INDUSTRY CONCENTRATION IN SOUTH AFRICA

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SUMMARY

INDUSTRY CONCENTRATION IN SOUTH AFRICA

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Understanding the reasons for industry concentrating in certain areas is an important policy issue. South Africa has experienced a socio-political policy of apartheid that had an industrial counterpart: an industrial decentralisation programme. Since 1994 and the country's first democratic elections, a new industrial policy has been pursued with the aim of facilitating industrial activity in certain areas of the country.

This study addresses the issue of manufacturing industry concentration in South Africa. First, a review of the theory of industry location and concentration is undertaken. This includes the theory of industry location put forward by Weber and Marshall. Then, more recent work by Krugman is examined within the context of the so-called New Economic Geography. The literature emphasizes the importance to industry location of factors such as being close to a supply of labour, minimization of transport costs and proximity to a market or source of demand for output. The New Economic Geography also deals with the notion of the development of an industrial "core" of the economy and a deindustrialised "periphery".

The development of industrial policy in South Africa is dealt with. This includes an overview of development of the South African economy from a geographical perspective. This is followed by a review of key policy changes affecting industrial development in South Africa. This includes Industrial Decentralisation Policy and the Regional Industrial Development Programme pursued in the apartheid era. An examination is undertaken of industrial policy in the democratic era in terms of the spatial development initiatives and the Regional Industrial Location Study.

Data that could be used in the analysis of industry concentration is reviewed. Then, the study examines the research hypothesis to be used in the study, namely that industry concentration in South Africa is a function of education level of the population, skills level of the workforce, average household income, urbanisation level of the population, population density and transport infrastructure density. The models involve cross-section analysis testing whether manufacturing industry concentration (measured in terms of manufacturing establishments) and manufacturing industry size (measured by manufacturing output) can be explained by factors such as education level of the population, skills level of the workforce, average household incomes, level of urbanisation, population density, road transport infrastructure density, as well as a dummy taking account of the decentralisation programme. The empirical analysis involves the use of the Cotton-Neumark decomposition method to test whether the attributes of the models can explain the differences in concentration of the manufacturing industry across provinces in South Africa.

The study concludes that the attributes of the models can explain differences in industry concentration between Gauteng province on the one hand and the remaining provinces on the other. Attributes such as education and skills levels are shown to be important in the case of provinces such as Gauteng, KwaZulu-Natal and Western Cape. Attributes such as incomes and population density are identified as important in provinces such as Northern Province and North West. Road transport infrastructure density is significant in Gauteng and KwaZulu-Natal. The decentralisation programme was found to be important in influencing industry location in the Eastern Cape province.

Finally, it is argued that industrial strategy in South Africa with a spatial or geographic element, such as the spatial development initiatives, must be implemented taking full account of factors that are most important in influencing industry concentration in a particular region.

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CSIR: Council for Scientific and Industrial Research

DBSA: Development Bank of Southern Africa

ESR: Export Specialisation Ratio

IDC: Industrial Development Corporation

IDP: Industrial Decentralisation Policy

IDZ: Industrial Development Zone

OLS: Ordinary Least Squares

PSR: Product Specialisation Ratio

R&D: Research and development

RIDP: Regional Industrial Development Programme

RILS: Regional Industrial Location Strategy

SDI: Spatial Development Initiative

U.S.: United States

CHAPTER 1

INTRODUCTION

The location of industry can be due to the decision by firms to locate near resource endowments, suppliers of intermediate inputs, supplies of labor and demand for final goods. The predominant factors influencing these decisions vary across industries and countries and play an extremely important role in determining the geographic location of industries relative to one another. In the economic literature, the concentration or localisation of industries can be determined by numerous factors, e.g. the endowment of raw materials and resources, political factors, history and accident and agglomeration effects (technology spillovers, skilled labour and intermediate inputs). The identification of factors influencing the location of industry in South Africa is particularly complex and interesting given that socio-political objectives have played a significant role in industrial strategy between 1946 and 1994. A key issue in this regard would be the extent to which the various industries have been dispersed or concentrated and which factors have played the dominant role in these patterns. Also, the structure of the South African economy has changed from primarily mining-oriented to one of manufacturing and service-oriented. This study examines the determinants of manufacturing industry concentration in South Africa.

1.1 CENTRAL RESEARCH QUESTION

The central research question for this study is: What are the principal determinants of industry concentration in South Africa?

1.2 RESEARCH HYPOTHESIS

The hypothesis for the study is that the concentration of manufacturing industry in South Africa, in accordance with economic theory on the subject, depends upon education level of the population, skills levels of the workforce, average household

income, urbanisation level of the population, population density, and road transport infrastructure density.

1.3 STUDY OBJECTIVES

The principal objective of the study is to identify the determinants of the concentration of the manufacturing industry in South Africa. This involves a cross section econometric analysis across the nine provinces making up South Africa to test whether there is a significant relationship between the concentration of the manufacturing sector, measured in terms of manufacturing establishments, and variables such as level of education of the population, skills level of the workforce, average household incomes, urbanisation level and road transport infrastructure density. In South Africa, this issue needs to be examined in the context of the past policy of industrial decentralisation. Therefore, the Industrial Decentralisation Policy attempted during the previous apartheid era is also included in the analysis to determine its influence on manufacturing industry concentration. The relationship between these explanatory variables and manufacturing industry size, measured in terms of manufacturing output, is also examined. A secondary objective of the study is to determine what implications this has for industrial policy in this country.

The study therefore aims to answer the following questions:

- What does economic theory have to say about industrial location and economic development?
- Is the South African manufacturing industry localised or concentrated?
- How important are labour aspects such as the level of education and the skills level of the work force in the concentration of the manufacturing industry in South Africa?
- What have been the roles of demand-side components such as urbanisation and population growth?
- How important is transport infrastructure in determining the concentration of industry in South Africa?

- What was the effect of the Industrial Decentralisation Programme on the concentration of the manufacturing industry in South Africa?
- What are the implications of the study for current manufacturing sector policy in South Africa?

1.4 LAYOUT OF STUDY

Chapter 2 of the study contains a review of the economic literature on industry location and concentration. Chapter 3 contains a review of industrial policy in South Africa, including the Regional Industrial Decentralisation Programme in the era pre-1994, as well as more recent industrial strategy post-1994, such as the Spatial Development Initiatives. Chapter 4 examines the data used in the econometric analysis of the study. Chapter 5 deals with the empirical analysis of data using the decomposition method to test the model of industry concentration specified in the study, while Chapter 6 presents some conclusions and policy implications.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The component of current economic theory most appropriate to analysing economic activity (i.e. employment creation) on a regional or spatial basis is that of the New Economic Geography[1] (see Krugman, 1991a & Krugman, 1998). This school of economic thought attempts to explain economic development in terms of "history and accident" (non-economic factors, e.g. political developments), the geographic location of industries relative to their suppliers and markets, advantages accruing from concentration of industries (e.g. increasing returns) which perpetuate industrial patterns over time long after the initial rationale for the location has diminished and identification of a core and periphery of an economy which may change over time.

While the New Economic Geography must take credit for revitalizing and being the champion of analysing the "economy in space" in recent times, the theory of industry location developed as far back as Weber (1929) and Marshall (1920) is first examined to set out the development of thought in this area of economics.[2] Thereafter, once the New Economic Geography is dealt with in the study, literature that has grown out of the concept will be examined.

2.2 LOCATION THEORY

Weber (1929) developed two regional cost factors that are fundamental to the location of industry:

- Transportation costs; and

[1] The "new economic geography" is also called "geographical economics" in Fujita & Thisse (1996).
[2] The work of von Thünen (1826) as set out in Fujita & Thisse (1996) is also a significant early contribution to the literature on geographical economics and is explained in the latter work on economic agglomeration.

- Labour costs[3].

Although it can be argued that transport costs are themselves determined by labour costs (see Weber, 1929), they ought to be examined separately to examine their effect on industrial location decisions specifically.

Weber's analysis is extremely important in terms of its treatment of transport and labour costs, i.e. whether it held one of the two components constant while allowing the other to vary. Permitting transport costs to vary while holding labour costs constant, Weber formulated his first general rule: that the location of manufacturing industries would be determined by the ratio between the "weight of localised material and the weight of the product".

The influence of the variation in labour costs would be determined by the "labour coefficient" or the ratio between cost of labour per ton of product (labour index) and the total weight of all goods (raw materials, fuels, etc) transported. The aforementioned total weight was termed the "locational weight". This combination led to the second general rule: "When labour costs are varied, an industry deviates from its transport locations in proportion to the size of its labour coefficient".

The omission between the first and second general rule was that transport costs were never held constant before labour costs were allowed to vary. This would have enabled an analysis of the effect, on location decisions, of introducing transport costs to a situation where labour costs were varied. Instead, the analysis was one in which transport costs were allowed to vary and labour was constant, followed by one of variable transport costs and variable labour costs. The effect of allowing labour costs to be varied and then introducing transport costs was never explored it seems.

Transport costs, on the other hand, were deemed to depend upon the weight of the product and the distance it had to be carried. In addition to these factors, transport costs were also held to be determined by: the type of transport system and the extent

[3] Weber also held that the following factors were not important in the location of industry: the depreciation rate, interest rate, cost of land and building costs.

of its usage; the nature of the region (topography); and the nature and extent of infrastructure and the characteristics of the goods themselves (Weber, 1929).

Another major examination of the notions of industry concentration and localisation of specialised industry was that of Marshall (1920). Having noticed the concentration of certain industries in particular centres, Marshall suggested that the localisation of industries arose through such factors as what he termed:

- Physical conditions (climate, soil type, resources such as mineral deposits). Industry location followed easy access to water, mineral deposits (iron industry close to coal deposits);
- Patronage of courts (the demands of a royal court for certain goods attracted skilled workers who passed on their knowledge and led to the replication of those skills even after the court had moved on);
- Deliberate invitation of rulers (rulers often invited skilled artisans to settle in specific centres. These workers often passed on skills to the locals, thereby broadening the overall skills base).

Once industry has become localised, it tends to remain in that locality for considerable time. The advantages of localisation put forward by Marshall include: the hereditary skills nurtured over time; the growth of subsidiary activities; use of highly specialised machinery; and a local market for special skills. However, disadvantages could also arise, namely: a heavily localised industry could make extreme demands for one kind of labour, e.g. the dominance of iron industries offered no employment to women so that wages and labour cost were high while average earning for households were low. To counter this, textile industries often began in these areas and led to a "twinning" of these industries. Also, a region dominated by one industry was vulnerable if this industry experienced reduced demand. This could be alleviated if several industries became active in the area so that workers could find alternative employment in hard times.

The localisation of industries was affected by external factors such as improvements in the means of communication, be it in technical terms or through reduced

transportation and freight costs. This would obviate the need for many different industries to concentrate and enable them to rather remain localised some distance from centres of demand. (See Marshall's treatment of this in terms of the changes in the agriculture sector in England).

Marshall (1920) suggested three reasons for the spatial concentration of industries:

- Localisation provides a pooled market for workers with specialised skills;
- Facilitates the development of specialised inputs and skills; and
- Enables firms to benefit from technological spillovers.

More recently, in terms of regional economics, location factors were categorized according to whether they bestowed a relative advantage to industries locating in the area through the availability, price and quality of local or nontransferable inputs (supply-side factors). These would be local inputs that are present in the area and cannot feasibly be imported into the area from outside nor transferred to another region. Examples of these would be climate, topography and local services such as police services, administrative resources and infrastructure (Hoover & Giarratani, 1984). Transferable inputs, on the other hand, are inherently mobile and would include labour. On the demand side, location is influenced by local demand (sale of nontransferable outputs in the area of location) and external demand (sale of transferable output to outside markets). Hoover and Giarratani (*op.cit.*) then go on to examine in detail the importance of the market as a location factor. Examples of this component would be the size and concentration of the population and their wealth.

