational level. Here, we follow the literature and practical considerations of data availability, in the selection a number of control variables. These include openness (openness is calculated as the share of total exports to nominal GDP), the contribution of manufacturing exports to total exports, population growth and human capital. This data, as well as data on GDP per capita and GDP growth were obtained from Global Insight Southern Africa's Regional Economic Explorer, which is based on a number of official Statistics South Africa and other sources (see Cameron 2005). Human capital is proxied by education levels higher than grade 12, following Fedderke (2001).

3.3 Results

Export diversity in South Africa

This section provides a descriptive overview of export diversity in South Africa. First, how much is exported in South African by its regions? Figure 1 provides an illustration of the 354 magisterial districts (which form part of one of the nine 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 and 0.99 per cent. The determinants of these subnational exports are analysed in Matthee and Naudé (2007).

Figure 1: Exports per magisterial district

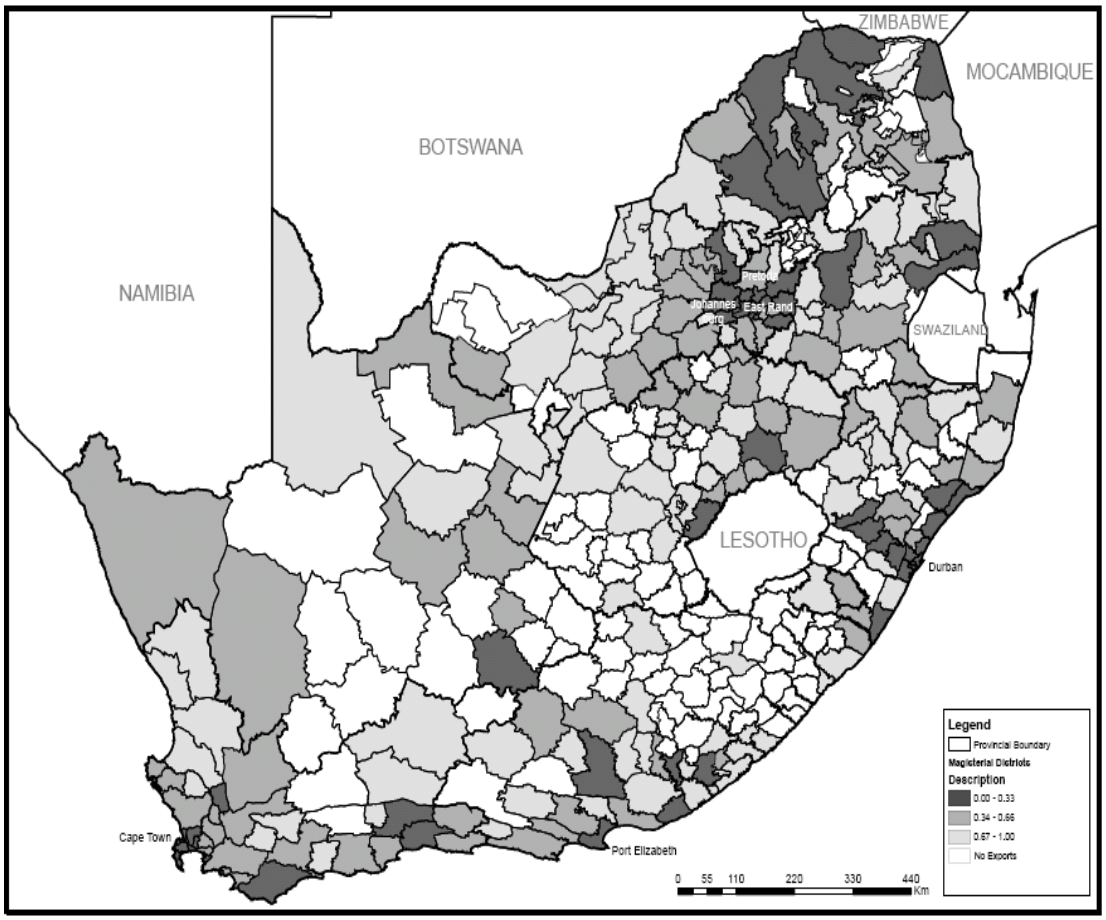


Source: Authors' calculations (map drawn by GISCOE).

Second, what are being exported in terms of diversity? Figure 2 graphically 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 darker coloured magisterial districts' Herfindahl index is nearer to 0, which indicates high diversity. The index value of the light-grey districts 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 32.90 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' calculations (map drawn by GISCOE).