Plant size economies are also important. In the 1960 study by Lichtenberg, (see Hoover & Garratiani, 1984), concentration was examined in terms of plant size (number of employees per establishment in the New York metropolitan region and in the U.S. as a whole for various industries. The finding was that New York plants were larger in terms of employees per establishment than plants in other regions in industries that showed a tendency to concentrate in New York (i.e. the region had more than 20 per cent of national employment in that industry).

2.3 NEW ECONOMIC GEOGRAPHY

More recently, the New Economic Geography has arisen primarily from the work of Krugman (1991a) and Krugman (1991b), taken further in Krugman and Venables (1995), Fujita and Thisse (1996), Krugman (1998) and Fujita, *et al.* (1999). The concepts of agglomeration, industry location and concentration put forward in these references were subsequently also examined in Neary (2001) and Davis and Weinstein (2002).

2.3.1 Forces working for and against concentration of economic activity

Krugman (1998) makes the point that while economic activities are extremely concentrated geographically, no one location is the focal point for production or consumption of one particular good. There are forces that work towards geographical concentration of economic activities and forces which work against it. The former are termed "centripetal" or "agglomeration" forces and the latter are termed "centrifugal" or "dispersion" forces (Fujita & Thisse, 1996)[4]. Each of these forces is disaggregated into its components by Krugman (1998) as set out in Table 2.1.

Table 2.1: Forces working for and against geographical concentration of economic activity

Centripetal forces	Centrifugal forces
Market-size effects (linkages)	Immobile factors
Thick labour markets	Land rents
Pure external economies	Pure external diseconomies

Source: Krugman (1998)

[4] In earlier work, Perroux (1950) states that the firm releases centripetal and centrifugal forces that either attract labour and other factors or repel them respectively.

In Table 2.1 the centripetal forces are the three sources of external economies put forward by Marshall. In terms of market-size effects or linkages, a large domestic market creates backward linkages (location near large markets are favoured for the production of goods subject to economies of scale) and forward linkages (a large domestic market supports the local production of intermediate goods reducing costs for downstream producers). Forward linkages are identified by Fujita and Thisse (1996) as responsible for the agglomeration of firms and workers (the supply of more varieties of industrial goods increases workers' incomes), while backward linkages are created when firms are attracted by larger numbers of potential consumers. Industrial concentration supports a substantial local labour market, especially for specialised skills, so that employers and employees can make contact with one another quite easily. A local concentration of economic activity may create pure economies through information spillovers.

In terms of the centrifugal forces identified in Table 2.1, immobile factors of production (e.g. land or natural resources) work against concentration of production from the supply side (a portion of production will locate near to the potential workforce) and the demand side (a portion of production will locate close to consumers). Concentrations of economic activity increase the demand for local land, thereby driving up land rents and becoming a disincentive for further concentration. Finally, concentrations of industrial and associated economic activity can generate pure external diseconomies such as congestion.

2.3.2 Core and periphery

Krugman (1991b) argued that a country could endogenously become differentiated into an industrialised "core" and agricultural "periphery". While attempting to realize economies of scale while minimizing transport costs, manufacturing firms would locate in the region with greater demand. However, the location of demand in turn depends upon the distribution of manufacturing activity. This notion of a core and periphery, was then expounded further in Krugman & Venables (1995) and again in Krugman (1998), both of which put forward the notion of the existence of an industrialised core and a deindustrialised periphery. This was set in the context of

international trade and globalization in the former case and in the context of different regions of an economy in the latter case. The forward and backward linkages mentioned earlier transform economies of scale at the firm level to increasing returns at the level of the region as a whole. The role of linkages in the formation of the Krugman core-periphery notion is important because it implies that the entire production of industrial goods can be concentrated in on region.

The model in Krugman and Venables (1995) uses a world consisting of two regions, North and South, each producing two goods, namely agricultural (characterized by constant returns to scale) and manufactured goods (characterized by increasing returns). The latter include intermediate goods used in the production process, as well as goods for final demand by consumers. Neither region has a comparative advantage in either of the goods. However, transport costs between the regions are initially extremely high. Each region will be self-sufficient and produce both goods for own consumption.

In Krugman (1998), the model applies to two regions within an economy. The economy has high transport costs which prevent specialization, implying that each region has an equal portion of manufacturing activity. As transportation costs fall over time, trade between the regions takes place. If there are many different kinds of manufactures, two-way trade in these occurs between the regions. If transport costs remain high, no specialization of activities occurs in the regions. As one region emerges with a stronger manufacturing base, so it will eventually attract more industries involved in intermediate activities (the production process – leading to backward linkages between industries). If one region produces more intermediate goods, better access to these goods will mean reduced costs of production of final goods (forward linkages). This will result in increased movement of manufacturing to that region. When transportation costs fall below a critical level, the global (or domestic) economy will organize itself into an industrialised *core* and deindustrialised *periphery*.

Meanwhile, demand for labour increases in the industrial region or core through the concentration and growth of industry, and a fall in the demand of labour in the *periphery*. Real wages then fall in the *periphery* and increase in the *core*. "Global

economic integration leads to uneven development" (Krugman & Venables, 1995). If transport costs continue to fall, the advantage of being located closer to markets and suppliers begins to decline. The *periphery* then emerges with an advantage in the form of a lower wage rate, to the point where this outweighs the disadvantage of distance from markets and suppliers. Manufacturing activities then move from the core to the periphery, enabling a convergence of wage rates and economic growth between the regions.

The model proposed by Krugman and Venables (1995), Krugman (1998) and then Fujita, *et al.* (1999) is examined and extended in Neary (2001). The latter makes the point that the agglomeration attained in the industrialised core country (or region) pushes up wages in the region and results in a disincentive for manufacturing industry to locate there. This is an important point, because while agglomeration is taken as an advantageous development for the manufacturing industry base on which the core rests, it eventually works against the core in terms of increased wages and leads to a movement of industry to the low-wage periphery.

2.3.3 Concentration and the location decision

Concentration in itself can explain the location of industry to a significant extent. This includes concentration of population in a number of relatively large urban areas with a high level of specialization of activities in these areas. This can be explained by some kind of increasing returns (Krugman, 1991b). That is, advantages are derived from agglomeration effects of being in close proximity to suppliers, markets and even competitors.

A model of industry concentration can be put forward with the key determinants of increasing returns, transport cost and demand. The reasoning is that, in keeping with the notion of scale economies, each manufacturer aims to serve national demand from one location. In order to minimize transport cost, locational choice is driven by proximity of a large local demand. However, demand is maximized where the majority of manufacturers decide to locate. This makes for an element of perpetuity in the location of manufacturing industry in an area. The key element of the model is

that firms' locational choices are determined by the concentration of the industry. This can be shown in a simple quantitative manner in Table 2.2.

Table 2.2: Manufacturing location decision matrix

Location of manufacturing employment	Cost element	Cost implications of location decision		
		East	Both	West
East only	Fixed	4	8	4
	Transportation	3	0	7
	Total	7	8	11
50/50 split	Fixed	4	8	4
	Transportation	5	0	5
	Total	9	8	9
West only	Fixed	4	8	4
	Transportation	7	0	3
	Total	11	8	7

Source: Krugman (1991a)

Table 2.2 shows that there are two regions in the country, namely: East and West in which industry can locate. Cost is divided into fixed, transport and total cost elements. The options for the location of the manufacturing industry are three: east only, west only and a 50/50 split between the two. Similarly, the locational options for the individual firm are to select east, west or both regions.

If manufacturing employment is concentrated in East only, the least cost option for the firm is to locate in the East. This is because although fixed costs are the same regardless of whether East or West is chosen, transport costs are minimized if the firm locates in the region where industry is already concentrated. It does not make sense to locate plants in both regions because transport costs are zero but fixed costs are double what they would be. The decision matrix is the same in the case where manufacturing employment is concentrated in West only, the minimum cost option then lying in the West region.

Ellison and Glaeser (1994) examine concentration of manufacturing industries in the U.S. to determine whether some sectors are more localised than others. They find that most of the industries in the manufacturing sector of the U.S. are indeed localised, but with wide variation in the degree of localisation. The analysis of geographic

concentration so developed is based on two models. One model holds that localised knowledge spillovers may induce firms to locate in close proximity to one another. The other model is based on the notion that firms will locate where some form of natural advantage accrues, e.g. access to raw materials.

2.3.4 History and accident

It is argued by Krugman (1991a) that, while cost and other factors are important, historical events and accident can result in certain activities taking place in particular areas for non-economic reasons at first. However in due course, some economic advantages accrue to industries or activities which perpetuate the activities in the areas long after original rationale has become of lesser importance or even irrelevant (e.g. the continued economic prominence of a large part of the original thirteen colonies of what is now the United States, including the area around the Great Lakes). This is perpetuated by advantages to industry accruing due to concentration of population (i.e. markets) and suppliers (Krugman, 1991a).

Similarly, Bloom and Sachs (1998) point to the prevalence of disease, climate, and distance from markets as being prime reasons for the lack of African industrialisation, and therefore economic growth rates, being relatively stunted over time.

2.4 ADDITIONAL FACTORS INFLUENCING INDUSTRY LOCALISATION, CONCENTRATION AND AGGLOMERATION

According to Weber (1929), the theory of agglomeration refers to local concentrations of industry that arise due to the fact that production of a unit of output can be produced more efficiently in these areas of concentrated production entities. A full discussion of the theory of agglomeration is contained in Weber (1929). Perroux (1950) examines the localization of economic activity in terms of "geonomic" space and "economic" space. The former refers to the concentration of "groups of men" and "groups of things" that can have economic consequences. "Economic" space is an abstract notion, not necessarily confined to geo-political boundaries and could include

the area of influence of major currencies for example. More recently, Fujita and Thisse (1996) explore the reasons why economic activities agglomerate in relatively few places, attributing it to externalities, increasing returns and spatial competition.

2.4.1 Role of transport costs

Transport costs are central to the analysis of the location of various industries as they can influence the prices of goods (e.g. agricultural goods to major cities) and the cost of trade between regions, thereby influencing the cost of living in these areas and migration to and from these areas (Fujita *et al.*, 1999). Transport costs can therefore lead firms to concentrate geographically (see Ellison & Glaeser, 1994).

The estimation of the magnitude of transport costs is important. According to Fujita *et al.* (1999) this can be done by measuring transport costs directly or by examination of trade volumes and determining how these fall with distance (i.e. including distance decay factors).

The direct estimation of transport costs results in many estimates. Rauch (1996) has divided commodities into two groups, namely homogeneous and differentiated. Rauch has also estimated transport costs (in terms of insurance plus freight costs) as approximately 13 per cent of value for homogeneous versus 6 per cent for differentiated goods (Fujita *et al.*, 1999). The second method of estimating transport costs, as a relationship between trade volumes and distance is by gravity models. In this case, distance is an extremely important determinant of trade flows, with the elasticity of trade with respect to distance between –0.6 and –1.0 (see Leamer & Levinsohn, 1996, for further review).

The way that the New Economic Geography deals with transport costs is criticized in Neary (2001) and Davis (1998). These authors argue that the Krugman model assumes that transport costs only matter in the case of manufactures and are assumed to be critical in the establishment of the core-periphery situation. This is alleged to be unrealistic according to these authors not only because agricultural goods would not be transported at zero cost, but because it also affects the core-periphery model. If

transport costs are introduced for agricultural goods, the interaction between the industrialised core and deindustrialised periphery is altered completely and agglomeration does not occur.

2.4.2 Endowment and industry location and agglomeration

A number of studies, see for example Head *et al.*, (1995), hold that industries locate in regions with favourable factor endowments, e.g. location of saw mills in timber areas, power stations near coal deposits, or steel mills near coal or iron ore deposits. Endowments would also include man-made inputs, the supply of which is not affected by the output of any particular industry. Porter (1990) considers factor endowments to include human resources (quantity, skills and cost of personnel), physical resources (abundance, quality and accessibility of land, water, mineral and timber resources), knowledge resources (scientific, technical and market knowledge), capital resources (cost of capital to finance projects) and infrastructure (transportation, communications and civil infrastructure). Ellison and Glaeser (1994) include access to raw materials in their model of natural advantage that seeks to explain localisation of industries in the manufacturing sector in the U.S.

Common ground between the notions of agglomeration and endowment in explaining localisation lies mainly in the fact that both hold that firms in the same industry cluster geographically. However, they differ in that only in the case of agglomeration externalities does the clustering add to the attractiveness of the location. For example, where there is an input that is immobile and exogenously supplied, firms using the input intensively will be attracted to the area (good examples in the South African context would be coal and iron ore). As firms cluster in the area, however, the location becomes less attractive as competition amongst users bids up the input price. Conversely, the same could apply on the demand side where exogenous forces had led to the concentration of downstream demand for a certain industry. This leads to an important point of difference between agglomeration and endowment: agglomeration benefits could result in two states/regions with identical endowments attracting very different shares of the investment in any particular industry.

The issue of agglomeration and regional inequalities is dealt with in Fujita *et al.* (1999). Agglomeration effects are important in two respects because they:

- Result in positive externalities on existing firms already located in an area; and
- Influence firms' location choice and reinforces positive externalities (positive circle of benefits.

In terms of agglomeration effects and its influence on the location decisions of incoming firms, a good reference is Head *et al.* (1995), where the experience of Japanese firms setting up operations in the United States is examined.

The notion of agglomeration effects is based on the premise that firms in the same industry tend to group together or cluster in certain regions. In economic terms, agglomeration effects arise through financial and technological externalities that encourage industry localization (see also the work of Fujita & Thisse, 1996 later in this regard). In terms of empirical work on agglomeration effects, Head *et al.* (1995) make the point that much empirical work needs to be done to establish the extent of the effects of these externalities emanating from geographical proximity. Also, the distances over which these effects operate needs to be better understood. The influx of Japanese firms into the U.S. in the 1980s and early 1990s provided much material in this regard. The work also examines the extent to which agglomeration effects are nationality-specific.

Agglomeration effects may initiate spillovers across provincial and local government borders – this influences the payoffs accruing to competing local governments. An important finding of the Head *et al.*, (1995) study is that Japanese firms do not invest in the same areas as U.S. counterparts. Initial investments by Japanese industries in an area results in additional investments in the same area by Japanese firms in the same sector/industry. This leads to an important conclusion: this pattern of location selection points to an agglomeration-externalities theory of industry localisation rather than a theory based on differences in state/regional endowments of natural resources, labour and infrastructure. Also, the attractiveness of a state does not end at the state

border. The attractiveness of a state increases with the level of industrial activity in neighbouring states.

Empirical studies of agglomeration effects are relatively few. Henderson (1986) examined data for the U.S. and Brazil and found evidence that industry localisation led to increased productivity. Glaeser *et al.* (1992) were able to attribute growth of cities to industry diversity and competition, rather than industry concentration. Dynamic agglomeration effects may be absent due to the mature nature of the industries in the sample.

Head *et al.* (1995) is also important in terms of examining empirical work on the investment location decision which uses a measure of aggregate manufacturing activity as an explanatory variable: Wheeler and Mody (1992), Woodward (1992), Coughlin *et al.* (1991) and Schmenner *et al.* (1987) all provide much useful material in this regard. The general finding of this group of studies is that *firms* are drawn to regions that have substantial manufacturing activity (i.e. they deal with the firm-level decision). In Schmenner *et al.* (1987), it is argued that geographically defined differences are not sufficient in themselves to explain why certain states (or regions for that matter) are more successful than others in attracting new investment in plants (firms). Rather, plant-specific (or firm-specific) factors are more useful in explaining these differences in location decisions.

Relatively fewer studies have examined industry-level location choices and have tended to focus on a limited set of industries. Both Carlton (1983), which examined domestic firms, and Luger and Shetty's (1985) study of foreign firms found evidence of industry-level effects in three specific industries. Smith and Florida (1994) examined investments by Japanese firms that supply components to the motor manufacturing sector and find that they locate near Japanese assembly plants and in areas with greater aggregate manufacturing activity. A key point for this study is that according to Head *et al.* (1995) these studies have not distinguished in any detail between endowment and industry-level agglomeration effects. Manufacturing activity may be correlated with a number of factors favourable to specific locations. The coefficient measuring the attractive power of manufacturing activity partly captures the effect of unobserved endowments.

Localisation is defined as the "geographic location of particular industries" (Head *et al.* 1995). It may occur as a result of numerous causes. However, the one that is of significance is that of agglomeration effects, which itself includes all economies which are an increasing function of the number of firms in relatively close proximity (not size of firms).

The cumulative location choices which make up the process of agglomeration enables "accidents of history" to influence the long-run geographical pattern of industry. This implies that the local expansion of a sector facilitates further expansion by increasing the supply of the factor that made the location attractive initially. Studies of agglomeration effects have focused on three mechanisms by which the phenomenon yields these positive feedback loops: inter-firm technological spillovers, specialised labour and intermediate inputs.

2.4.2.1 Technology spillovers

Technological spillovers are the most oft-quoted cause of agglomeration effects. This implies positive communications of a technical nature passing between participants in an industry. Physical proximity may contribute to the flow of information as it may make contact more casual and less costly. Spillovers may include communication between foreign-owned firms as to operations requirements in a given region, contact with local governments and low cost transportation options. Little is known about these spillovers and their extent, i.e. over geographical boundaries and their relative strength *viz-à-viz* the other possible causes.

Porter (1990) argues that geographic concentration has significant impacts on innovation and development. This is held to be due to the concentration of rival firms, customers and suppliers, all of whom promote efficiencies and specialization. Rival firms located in close proximity to one another will respond more quickly to market changes, while suppliers located near one another will be able to adjust rapidly to customer requirements as they arise. The concentration of customers will assist in supplying feedback on products to firms in the area. The geographic concentration of firms, suppliers and customers in this way will, Porter argues, also attract skilled

people to the area and attract more firms in turn. The concentration of industry therefore plays an important role in the competitive advantage of cities and regions.

Audretsch and Feldman (1996) examine the extent to which industrial activity clusters spatially and the links this geographic concentration may have with knowledge externalities. According to Audretsch and Feldman, private sector and tertiary investment in R&D spillovers can accrue to third party firms in related industries. Although these authors cite studies by Jaffe (1989), Jaffe *et al.* (1993) and Feldman (1994) as examples of evidence of knowledge spillovers, they make the point that there are no studies that examine the underlying propensity for industrial activity to cluster spatially. While studies have examined the extent of dispersal across industries these authors link geographic concentration in manufacturing to industry-specific characteristics, e.g. with respect to the importance of knowledge spillovers. The study examines knowledge spillovers in terms of industry research and development, that is approximated by data on industry expenditure on R&D divided by sales. Other variables include: skilled labour (industry employment comprising professional and skilled workers) and transportation costs (mean distance shipped). A key finding of the study is that innovations tend to occur in certain industries more than others, e.g. the more technology-driven sectors and that propensity for industry and innovation concentrations also vary across industries. Ellison and Glaeser (1994) also examine knowledge spillovers in their model of localisation or geographic concentration of manufacturing industries. Fujita and Thisse (1996) hold that information and ideas have the characteristics of public goods and can therefore generate spillover effects. In so doing, the process of innovation can lead to economic agglomeration.

Fujita and Thisse (*ibid*) distinguish between "technological" externalities and "pecuniary" externalities. Technological externalities refer to the effects of non-market interactions that come about as a result of processes affecting the utility of an individual or the production function of a firm. In contrast, pecuniary externalities refer to the benefits of economic interactions that take place through the pricing mechanism. Each type of externality results in the agglomeration of economic activities. Finally, the issue of technological spillovers, it is argued, is an important omission of the New Economic Geography. Neary (2001) argues that the New

Economic Geography attributes the hysteresis or lock-in of firms to a region to monetary externalities, not from technological externalities or spillovers.

2.4.2.2 Specialised labour

As asserted by Marshall (1920), localised industry creates a pooled market for workers with specialised skills. This attracts specialised workers for two reasons:

- Spatial concentration of industry enables workers who are laid off to find employment in other firms in the same or related industry, assuming not all firms are affected in the same manner or to the same extent (see also David & Rosenbloom, 1990).This ensures that periods of unemployment are relatively short. Firms also benefit from a pool of skilled labour and reduced risk premium embodied in the wage.

- A complimentary effect is proposed by Rotemberg and Saloner (1990): workers in an area will be more willing to invest in human capital if they are confident they will realize the benefits thereof. A monopsony situation will place the advantage in the hands of employers.

2.4.2.3 Intermediate inputs

Krugman (1991b) argues that a combination of scale economies and moderate transportation costs will encourage users and suppliers of intermediate inputs to cluster in close proximity to one another. These agglomeration effects further reduce transportation costs and generate sufficient demand to promote the production of highly specialised components. This attracts assemblers and further levels of specialization. The Korean experience of location and agglomeration is set out in Lee and Choe (1990) in Lewis and Bloch (1998). A two-country model focusing on intermediate goods is dealt with in Fujita *et al.* (1999).

2.4.3 Factors influencing the size of cities

The size of cities, and in turn population density, is an important aspect of industry concentration and can be influenced by numerous factors. In terms of the increasing

returns approach, Henderson (1974) argues that population agglomeration or cities arise because of technological economies of scale in production and consumption and the fact that these activities are neither space- nor land-intensive. Economies of scale may therefore arise in the final output level or intermediate input level, such as in the case of transportation systems or capital and labour market development. In the latter case, the increasing returns approach would be that of Krugman (1991a) which holds that there is tacit competition amongst locations for mobile factors of production.

This does not imply that cities may grow indefinitely. The size of cities varies because different cities specialize in the production of different traded goods. This specialization of activities arises where there are no major positive production benefits from locating two industries in the same city, and locating production of the two goods in the same city only increases total production costs. Labour employed in the two industries experiences increasing per capita commuting costs, while economies of scale occur only with labour employment within each industry.

If the industries are located in the same city, average per capita commuting resource costs for a given level of scale economy exploitation or industry employment within either industry are greater than if the industries are located in separate cities. This is why cities specialize in the production of different traded goods. However, running counter to the specialization advantage are the transportation costs of trade between specialised cities. For example, certain goods such as retail goods are not traded between cities because of the high transportation costs. Cities will tend to specialize in bundles of goods where there are linkages between the production of the goods within the bundles. Fujita and Krugman (1995) and later Fujita *et al.* (1999) argue that manufacturing concentrates in a city because of the forward and backward linkages generated by that concentration.

Brezis and Krugman (1997) argue that major technology changes are more readily adopted by newer, less established urban centres which are then able to usurp the dominant position enjoyed by older more established urban centres as the technology matures. Examples examined in Brezis and Krugman (1997) include the movement of the textile industry from Holland (cities such as Haarlem and Leiden) to Britain (cities such as Manchester) and the declining importance of the steel industry in the United

States, in Pittsburgh for example. This would not necessarily be the case for large, diversified cities with a greater variety of activities, but in smaller cities with more limited or focused export bases.

The importance of urbanisation economies to industry clusters (or groupings) is pointed out in Hoover and Garratiani (1984). In terms of urbanisation economies, economies accrue to clusters as the size and concentration of the urbanised area increases. The level of urbanisation is therefore an important determinant of industry concentration.

The random growth theory approach holds that a distribution of cities of different sizes emerges from simple stochastic processes (Davis & Weinstein, 2002). This work draws on the notion of Zipf's Law which covers the distribution of city sizes; and is explored in detail in Gabaix (1999). The location fundamentals theory can be thought of as a variation of the random growth theory. Rather than city growth being random, the fundamental economic characteristics or endowments of locations are themselves random.

There are differences between the increasing returns, random growth and location fundamentals theories in terms of how city size is affected by large, temporary shocks. The increasing returns approach holds that even small shocks may lead to large and permanent changes in relative city size. The random growth theory holds that growth follows a random walk in that all shocks will have permanent effects. The location fundamentals theory approach holds that as long as the shock is temporary, even major shocks are reversed as the locational advantages enjoyed by the city manifest themselves in rapid growth rates that assist the city's recovery back on to its long term growth trajectory.