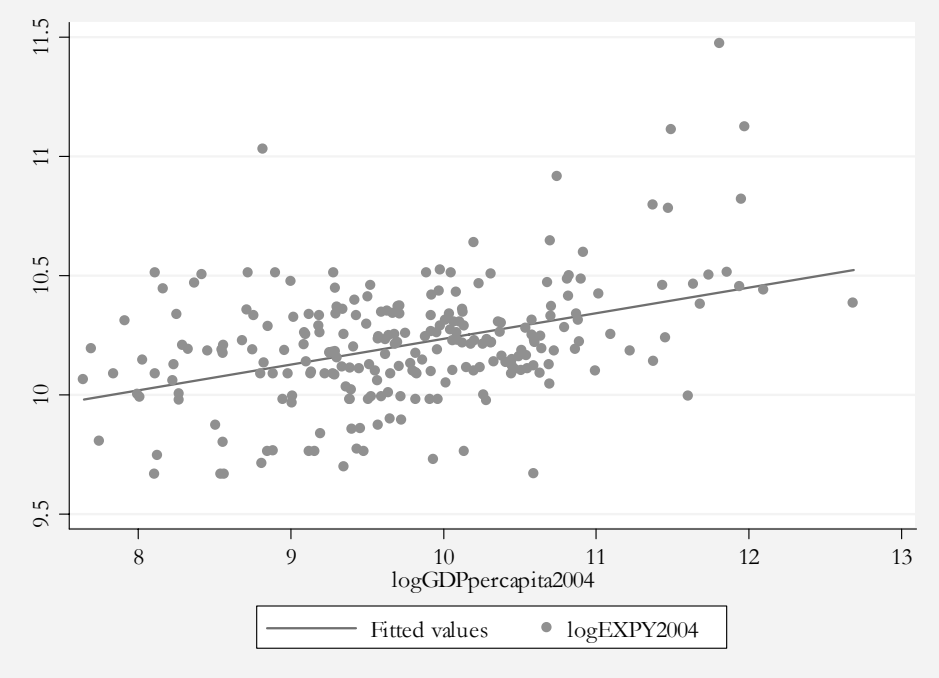
The type of sector that is predominant in a region also matters. As explained above, Hausmann et al. (2005) construct an index (PRODY) that represents the income level associated with that sector. This index is basically the weighted average of per capita GDP of all regions producing in that export sector. 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 GDP 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

Source: Authors' calculations based on Department of Customs and Excise data.

Figure 3: Fitted Values of EXPY in 2004



Source: Authors' calculations.

Hausmann et al. (2005) develops 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.

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.

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, Bruinsma et al. (2000: 260) remarks 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 et al. (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.

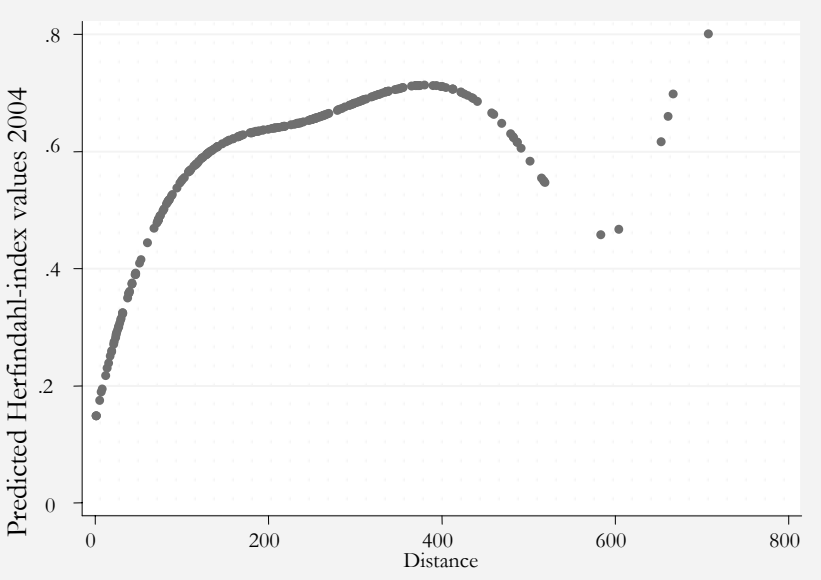
As the focus here is on export diversity, and empirical evidence shows that domestic transport costs matter, one needs to establish the impact of these costs on the level of a region's export diversity. Naudé and Matthee (2007) use cubic-spline density functions to determine the significance of domestic 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 is important for export diversity. 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. (6)

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 a high Herfindahl index value 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).