Davis and Weinstein (2002) use the case of Japanese cities bombed in World War II to argue that the influence of location fundamentals is an extremely strong factor in the determination of population density and the size of cities, even in the face of major shocks as long as they are *temporary*. Even a major temporary shock to a city such as sustained air attack and even atomic bombing in the cases of Hiroshima and

Nagasaki, were not sufficient to push these cities off their projected long term population trajectories.

The relevance of the material on the growth of cities for this study lies in the role that cities can play in the concentration of industry in South Africa. In this regard, an important implication is the way in which cities are taken into account as large urban centres and significant concentrations of population that dominate economic activity in a region.

2.4.4 Effect of national boundaries on trade and labour mobility

Fujita *et al.* (1999) point out that even the most "open" borders, e.g. the Canada-U.S. border can inhibit international trade. On average the exports of Canadian provinces to other provinces of that country are up to twenty times larger than to U.S. states located a similar distance or even closer. Engel and Rogers (1996) estimate that a national border can imply obstacles to trade equivalent to 1 700 miles distance. This is an especially important issue in the case of South Africa which is not only much further than this distance but also faces borders, modal changes (land, sea) and tariff barriers.

National barriers impose strict and unavoidable restrictions on the movement of the population, even where populations may be broadly homogeneous in social and cultural terms. This will mean population movements between regions of the same country will be easier and more utilized than between neighbouring countries for example (Fujita *et al.* 1999).

The rationale to the model is that labour mobility is critical for agglomeration to occur and can be examined in the context of the manufacturing sector as both a producer and consumer of intermediate goods. A region that has a relatively large manufacturing sector will have a large number of intermediate activities and products. This implies reduced production costs for final goods, i.e. forward linkages. A final goods sector with a significant manufacturing emphasis will provide a sizeable market for intermediates, i.e. backward linkages. These linkages lead to a specialization that

means the concentration of manufacturing (or certain sub-sectors thereof) in particular regions.

2.4.5 Transport networks and regional divergence

The density of, and access to, transportation networks has also been identified as an element accounting for divergence between regions (Krugman, 1991a). Transportation networks have traditionally been more dense in the developed parts of the United States, often resulting in reduced transport costs through better access (in the absence of excessive congestion). The theory holds that if transport costs are reduced between certain centres (economies of scale in transport), location of manufacturing is made more attractive due to advantages of access to markets. Investment in infrastructure can therefore be a key determinant in attracting industry and enhancing economic growth (see Martin & Rogers, 1995 for a study on impacts on location of investment in domestic and international public infrastructure in the context of the European Union). Whether a city is a port with access to international markets is also an important factor (see Fujita & Mori, 1996 and Fujita *et al.*, 1999).

2.4.6 Review of variables and objectives tested in studies on location and concentration

Table 2.3 summarizes the variables used in more recent empirical studies on industry location and concentration as well as the nature of the relationship being tested, using the studies conducted by Bartik (1985) and Schmenner *et al.* (1987). It is noteworthy that a number of key variables produced results different to what was expected. Both studies used location of new plants as dependent variables.

Education level of the population, depicted by Bartik (1985) as state median level of education and by Schmenner *et al.* (1987) as percentage completing high school, both expected a positive coefficient. Both studies, however, produced a negative coefficient. In the case of population density (population per square mile of state), Bartik did not put forward any expectations, hence the question mark, while

Schmenner expected a positive coefficient. In the event, population density for both produced negative coefficients.

Road density was used by Bartik as an explanatory variable. Again, a positive relationship was expected, but a negative coefficient resulted. Results for these explanatory variables were also not significant.

The results for some of the other variables were better. Wage rates (manufacturing wages) were expected by both studies to be negative, obviously because new plants were expected to steer clear of high wage centres. Both studies produced negative and significant results for this variable. Percentage unionization of the workforce also produced negative results as expected because new plant locations would tend to avoid areas of high union membership. Results were also significant. Building and construction costs were expected to be negative as new firms would want to minimize building expenses. The results of the studies were mixed: Bartik's results were positive, while those of Schmenner *et al.*, were negative as expected. The results for tax rates were negative as expected, as firms avoided locating new plants in states with high tax rates.

Table 2.3: Summary of studies on industry location and concentration

Study	Explanatory variables (unit of measurement)	Relationship tested	Finding
Schmenner, Huber & Cook (1987)	Unionism (percentage unionization);	-	-
	Wage rates (average wage);	-	-
	Education (percentage completing high school);	+	-
	Building costs (building cost index);	-	-
	Energy costs (average cost per KWH eq);	-	+
	Tax rates (corp & income tax);	-	-
	Geographic/demographic factors (mean winter temperature);	-	-
	Population density	+	-
Bartik (1985)	Land area (ln state land area excl. federal land)	+	+
	Unionization percentage (percentage unionized in state)	-	-
	1-corporate tax rate (ln 1-corp tax rate)	+	+
	Property tax rate (ln 1+ business property tax rate)	-	-
	Unemployment insurance tax rate (1+ unemployment insurance rate)	-	+
	Workers' compensation insurance rate (1+ workers' compensation insurance rate)	-	+
	Road miles (ln highway miles per square mile)	+	-
	Existing manufacturing activity (ln total manufacturing hours in state per square mile)	+	+
	Wage rate (ln average manufacturing wage)	-	-
	Education level of population (state median years of education)	+	-
	Construction costs (ln construction cost index)	-	+
	Population density (ln 1970 population per square mile)	?	-
	Energy price (ln average energy cost per unit in manufacturing)	-	-
	Work stoppages (% of work time in state lost to work stoppages 1972-1977)	-	-

2.5 CONCLUSIONS

The economic literature covered in this chapter shows that the subject of industry concentration has a long history, beginning with such authorities as Weber and Marshall, and more recently Krugman. It therefore exhibits solid theoretical underpinnings. Some empirical studies have also been examined, indicating that models on the subject have also been tested, if only fairly recently.

An examination of empirical work undertaken (see Schmenner et al, 1987 & Bartik, 1985) and theoretical work such as Krugman (1991b) indicates that the concentration of economic activity is determined largely by the presence of variables such as education, skills levels and presence of transport infrastructure and the agglomeration effects that are generated through the geographic distribution of these characteristics. The choice of explanatory variables such as these is therefore entirely in keeping with these previous studies and the need to explore the role of geographic distribution of these variables in the concentration of economic activity (manufacturing industry) in South Africa is the central objective of this dissertation. The use of the term "new economic geography" is extremely appropriate in this regard.

CHAPTER 3

REVIEW OF INDUSTRIAL DEVELOPMENT IN SOUTH AFRICA

3.1 INTRODUCTION

This chapter examines the development of South African industry from a geographical perspective. It then goes on to examine the key policy changes affecting the concentration of industry in South Africa both during the apartheid era and during the democratic era. The policy elements applied during the former period were the Industrial Decentralisation Policy and the Regional Industrial Development Programme. The policy applied during the latter period, until the present, includes the Spatial Development Initiatives and the Regional Industrial Location Study.

3.2 OVERVIEW OF DEVELOPMENT OF THE SOUTH AFRICAN ECONOMY FROM A GEOGRAPHICAL PERSPECTIVE

The South African economy has undergone fundamental change in recent years. The mining sector has become less important while manufacturing and services have grown (DBSA, 1999). This chapter of the study sets out the principal characteristics of the South African economy, the policies applied with a view to influencing the concentration of industry in the country and the effectiveness of these policies. This will include the decentralisation policy applied prior to the 1994 democratic elections in the country and the various industrial strategies adopted by the government post-1994. Table 3.1 shows how the structure of the South African economy has changed between 1980 and 1998.

Table 3.1:Economic growth and structural change in South Africa, 1980 to 1998

Sectoral contribution	1980	1998	% change 1980-1998
Gross domestic product (GDP) ($m)	80 544	133 461	2.85*
Agriculture value added (% of GDP)	6	4	(2)
Industry value added (% of GDP)	48	32	(16)
Manufacturing value added (% of GDP)	22	19	(3)
Services value added (% of GDP)	46	64	18

Source: World Bank
(* denotes annual average percentage change in GDP between 1980 and 1998)

Since 1994, South Africa has been divided into nine provinces under a federal system of government. Each of the nine provinces (state-level equivalent) is composed of a number of magisterial districts (county-level division). The provinces concerned are:

- Western Cape
- Northern Cape
- Eastern Cape
- Free State
- KwaZulu-Natal
- Gauteng
- Mpumalanga
- Northern Province
- North West

The geographic pattern of economic activity has changed over time in South Africa, as set out in Table 3.2.

Table 3.2: Contribution to gross domestic product (GDP) per province, 1991 & 1996

Province	% contribution to GDP (1991)	% contribution to GDP (1996)
Gauteng	37.2	36.5
Northern Province	3.7	4.2
Mpumalanga	8.6	7.2
KwaZulu-Natal	14.9	16.1
Eastern Cape	7.6	7.5
Free State	6.4	5.7
Northern Cape	2.1	2.3
Western Cape	13.8	15.6
North West	5.7	4.9

Source: Development Bank of Southern Africa (2000)

Table 3.2 sets out the changes between 1991 and 1996 of contribution to GDP of economic activity in the provinces. It is apparent that the traditional inland core areas of the economy, e.g. Gauteng and Free State have contributed a declining share of GDP. As Table 3.2 shows, the contribution to GDP by Gauteng has fallen between 1991 and 1996 from 37.2 per cent to 36.5 per cent, while that of Free State has fallen from 6.4 per cent to 5.7 per cent. Meanwhile, the contribution of Northern Province, KwaZulu-Natal and Western Cape have increased: Northern Province (3.7 to 4.2 per cent), KwaZulu-Natal (14.9 to 16.1 per cent) and Western Cape (13.8 to 15.6 per cent). All of these are situated on the border of South Africa, either inland or on the coast that may explain a possible shift of industry location from the hinterland to the borders of the country.

This could imply some level of change in the core of the economy from inland to areas with outlets to the sea or near international borders to minimize transport costs in the latter two cases. In the case of Northern Province, growth could stem from the fact that since the deregulation of road freight in 1989, the level of road freight traffic has increased through the Beit Bridge border post, involving some level of activity along the corridor into Africa. Previously, this freight would have moved northwards via Botswana by rail.

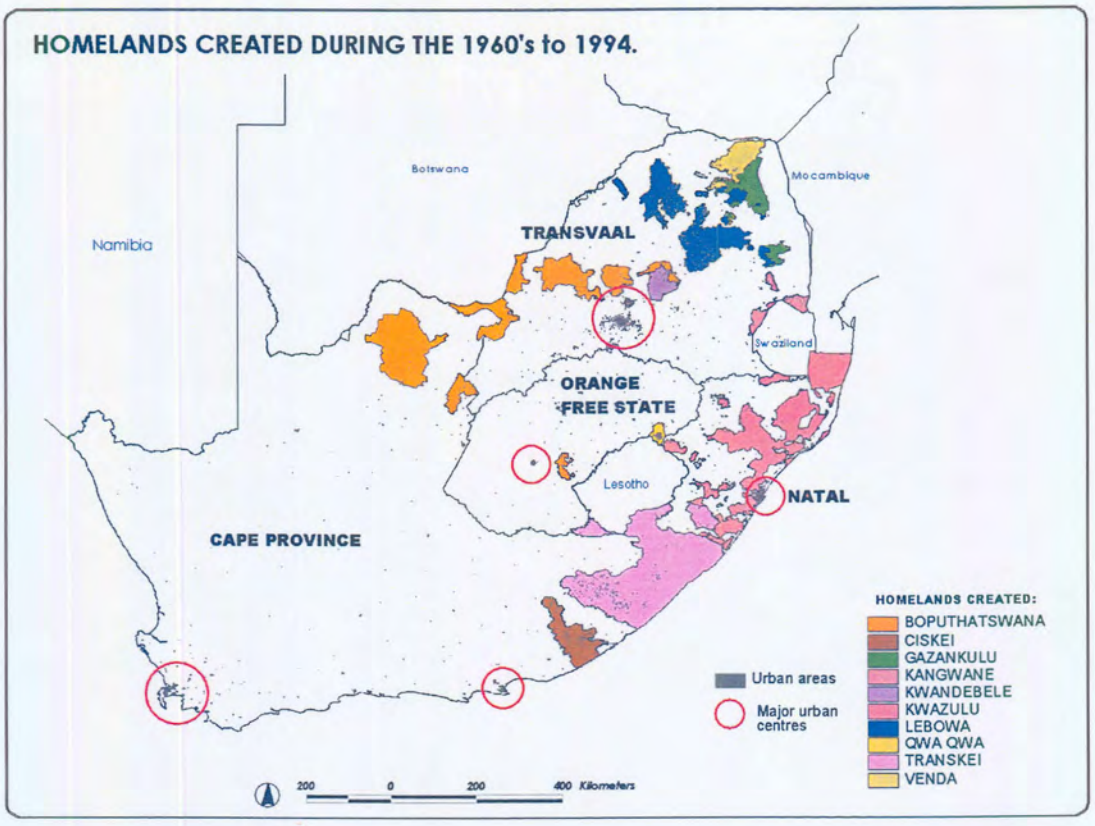
3.3 KEY POLICY CHANGES AFFECTING THE CONCENTRATION OF INDUSTRY IN SOUTH AFRICA

This section comprises an analysis of the main initiatives applied in South Africa to influence the location of industry.