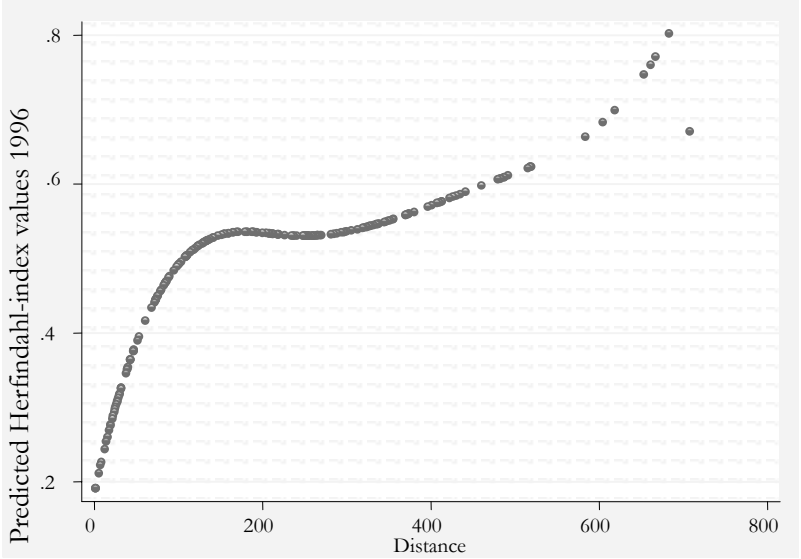
Figure 4: Cubic-spline density function for Herfindahl-index values in 2004



Source: Authors' calculations.

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



Source: Authors' calculations.

Export diversity and growth: regression results

Before the regression results are illustrated and explained, a detailed explanation of the growth variables is provided. The dependent variable is the average annual growth rate of real GDP over the period 1996-2004. Human capital is the average human capital of 1996 and 2004. 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 1996-2004. The logarithm of the level of real GDP per capita in 1996 is used as the initial GDP per capita. Each index (specified in equations one to three) is reported as the average between 1996 and 2004. The regressions run were only for the magisterial districts that had positive exports during the period 1996-2004. Table 2 provides a summary of all variables used.

Table 2: Summary (Dependent Variable Real GDP Growth, 1996-2004)

Variable	Mean	Standard Deviation	Min	Max
Real GDP growth	0.67	0.74	-7.01	3.80
Population growth	1.07	0.38	0.08	2.25
Initial GDP per capita	17773.58	1207.26	1207.56	216178.3
Human Capital	3.80	2.73	0.56	17.79
Openness	0.31	0.24	0	1.98
Distance	304.01	80.51	27.9	684
Total Exports	5480051	385596	32.53	1.21e+07
Index 1	0.86	0.45	0	1.59
Index 2	1.03	0.56	0	1.97
Index 3	0.73	0.38	0	1.34

Source: Authors' calculations.

Table 3 reports the results of the various regressions run with the three indices. The results indicate that two of the three indices are significant at the 1 per cent level and the other at the 5 per cent level. None of the other variables is, however, significant. This may be that the manner in which the indices are constructed encompasses the effects of say, human capital, population growth and openness. A piecewise correlation between these variables and the indices revealed that they are significantly correlated at the 5 per cent level. The negative sign of the coefficients are similar to Al-Marhuni's (2000) results. The negativity implies that, with other given factors, larger export diversification and lower concentration or specialization contributes to real GDP growth. Therefore, it matters what types of products a magisterial district export. The coefficient on distance, which proxies for domestic transport costs, is negative in all three instances, although not significant.