3.3.1 Regional economic policy in South Africa during the Apartheid Era: Industrial Decentralisation Policy and the Regional Industrial Development Programme

The regional economic policy applied to South Africa during the apartheid era is examined in this section. Its importance lies in the fact that along with the creation of the political entities known as homelands (see map in Figure 1), a policy of *industrial decentralisation* was pursued, which involved the use of various incentives (e.g. subsidies based on number of workers employed) to manufacturing industry to establish itself in certain areas of the homelands. The country, including the homelands, was divided into nine development regions for the purposes of the industrial decentralisation policy. Each of the nine development regions of the country and its development programme was set out in the RIDPs. The rationale to the policy was to place industry close to concentrations of labour to prevent large scale transportation of workers into the main industrial centres in line with the notion of *apartheid* or separate development (transport was also subsidized).

The extent to which this policy influenced the location of industry and impacted on employment is an important issue. That is, the issue is whether industry simply moved to maximize the benefits of the incentives offered to firms wishing to establish themselves outside the main centres and whether they remained in these locations once these incentives were removed.



Source: CSIR

Figure 1: Homelands in South Africa[5]

In this regard, Lewis and Bloch in DBSA (1998) make the point that "…three decades of regional industrial development programmes premised on a logic of promoting dispersion… did not actually accomplish much dispersal of industry". In an assessment of the dispersal of industry in South Africa for the period 1939-1979, Maasdorp (1990) concluded that dispersal did not materialize in the country.

The RIDP was evaluated towards the end of the 1980s to determine whether and to what extent it had been effective (Development Bank of Southern Africa, 1989). Some important conclusions were formulated by a Panel of Experts drawn from the academic and business environment in the country.

[5] The system of homelands included "autonomous" states such as Transkei, Bophuthatswana, Venda and Ciskei - the so-called TBVC states - and the "self-governing territories" which included the remainder of the areas identified.

The study contained a number of important conclusions that are relevant for this study (Development Bank of Southern Africa, 1989):

- The RIDP did not have a major impact on rural-urban migration patterns. Nor did it have an impact on the movement and location of the urban population in the country or the level of urbanisation in the country; and
- Comparative advantage of regions was important – regions ought not to have been evaluated only in terms of their success in manufacturing activities but also in terms of agriculture, tourism, financial and business services and other non-manufacturing sectors.

The RIDP included a comprehensive set of incentives to attract firms to the allocated industrial development points. An overview of these incentives, and their respective funding allocations, are contained in Table 3.3.

Table 3.3 shows that the largest single incentive was that of the rail rebate (R1.08 billion allocated over the period 1982-1991). The next largest item was that of the employment concession (R920 million) that encouraged firms to employ workers as the incentive was based on numbers employed. The interest concession on industrial investments was also significant (R696 million) and the rebate on road transport (R589 million). These main incentives in the RIDP could be said to have encouraged firms to employ workers simply to maximize their employment concession, while the substantial transport rebates would have mitigated against the location of industrial enterprises in terms of distance from markets and supporting facilities.

The question then arises as to the success of the programme in generating employment opportunities. An overview of the number of projects, employment created and associated capital invested in the RIDP per component is contained in Table 3.4.

Table 3.4: Components & results of RIDP incentives, 1982 to 1991

Component of programme	Number of projects	Job opportunities	Capital investment (R000s)
Industrial Development Points	2 670	136 139	2 583 425.03
Deconcentration Points	502	24 955	932 567.24
Metropolitan Areas	259	6 640	1 214 605.34
Other Industrial Points	619	20 371	542 490.46
Ad hoc cases	167	8 086	204 118.46
Total	**4 217**	**196 191**	**5 477 206.53**

Source: Decentralisation Board Annual Reports 1982/83 to 1990/91

As Table 3.4 shows, the RIDP resulted in 4 217 projects between the years 1982 to 1991. This entailed 196 191 jobs and an investment of R5 477 million. The largest component of the RIDP involved projects at Industrial Development Points, which comprised 2,670 projects (63 per cent of total projects), 136 139 jobs (69 per cent of total jobs) and R2 583 million (47 per cent of total investment). Projects at Deconcentration points were next important in terms of jobs and involved 502 projects (12 per cent of total projects), 24 955 jobs (13 per cent of total jobs) and R932 million (17 per cent of total investment). The next important component of the RIDP was that of projects located at Other Industrial Points. This involved 619 projects (15 per cent of total projects), 20 371 jobs (10 per cent of total jobs) and R542 million (10 per cent of total investment). Finally, Metropolitan Areas accounted for 259 projects (6 per cent of total projects), 6 640 jobs (3 per cent of total jobs) and R1 214 million (22 per cent of total investment).

The importance of the incentives according to the organizations involved in the schemes were, in order, set out in Table 3.5.

Table 3.5: Attitudes to RIDP incentives of organizations involved

Incentive	Ranking
Labour subsidy	1
Interest concession	2
Rental subsidy	3
Rail rebate	4
Road transport	5
Housing subsidy	6
Relocation grant	7
Training allowance	8
Tender preferences	9

Source: Development Bank of Southern Africa (1989)

From Table 3.5, it is important to note that the labour subsidy was the most popular incentive to the entrepreneurs involved, although it was not the most important incentive in financial terms. Its importance could be linked to the ease with which the labour subsidy could be manipulated by firms - because it was based on number of employees, workers could be employed to fill numbers without actually working. In contrast, transport rebates were the largest single expenditure item as an incentive but were only ranked after some of the other incentives.

The report by the Panel of Experts on the RIDP (Development Bank of Southern Africa, 1989) referred to the fact that agglomeration economies derived by firms would include the growth of skilled labour and the benefits derived from being in close proximity to markets and suppliers. However, the report did argue that in the absence of these agglomerations effects, firms would relocate in line with incentives offered under programmes such as the RIDP, such as the aforementioned labour incentives.

In its analysis of the success of the decentralisation programme, the report went on to state that: "Industrial development flourishes in areas with adequate physical

infrastructure, social facilities, support services and skilled labour. Evidence suggests that these pre-conditions are not met at all the development points. A clear relationship exists between industrial and urban development. Particular cases where successful integration was achieved are urban complexes such as Mdantsane/Dimbaza, Ladysmith/Ezakeni and Mogwase".

This was a significant finding because it stated that the RIDP was not successful in many cases due to the lack of fundamental attributes of the development points. Moreover, the programme seems to have met with success in several larger urban centres and not in several smaller centres with no comparative advantage.

3.3.2 Industrial policy in the Democratic Era: Spatial Development Initiatives and the Regional Industrial Location Study

Since the country's democratic elections in 1994, industrial policy was driven through the SDIs, together with initiatives such as the RILS.

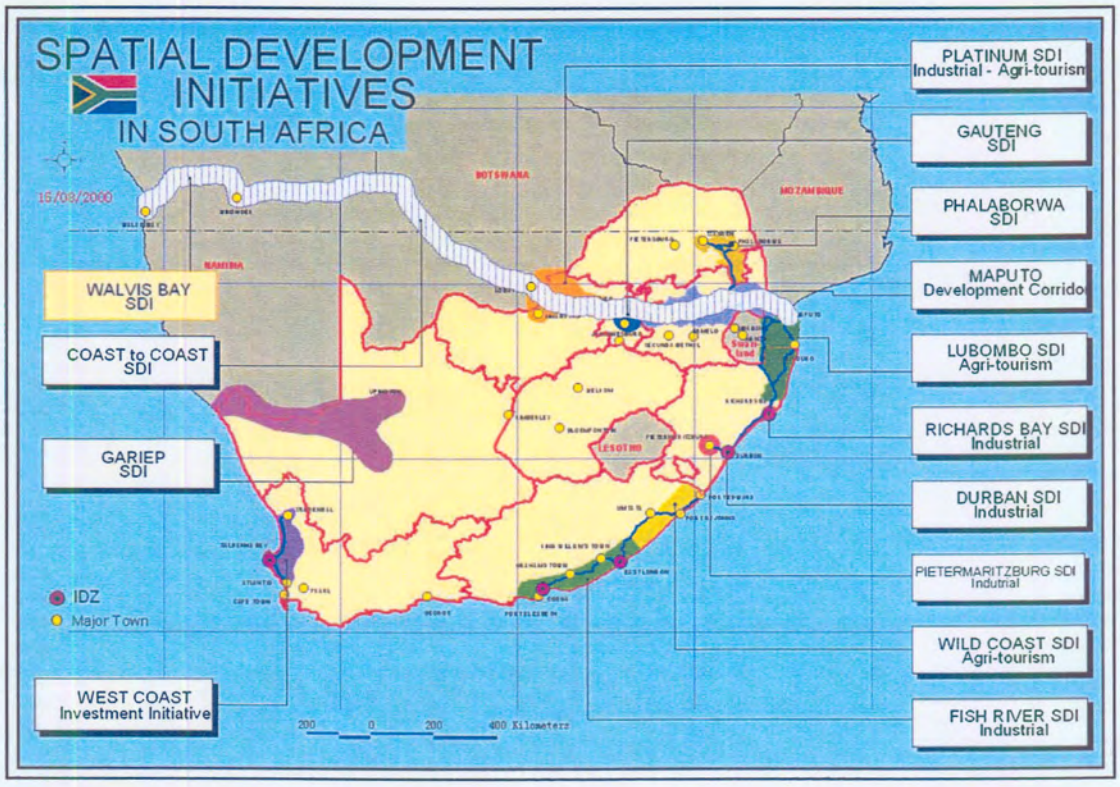
The SDI process began in 1995 and was the first attempt by the new government (primarily the Department of Trade & Industry and the Department of Transport) to take economic policy into the implementation arena. It sought to identify key areas of the country that could be the focus for economic development in the post-apartheid era and promote investment in these areas. The areas would be identified on the strength of the core economic activities (along sectoral lines) that characterized the area and then strategies could be devised focused on these lead sectors. Anchor projects would then also be identified as being the key projects that could initiate and sustain the SDIs into the future. More often than not, the SDIs encompassed existing or proposed transport infrastructure and took the form of a development corridor. A key component would then be the active promotion by government of investment in the anchor projects in the SDIs by the private sector. The role of government would then be to identify projects and to facilitate involvement by interested parties.

An overview of some of the different types of SDIs and their respective sectoral focus is provided below:

Industrial:	KwaZulu-Natal SDI
	Fish River SDI
	Richards Bay-Empangeni SDI
	Phalaborwa SDI
Agri-Tourism	Lubombo SDI
	Wild Coast SDI
Mixed sectors	Maputo Development Corridor
	West Coast Investment Initiative

Other initiatives are in the process of identifying projects, e.g. the Platinum SDI. In addition, various centres were identified for the location of Industrial Development Zones to support the SDIs, e.g. Saldhana, Durban and Richards Bay.