Table 3: OLS regression results for index regressions (dependent variable real GDP growth, 1996-2004)

	(1)		(2)		(3)	
Variable	Coefficient	Robust SE	Coefficient	Robust SE	Coefficient	Robust SE
Constant	0.43	0.54 (0.79)	0.41	0.54 (0.76)	0.48	0.53 (0.91)
Population growth	013	0.10 (1.27)	0.13	0.10 (1.28)	0.12	0.10 (1.25)
Log initial GDP per capita	0.09	0.06 (1.61)	0.08	0.06 (1.42)	0.08	0.06 (1.50)
Human capital	0.02	0.02 (0.89)	0.02	0.02 (0.90)	0.12	0.02 (0.90)
Openness	0.11	0.44 (0.26)	0.03	0.51 (0.05)	0.05	0.46 (0.12)
Distance	-0.00	0.00 (-1.24)	-0.00	0.00 (-1.10)	-0.00	0.00 (-1.23)
Index 1	-0.67	0.24*** (-2.83)				
Index 2			-0.47	0.21** (-2.27)		
Index 3					-0.74	0.28*** (-2.66)
No. observations		281		281		281
R^2		0.0867		0.0743		0.0822
Root MSE		0.71107		0.71588		0.71284

Note: t-ratios in parenthesis; *** significant at 1%, ** at 5% and * at 10% level.

Source: Authors' calculations.

The results in Table 3 show that export diversity is significantly associated with GDP per capita growth, with all the indices significant at the 1 per cent level. However, which type of diversity, either horizontal or vertical, may also matter. Table 4 contains regression results on subnational GDP growth and proxies for the type of export diversity, i.e. horizontal and vertical diversification. Two explanatory variables are used. The first variable is the Herfindahl index values for manufacturing exports (see equation (1)). This proxy for horizontal diversity within the manufacturing sectors itself and would indicate the extent to which a magisterial districts range of manufactured output is diversified. The second variable is primary exports as a percentage of total exports. This proxies for vertical diversity—we expect that if vertical diversity matters, magisterial districts that have reduced the relative share of primary exports, i.e. diversified their exports in a vertical manner, would have grown faster. The average for 1996-2004 for both variables is used.

Table 4: OLS regression results for the horizontal/vertical diversity regression (dependent variable real GDP growth, 1996-2004)

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

Note: t-ratios in parenthesis; *** significant at 1%, ** at 5% and * at 10% level.

Source: Authors' calculations.

From Table 4 it can be concluded that vertical integration in South Africa is not a significant source of economic growth on 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 matters for growth.

4 Summary and conclusions

There is a widely shared belief that exports are good for economic growth, and that greater openness could lead to less spatial inequality in income within a country. However, in practice greater export growth has not generally been accompanied by less spatial income inequality. In this paper we investigated one possible explanation for this, namely that different subnational regions tend to export different products, and that it is the type and quality of products that are being exported that matters for economic growth. Research on the level of countries tend to concur that export diversity and diversification may be important for economic growth, but so far very little research have focused on the subnational/regional level.

The contribution of this paper was therefore to provide empirical evidence on the relationship between exports, and in particular export diversity, and regional growth in a developing country context. Using export data for 19 sectors from 354 subnational (magisterial) districts of South Africa, we constructed various measures of subnational export diversity, including the recently proposed EXPY and PRODY measures proposed by Hausmann et al. (2005). This is the first time, as far as we are aware, that these latter measures were used to inform spatial growth issues.

Our results showed that it is not only how much that is exported, but that it is also important what it is that is exported. Regions with less specialization and more diversified exports generally experienced higher economic growth rates, as well as contributed much more to overall exports from South Africa. For instance, in terms of the Herfindahl Index, subnational regions (magisterial districts) with an index value of higher than 0.9 (high specialization) 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 per cent of South Africa's total exports in 2004. The positive relationship between export diversity and growth on a regional (subnational) level is similar to the positive relationship Al-Marhubi (2000) found on a cross-country level, and our finding that on a subnational 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).

We also find that distance (and thus transport costs) may matter for export diversity. Estimating a cubic-spline density function for the various measures of export diversity, we 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 us to obtain an indication of how the distance-export diversity relationship had changed over time (the period in question was characterised by significant trade liberalization). This showed that distance (transport costs) has become more important since 1996 (under greater openness), with fewer diverse magisterial districts located further away from ports in 2004 than in 1996. One possible explanation for this changing pattern of export diversity may be due to the impact of greater foreign direct investment (FDI) in South Africa since 1996, following the opening up of the economy and the transition to democracy. Evidence from other developing countries suggests that multinational firms tend to prefer locations close to ports. For instance Bruinsma et al. (2000) finds 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 e.g. 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 this paper in the finding that it is horizontal diversification and not vertical diversification per se, that is associated with higher economic growth, as well as our earlier finding (see Matthee and Naudé 2007) 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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