The SDIs referred to above have identified projects (as at 2000) to the value of $32.4 billion, creating 86 000 jobs. A breakdown of some of the sectors, and their *direct* relative potential employment opportunities is contained in Table 3.6 below. Figure 2 shows the locations and themes of the SDIs in South Africa.



Source: CSIR

Figure 2: Location and themes of SDIs in South Africa

The rationale for the SDIs and a review of the entire programme can be found in Development Bank of Southern Africa (1998). Lewis and Bloch (in DBSA, 1998) set out the aims of the SDI programme as achieving economic growth and regional development through three key components:

- Crowding in private sector investment through public sector investment;
- Establishment in specific SDI areas of IDZs to encourage investment; and
- Facilitation of investment through identification of investment projects and linking these to potential investors through investor conferences.

Table 3.6: SDI capital investment and anticipated employment creation per economic sector

Sector	Number of projects	Fixed capital (Rm)	Jobs (min)	Jobs (max)	Capital required per job (Rands) (max case)
Agriculture & agriprocessing	124	380.40	26 223	26 427	14 394
Fishing & marine products	10	5.14	495	3 460	1 486
Forestry	1	13.00	5 000	5 000	2 600
Automotive & transport	42	1 512.44	7 085	11 649	129 835
Chemicals, rubber & plastics	53	8 915.93	6 483	7 083	1 258 779
Clothing & textiles	29	30.54	2 553	2 553	11 961
Electronics	2	9.50	463	463	20 518
Energy	5	3 062.50	0	0	
Food & beverages	18	936.05	325	350	2 674 440
Furniture & wood products	23	456.66	3 030	12 000	38 055
Infrastructure	112	2 612.18	1 135	1 395	1 872 532
Leather & footware	5	3.67	230	420	8 731
Machinery & electrical equipment	1	3.00	130	130	23 077
Metals & metal products	59	8 949.53	13 070	13 167	679 694
Mining & minerals processing	52	2 850.0	3 848	3 968	718 247
Nonmetals & non-metallic products	11	473.32	381	381	1 242 322
Other	5	31.37	0	0	
Printing, pulp & paper	2	280.00	1 200	1 200	233 333
Property development	36	121.50	1 459	1 609	75 514
Services	13	78.78	0	0	-
Tourism	165	1 728.00	3 311	3 575	483 354
Total	**773**	**32 378.60**	**84 942**	**86 309**	**375 148**

(Source: www.sdis.org.za)

The criteria which have driven the designation of SDIs are centred around, firstly, the need to assist areas which were deemed to have been particularly adversely affected by past policies such as the creation of homelands, e.g. the Eastern Cape. Secondly, areas would be selected where they exhibit "inherent economic potential" and would therefore promise good investment returns.

A further key study in the post-apartheid era would be the RILS completed by the Industrial Development Corporation, which examined the "modus industry" or concentration of industry in terms of number of manufacturing establishments or employees, at the magisterial district level. The RILS also examined the clustering of industries at the regional or provincial level.

Table 3.7 presents data from the study showing the characteristics of the various provinces in terms of their economic relationships with other provinces in South Africa and the rest of the world. On the output side, data was examined in the RILS regarding the various provinces, that is whether they produce for intermediate demand in the province, final demand in the province, exports to other provinces and international exports. On the inputs side, the provinces were examined in terms of whether they imported from other provinces, from the rest of the world or from local (within the province) sources.

Table 3.7 shows that KwaZulu-Natal province is the most export-oriented province, with 18.5 per cent of output being exported internationally and a resulting lesser dependence on other provinces as a market (64.9%). The province also shows a relatively high proportion of output being taken up by intermediate demand (12.1 per cent of output). Gauteng exhibits a similar pattern in that it shows the least dependence on other provinces as a market (56 per cent of output) and international exports of 13.6 per cent of output which is supported by a high intermediate demand for output (24.5 per cent of output) and relatively high final demand (5.9%). It is significant that the provinces of Western Cape, Northern Province and Mpumalanga, all "border" provinces albeit two inland, show a high proportion of international exports (12.8, 13.1 and 14.4 per cent

respectively) with low levels of final demand in the two inland provinces (1.7 and 0.7 per cent for Northern Province and Mpumalanga respectively). The provinces of Northern Cape and North West have the highest proportions of exposure to other provinces as markets (89.7 and 87.8 per cent respectively) and the lowest intermediate and final demand within the province, indicating a low level of industrial beneficiation capacity in these provinces.

In terms of inputs, Gauteng, KwaZulu-Natal and Western Cape show a strong leaning to local (within province) sources (53.8, 40.6 and 41.1 per cent of inputs respectively). Provinces such as Eastern Cape (18.7 per cent of inputs) and Mpumalanga (16.9 per cent of inputs), due to their proximity to external supplies but also as a result of their being relatively less-developed industrially. Gauteng and KwaZulu-Natal also show a reliance on international imports (15.1 and 16.1 per cent respectively). The Northern Cape, Free State, Northern Province and Eastern Cape all import from other provinces to a significant extent (67.9, 63.5, 59.5 and 58.9 per cent of inputs respectively).

Table 3.7: Provincial economic demand for inputs and outputs (%)

Province	Demand for Total Output (%)*				Intermediate Input Demand (%)*		
	Internal Demand		External Demand		Internal Demand		
	Intermediate Demand (%)	Final Demand (%)	Provincial Exports (%)	International Exports (%)	Imports from Other Provinces (%)	International Imports (%)	Local Sources (%)
Eastern Cape	5.1	1.9	84.6	8.4	58.9	18.7	22.4
Free State	3.8	3.3	80.2	12.7	63.5	8.6	27.9
Gauteng	24.5	5.9	56.0	13.6	31.1	15.1	53.8
KwaZulu-Natal	12.1	4.5	64.9	18.5	43.3	16.1	40.6
Mpumalanga	6.4	0.7	78.5	14.4	47.0	16.9	36.1
North West	2.8	1.0	87.8	8.4	55.1	8.4	36.5
Northern Cape	1.7	0.7	89.7	7.9	67.9	8.6	23.5
Northern Province	1.7	1.5	83.7	13.1	59.5	11.0	29.5
Western Cape	9.6	5.1	72.5	12.8	44.1	14.8	41.1

* Each of Output and Input sum separately to 100 per cent for each province
(Source: Industrial Development Corporation, Regional Industrial Location Study, Executive Summary, 1996)

3.3.2.1 Sectoral concentration and export competitiveness

The RILS included the calculation of two ratios aimed at categorizing the various sectors in the provinces in terms of their concentration using the location quotient (product specialization ratio or PSR) and their competitiveness (export specialization ratio or ESR).

The sectors in each province were evaluated in the RILS according to whether they performed well in terms of either ratio, neither or both. Those sectors that had a high PSR and ESR were termed "performers". The categorization of sectors per province is contained in Table 3.8. The table shows that only sectors in five provinces managed to attain the status of "performers" (the strongest being KwaZulu-Natal), while the situation was not much different in terms of the next category, "Small but Export focused". Provinces such as Free State displayed a distinct inward focus, while the Northern Cape showed only "Weak Sectors" in its economic portfolio. Gauteng showed itself to have a spread of industries in all categories, indicating some level of restructuring necessary. Mpumalanga and North West failed to show themselves strongly in the "Performers" block. However, both KwaZulu-Natal and Western Cape came up with industries in all categories but the weakest.

Table 3.8: Sectoral performance in terms of PSR and ESR per province

RILS Category	KwaZulu-Natal	Western Cape	Northern Cape	Free State	Eastern Cape	Mpumalanga	Northern Province	Gauteng	North West
Performers High ESR High PSR	Basic metals Chemicals Paper Wood Fabricated metals	Chemicals Food proc			Non-metallic minerals prod Fabricated metals	Textiles		Textiles Wood	
Small but Export Focus High ESR Low PSR	Food proc	Fabricated metals Basic metals Textiles		Textiles	Textiles Food proc Wood		Basic metals	Non-metallic minerals Chemicals Basic metals	Paper Textiles Fabricated metals
Internal Focus Low ESR High PSR	Textiles Non-metallic minerals	Non-metallic minerals Wood		Chemicals Food proc Wood Paper Non-metallic minerals	Basic metals Paper	Food proc Paper Basic metals Non-metallic minerals	Food proc Chemicals Paper Non-metallic minerals	Fabricated metals	Basic metals Chemicals Food
Weak sectors Low ESR Low PSR		Paper	Wood Basic metals Textiles Chemicals Food proc Fabricated metals Paper Non-metallic minerals	Fabricated metals Basic metals	Chemicals	Chemicals Fabricated metals Wood	Wood Textiles Fabricated metals	Food proc Paper	Non-metallic minerals Wood

Source: Industrial Development Corporation (1997)

3.4 CONCLUSIONS

Industrial policy and strategy in South Africa has undergone major changes in emphasis over the years. This has involved the shift from the RIDP with its main objective of industrial decentralisation in the period prior to 1994 and especially the years 1982 to 1991. This was followed by the SDI programme and the RILS of the post-1994 democratic era with its emphasis on the development of certain key areas based on their perceived comparative advantage. This policy shift has important implications for the study because a key objective of the study will be to determine whether and to what extent the policy of industrial decentralisation was successful.

CHAPTER 4

DATA REVIEW

4.1 INTRODUCTION

This chapter presents an overview of the data used in the analysis of the determinants of industry concentration in South Africa.

4.2 DATA SOURCES

Data used in the cross section analysis is set out in Table 4.1:

Table 4.1: Data used in the cross section analysis

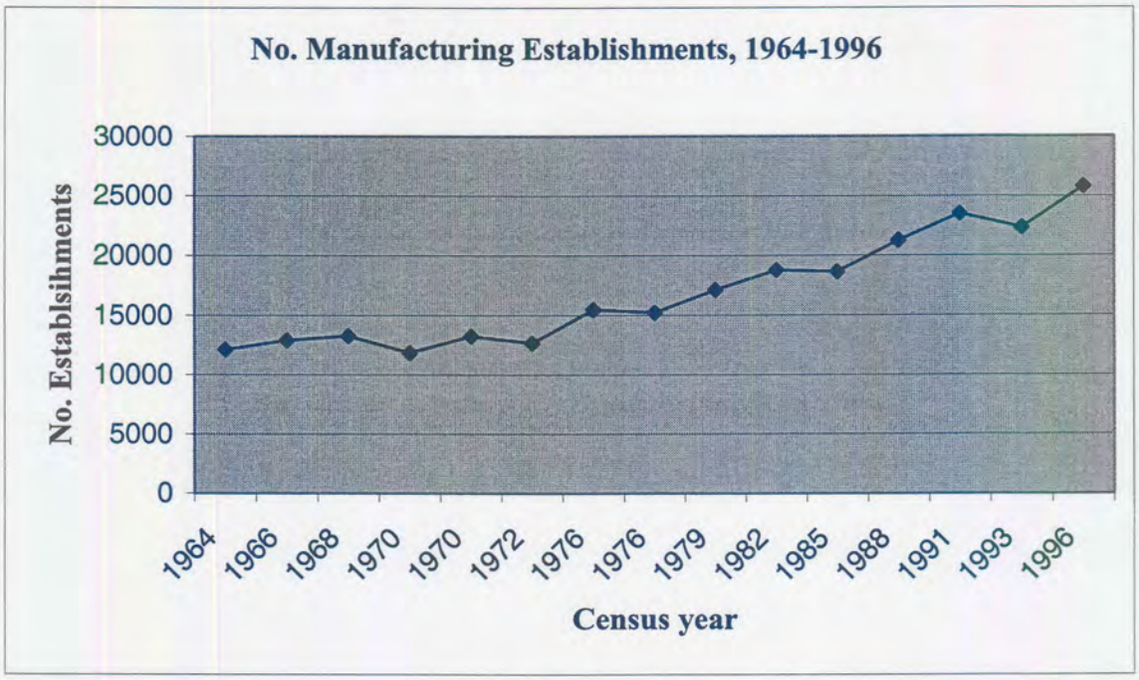
Variable	Components	Source	Year
Manufacturing Establishments	Total Number of Manufacturing Establishments per magisterial district	Statistics South Africa Manufacturing Census	1996
Manufacturing Output	Total Manufacturing Output per magisterial District	Statistics South Africa Manufacturing Census	1996
Education	Number of persons with secondary education and higher per magisterial district	Development Bank of Southern Africa	1994
Skills	Number of skilled workers in the workforce, i.e. those of a professional, technical, managerial & administrative level per magisterial district	Development Bank of Southern Africa	1994

Variable	Components	Source	Year
Income	Average household income per magisterial district	Statistics South Africa Population Census	1996
Urban	Urban population per magisterial district	Statistics South Africa Population Census	1996
Population	Total population per magisterial district	Statistics South Africa Population Census	1996
Area	Area of magisterial district in hectares	Statistics South Africa Population Census	1996
Road infrastructure	Length of surfaced roads in kilometers per magisterial district	The Knowledge Factory ("Enhanced Spatial Platform")	2000

These data were then used to construct a number of variables for modeling purposes in Chapter 5.

4.3 REVIEW OF DATA USED IN THE ANALYSIS

Taking into account the variables examined in studies such as Schmenner, *et al.*, (1987), Figure 3 depicts the overall data on number of establishments in the manufacturing sector for Censuses of that industry between 1964 and 1996, a distinct upward trend being noticeable. However, a number of issues need to be borne in mind when examining this data over time. Classifications of industry have changed over the years, e.g. in 1970 and again in 1991, government enterprises have been included and excluded (in 1976) and establishments in the former TBVC states (Transkei, Bophuthatswana, Venda and Ciskei) have been included since 1994. The latter point is significant in terms of the analysis of the effects of the decentralisation policy, and would explain to some extent the pronounced upturn in the data between 1993 and 1996. The fluctuations in data may be due to the impacts of economic sanctions in the years pre-1994, as well as cyclical downturns and upswings in the economy (e.g. the dip in 1970, and then between 1991 and 1993 – the white collar recession).



Source: Statistics South Africa

Figure 3: Number of manufacturing establishments in South Africa, 1964 to 1996

Tables 4.2 and 4.3 contain data for the variables used in the analysis across all provinces of South Africa.

Table 4.2 shows a high concentration of South Africa's manufacturing industry in Gauteng (43.4%), with substantial concentrations in KwaZulu-Natal (19.3%) and Western Cape (18.5%). The remaining provinces account for 18.8 per cent of manufacturing establishments. A slightly different pattern is apparent from the spread of manufacturing output across provinces. Gauteng accounts for 40.1 per cent of manufacturing output, while KwaZulu-Natal accounts for 22.1 per cent and Western Cape 14.6 per cent. The remaining six provinces account for 23.2 per cent of total manufacturing output.

Table 4.2: Key data used in the analysis across provinces: dependent variables

Province	Manufacturing Establishments (% of total), 1996	Manufacturing Output (% of total), 1996
Western Cape	18.4	14.6
Northern Cape	1.3	0.4
Eastern Cape	5.9	8.8
Free State	3.8	3.7
KwaZulu-Natal	19.4	22.1
Gauteng	43.1	40.1
Mpumalanga	3.2	6.8
Northern Province	2.3	1.2
North West	2.6	2.3
Total	100	100

Source: Statistics South Africa

The same pattern exists for education levels of the population, with Gauteng showing 2.3 million people in the province with a secondary education or higher. KwaZulu-Natal has 1.5 million people conforming to this criterion and Western Cape 1.1 million people with a level of higher education. A number of other provinces, namely: Free State (473 737 persons), North West (478 762 persons) and Northern Province (531 109) have lower populations of educated people.

In terms of skilled members of the workforce, the distribution is similar to that of educated population. Gauteng has the largest number of skilled workers (435 327), while KwaZulu-Natal and the Western Cape have 259 624 and 212 418 skilled workers respectively. The Northern Province has the next highest number of skilled workers, 128 574. The Free State (69 920), North West (69 339) and Mpumalanga (68 734) have broadly similar numbers of skilled workers living in these provinces.

Table 4.3: Key data used in the analysis across provinces: explanatory variables

Province	Educated population	Skilled workers	Average household income (Rands)	Urbanisation (% of total)	Population (% of total)	Area (ha) (% of total)	Surfaced Road length (km)
Western Cape	1 106 713	212 448	35 592	13.0	7.5	9.2	8 349
Northern Cape	131 666	20 280	20 433	2.7	2.0	25.9	6 708
Eastern Cape	NA	NA	14 133	10.7	14.8	20.3	9 614
Free State	473 737	69 920	15 706	8.4	6.1	9.1	10 329
KwaZulu-Natal	1 515 273	259 264	15 335	21.8	27.3	9.6	7 978
Gauteng	2 306 965	435 327	41 081	29.0	15.0	1.2	6 332
Mpumalanga	392 572	68 734	20 480	5.0	7.4	5.6	9 356
Northern Province	531 109	128 574	18 863	2.4	10.2	8.5	8 256
North West	478 762	69 339	14 622	6.9	9.9	10.5	8 197
Total	6 936 797	1 263 886	19 994	100	100	100	75 119

Source: Study data

The data for average household income reveals a slightly different pattern. The province with the highest income is Gauteng (R41 081 per household), followed by Western Cape (R35 592), Mpumalanga (R20 480) and Northern Cape (R20 433). All other provinces, including KwaZulu-Natal, have average household incomes below the national average of R19 994. In terms of urbanised population, Gauteng has the largest number of people (29 per cent of the total), KwaZulu-Natal (21.8 per cent of the Urban population) and Western Cape (13 per cent of the total). Of the remaining provinces, population Eastern Cape holds a fairly high proportion of urbanised population (10.7%) while Free State (8.4%) and North West (6.9%) feature prominently than in other attributes.

The position is quite different if the total population per province is examined. KwaZulu-Natal (27.3%) is followed by Gauteng (15%) and a number of rural provinces, Eastern Cape (14.8% of the population.), Northern Province (10.2%) and North West (9.9%). In terms of surface area, Gauteng is extremely small (1.2% of the total surface area of the country), while Northern Cape is the largest (25.9 %) and Eastern Cape (20.3%). Most of the remaining provinces are of similar size: North West (10.5%), KwaZulu-Natal (9.6%), Western Cape (9.2%), Free State (9.1%) and Northern Province (8.5%). In terms of length of surfaced road infrastructure, Free State has the longest surfaced road infrastructure (10 329 km), while Gauteng has the shortest (6 332 km). A number of provinces have similar lengths of surfaced road infrastructure: Western Cape (8 349 km), Northern Province (8 256km) and North West (8 197km).

4.4 CONCLUSIONS

The review of data used in the empirical analysis in this chapter indicates that Gauteng has the largest concentration of manufacturing establishments, the highest concentration of urban population and the smallest land area. However, the data also shows that a number of provinces with small amounts of manufacturing industry have large portions of the population (e.g. Northern Province and North West), an indication of high levels of unemployment.

CHAPTER 5

DATA ANALYSIS AND RESULTS

5.1 INTRODUCTION

This chapter deals with a cross-section analysis of the determinants of industry location and concentration in South Africa. This entails an examination of the determinants of concentration of manufacturing concerns in each of the nine provinces comprising South Africa. It seeks to determine whether significant differences exist between the provinces and the structural and regional causes of these differences using magisterial district level data (each of the nine provinces are composed of a number of magisterial districts).

This was similar to the approach used by Cotton (1988) and Neumark (1987) and taken further in Levernier and Ewing (1998) which involved the application of a decomposition method to analyse interregional differences in incomes and wages, based on differences in attributes or characteristics of the regions and differences linked to regional location as such. Where the attributes of the regions were the same, differences in incomes were argued to be due to factors such as racial discrimination (non-attribute based differences). The Cotton-Neumark decomposition method, so named by Levernier and Ewing (1998), therefore, is used as a means of distinguishing between those characteristics that are attributable to variable differences between regions from those that are tied to regional location specifically. The decomposition method is used in this study to analyze differences in manufacturing sector concentration and output between provinces in South Africa in terms of whether they are based on attributes or characteristics of the respective provinces (termed attribute-based differences), or whether they are specifically linked to the location of the provinces (attributes all the same between provinces) with factors other than those included in the model (termed non-attribute based differences).

5.2 HYPOTHESIS

The hypothesis for the analysis is that industry concentration, measured in terms of number of manufacturing establishments per magisterial district (a measure of industry concentration), in South Africa depends upon education level of the population, skills level of the workforce, average household income, urbanisation level of the population, population density and density of surfaced road infrastructure. A model using manufacturing output (as a measure of industry size) was also tested against the stipulated explanatory variables. A dummy variable was also included in both models to account for the decentralisation programme. The data used in the models and the specifications of the models are contained in Section 5.3.

5.3 DATA AND MODEL SPECIFICATIONS

Two model specifications were used in the empirical analysis. The information set (explanatory variables) was the same for both, but differed in terms of the dependent variables employed.

The first specification that was tested is as follows:

ManuEst = f(EduPop, SkillsEmp, AvHldInc, UrbPop, PopDens, RoadDens, DecentDum)

where:
ManuEst: manufacturing establishments
EduPop: education level of the population
SkillsEmp: skills level of the workforce
AvHldInc: household income
UrbPop: urbanisation level of the population
PopDens: population density
RoadDens: road density
DecentDum: decentralisation dummy

Secondly, a model with manufacturing output as dependent variable was specified as follows:

ManuOutpt = f(EduPop, SkillsEmp, AvHldInc, UrbPop, PopDens, RoadDens, DecentDum)

where:
ManuOutpt: manufacturing output

The explanatory variables were selected on the basis that they are the most easily influenced by government in South Africa, e.g. through spending on education, skills development, urbanisation (reorganization of local authorities structures) and population density (i.e. through land use planning) and investment in road transport infrastructure. Average household incomes might be influenced by tax reductions or by income-enhancement programmes. A dummy variable was included to account for the case where the magisterial district contained a development point under the decentralisation programme.

The explanatory variables used in the analysis were derived using the adjustments to the base data in section 4.1 as per Table 5.1.

Table 5.1: Adjusted explanatory variables used in model

Explanatory variable	Definition
Education level of population (EduPop)	Percentage of the population in the magisterial district with secondary education and higher
Skills level of workforce (SkillsEmp)	Percentage of the workforce in the magisterial district with professional, technical or managerial skills
Household income	Average household income in the

Explanatory variable	Definition
(AvHldInc)	magisterial district
Urbanisation level of population (UrbPop)	Percentage of the population in the magisterial district classified as urban
Population density (PopDens)	Population per square hectare area of the magisterial district
Road density (RoadDens)	Length of surfaced roads per square hectare area of the magisterial district
Decentralisation dummy (DecentDum)	Magisterial district contained a development point under decentralisation programme

A number of distinctions need to be made in regard to variables that might seem to be similar or related. Level of education of the population is quite distinct from skills level of the workforce. The former is a general measure of education relating to the population of the magisterial district, while the latter relates to the skills possessed by the labour force in the magisterial district. Urbanisation level of the population relates to the population residing in urban centres and settlements. This is not the same as population density that does not relate to urban areas explicitly but represents the density of population in relation to the entire area of the magisterial district. This distinction has important implications. If the population of the magisterial district increases, then the population density increases. However, the level of urbanisation of the magisterial district might decrease if the increased population is not in the urbanised area.

A number of additional variables, both dependent and explanatory, were also introduced to the models outlined in this section. In terms of dependent variables representing firm size (as distinct from industry size), these included per capita output, employees per establishment, output per worker and output per establishment. These variables were introduced in line with the notion that increasing firm size would occur together with industry concentration, as in the case of Lichtenburg in Hoover and Giarratani (1984). Additional explanatory variables included average manufacturing wages and manufacturing employment. The inclusion of these

variables was intended to test the contention of the Bartik (1985) and Schmenner, *et al.*, (1987) as well as the New Economic Geography that manufacturing industry follows average manufacturing wages and manufacturing employment. The results of these additional variables were examined to determine whether they improved the basic models set out in this section.

5.4 ECONOMETRIC TOOLS AND METHOD

A cross-section analysis was undertaken testing the determinants of the model mentioned previously. It included the use of the decomposition method contained in Cotton (1988), Neumark (1987) and Levernier and Ewing (1998) to compare the various provinces of South Africa in terms of these relationships. Ordinary Least Squares was used as the method of estimation in the decomposition exercise.

5.4.1 Decomposition method

The application of the decomposition method followed the one used first in Cotton (1988), Neumark (1987) and Levernier and Ewing (1998). The decomposition equation was set out in Cotton (1988) for wage decomposition and applied to racial income differences. Neumark undertook a similar study and applied it to the analysis of gender issues. Levernier and Ewing (1998) examined which variables could be included in an equation determining income and analysed interregional differences in mean income.

The Cotton-Neumark decomposition approach as set out in Cotton (1988) and Neumark (1987), and explored further in Levernier and Ewing (1998), entailed an equation of the following form for any combination of census regions:

$$Y_1 - Y_2 = \Sigma B^* (X_1 - X_2) + \Sigma X_1 (B_1 - B^*) + \Sigma X_2 (B^* - B_2)$$

where:

Y_1, Y_2: mean of dependent variables between regions 1 and 2

X_1, X_2: mean value of characteristic X in the two regions

B_1, B_2: value of coefficients from OLS regressions

B^*: weighted average of coefficients from OLS regressions for all regions.

The Cotton-Neumark decomposition method employed in Levernier and Ewing (1998) was then used to distinguish between the explained and unexplained components of income variations between regions.

Adapted for the South African situation, this involved using magisterial district level data in a cross-section analysis across the nine provinces, with dependent variables consisting of those listed previously, namely: Manufacturing Establishments and Manufacturing Output, as measures of manufacturing industry concentration and variation in manufacturing output and industry size respectively. These were regressed on the explanatory variables contained in Table 5.1 for each province separately, the regression results then being used in the decomposition and involved comparing the other provinces in turn to one province, i.e. Gauteng. The decomposition equation used in the analysis took the following form:

$$Y_1 - Y_2 = \Sigma B^* (X_1 - X_2) + \Sigma X_1 (B_1 - B^*) + \Sigma X_2 (B^* - B_2)$$

.....

.....

$$Y_1 - Y_9 = \Sigma B^* (X_1 - X_9) + \Sigma X_1 (B_1 - B^*) + \Sigma X_9 (B^* - B_9)$$

where subscripts 1 through 9 relate to provinces in South Africa.

The decomposition involved the calculation of explained differences between the base province, i.e. Gauteng, and each of the other provinces in terms of the attributes used (the first expression on the right hand side of the above equations). The provinces were then compared in terms of non-attribute based differences, i.e. differences between the base province and the other provinces assuming the provinces all have the same attributes (second and third expressions on the right hand side of the equations above). A decomposition result showing positive-attribute based differences means that the base province has an advantage over the other province due to the attributes of the model. A positive non-attribute based difference shows that the base province is still dominant but not because of the attributes. In the case of the non-attribute based differences, all provinces have the same attributes. Negative non-attribute based differences mean that the other province is performing better than the base province, with the attributes the same across provinces.

5.5 RESULTS EXPECTED

It was expected that *a priori* there should be a strong relationship between the dependent variables and the independent variables for the overall cross-section analysis. The results of the decomposition exercise for the nine provinces were expected to indicate the differences in magisterial districts between provinces in respect of number of establishments as a measure of industry concentration and output as a measure of industry size. More explicitly, it would indicate the average variation in both establishments and output per magisterial district from province to province.

The expected signs of the coefficients in the relationships with both Manufacturing Establishments and Manufacturing Output as dependent variables were as contained in Table 5.2.

Table 5.2: Expected signs of coefficients per explanatory variable

Explanatory variable	Expected sign of relationship with dependent variable
Education level of population	+
Skills level of workforce	+
Average Household Income	+
Urbanisation level of population	+
Population density	+
Road density	+
Decentralisation Dummy	+

From Table 5.2, it was expected that the relationship between both number of manufacturing establishments and manufacturing output on the one hand and education level of the population on the other would be positive. That is, the level of industry concentration would depend upon the percentage of the population with secondary education and higher: Firms would be expected to concentrate around educational institutions and educated populations because of the benefits of being near an educated supply of labour. This also promises some level of increasing returns put forward in Krugman (1998). Also, manufacturing output (measure of manufacturing establishment size) would be expected to be highest where the level of education of the population would be highest. The relationship with skills level of the workforce was expected to be positive, with the concentration of manufacturing establishments moving with the supply of skilled labour. Skills level of the workforce was also expected to lead manufacturing output or establishment size as the greater concentrations in skilled labour will result in increased output or larger firms. Again, this conforms to the theory of concentration put forward by Krugman (see section 2.3.3). Manufacturing industry would be expected to concentrate and benefit from locating near a highly skilled workforce because of the increasing returns which might result, as per Krugman (1998) and Marshall (1920). This implies an agglomeration effect because skilled workers would be expected to move between the firms of the same industry.

The coefficient for average household income was expected to be positive, that is, the number of manufacturing establishments and output will increase with household incomes due to the proximity of a market and the demand this implies. This conforms to the theory that industry will concentrate near sources of demand. The coefficient for urbanisation level of the population was expected to be positive, with geographic concentrations of manufacturing establishments and larger levels of output (industry size) being associated with a higher level of urbanisation, again to maximize increasing returns (Krugman, 1991b & Krugman, 1998). The relationship with population density was expected to be positive, because the concentration of manufacturing industry would be expected to lead concentration of the population in terms of the area of the magisterial districts and provinces to take advantage of increasing returns (Krugman, 1991b & Krugman, 1998). The coefficient for length of surfaced road infrastructure was expected to be positive with industry clustering in areas with high density of levels of road infrastructure so as to reduce transport costs (Krugman, 1991a). Finally, the coefficient for the decentralisation dummy was expected to be positive. That is, the manufacturing industry was expected to be concentrated where the decentralisation programme might have been targeted, if it was successful.

An important component of the analysis using the decomposition method was the number of magisterial districts comprising each province. These were later used in the calculation of weighted averages of the slope coefficients and the means used in the decomposition undertaken. The number of magisterial districts per province are contained in Table 5.3.

Table 5.3: Magisterial districts per province

Province	Magisterial districts
Western Cape	41
Northern Cape	26
Eastern Cape	77
Free State	52
KwaZulu-Natal	63
Gauteng	23
Mpumalanga	31
Northern Province	29
North West	28
Total	**370**

The analysis that follows will distinguish between the location and concentration of firms together in the manufacturing sector, represented by number of Manufacturing Establishments, and the variation in total output and therefore industry size as represented by Manufacturing Output.

5.6 ANALYSIS OF RESULTS: MANUFACTURING ESTABLISHMENTS

This section presents the analysis of results for the decomposition relating to Manufacturing Establishments.

5.6.1 Regression results: Manufacturing Establishments

In terms of the methodology, a regression was run on each of the provinces individually, using number of Manufacturing Establishments per magisterial district as the dependent variable. The adjusted R^2 values for each of the regressions per province are contained in Table 5.4.

Table 5.4: Regression results per province, using Number of Manufacturing Establishments as dependent variable

Province	Adjusted R^2
Gauteng	0.912
North West	0.768
Mpumalanga	0.746
Northern Cape	0.724
Western Cape	0.701
Free State	0.687
Eastern Cape	0.629
KwaZulu-Natal	0.626
Northern Province	0.568

The regression models run for each of the provinces yielded varying results in terms of the relationship between Manufacturing Establishments (as a measure of manufacturing industry concentration) as the dependent variable and the stipulated explanatory variables. All regressions yielded adjusted R^2 values of greater than 0.56, indicating strong regressions in cross section-analysis terms (see Baltagi, 1999). Gauteng (0.912), North West (0.768), Mpumalanga (0.746), Northern Cape (0.724) and Western Cape (0.701). A number of provinces exhibited adjusted R^2 values slightly less than this: Free State (0.687), Eastern Cape (0.629) and KwaZulu-Natal (0.626). One province, Northern Province, showed an R^2 result of 0.568, the lowest of all the regression results. Therefore, the results indicated that the goodness of fit of the model was good across provinces, and that the explanatory variables explained a significant portion of the variation in the dependent variable.

The results for each of the regressions are shown in Table 5.5. The coefficients obtained for each variable are contained in the table. The relevant t-statistics are in parentheses below the coefficients. Results significant at the 10 per cent level are indicated in bold.

Table 5.5: Regression results for number of Manufacturing Establishments, coefficients with t-statistics in parentheses

Province	Intercept	EduPop	SkillsEmp	AvHldInc	UrbPop	PopDens	RoadDens	DecentDum
Western Cape	68.620 (0.51)	-4.320 (-0.79)	**30.201** **(3.58)**	0.002 (0.46)	**-5.109** **(-2.41)**	0.602 (1.08)	3 505.3 (1.46)	74.344 (1.07)
Northern Cape	-36.129 (-1.96)	1.844 (1.40)	-0.080 (-0.75)	0.001 (0.89)	0.040 (0.26)	**9.866** **(2.92)**	47.005 (0.02)	5.425 (0.51)
Eastern Cape	-57.944 (-3.67)	NA	NA	0.003 (1.55)	0.113 (0.50)	**5.062** **(6.21)**	187.01 (0.10)	**62.480** **(2.73)**
Free State	-50.641 (-3.76)	1.066 (0.97)	1.862 (1.56)	**0.003** **(3.21)**	-0.098 (-0.53)	**0.300** **(1.96)**	-901.75 (-1.12)	**20.148** **(1.76)**
KwaZulu-Natal	-307.113 (-5.25)	-5.510 (-1.21)	**6.749** **(2.18)**	**0.020** **(4.18)**	-0.322 (-0.20)	-0.208 (-0.80)	**6 424.36** **(2.52)**	-32.981 (-0.48)
Gauteng	2 723.11 (2.21)	**43.146** **(6.15)**	19.198 (1.06)	-0.009 (-1.31)	**-39.873** **(-2.96)**	**1.276** **(2.52)**	**5 032.34** **(2.01)**	**-1 149.85** **(-2.48)**
Mpumalanga	-32.717 (-2.75)	0.318 (0.43)	0.097 (0.22)	**0.003** **(5.59)**	-0.040 (0.24)	0.112 (0.34)	70.966 (0.13)	-10.181 (-1.12)
Northern Province	-12.450 (-0.77)	0.237 (0.29)	-0.139 (-0.40)	**0.002** **(2.54)**	**-0.556** **(-1.90)**	-0.927 (-1.49)	1 424.85 (1.49)	14.387 (1.43)
North West	-57.991 (-4.20)	0.432 (0.61)	0.862 (1.05)	**0.003** **(3.26)**	0.159 (0.77)	**3.293** **(2.31)**	1 057.90 (0.83)	**26.113** **(1.86)**

Note: Results significant at the 10 per cent level are indicated in bold.

The regression results obtained show, as in the case of Cotton-Neumark, that some variables are more significant in some regions than others. The regression results show that the coefficients for education level of the population were generally positive as expected (except for Western Cape and KwaZulu-Natal) but significant in only one province, Gauteng (t-statistic of 6.15). The results for education level of the population were surprising not only because the results of only one province (Gauteng) had the correct sign and significance, but the sign of the results for two of the larger provinces (Western Cape and KwaZulu-Natal) was unexpectedly negative. This latter result indicates that manufacturing industry might concentrate in these provinces for direct access to export routes and might be extremely outward-oriented as the results of the RILS study showed. Moreover, manufacturing industry might be attracted to these regions by the presence of other factors.

The results for education level of the population have important implications for policy, because they suggest that concentration of the manufacturing sector is dependent upon the education level of the population in one very significant instance, that of Gauteng, the most developed of the provinces and the one with the highest concentration of manufacturing industry. Therefore, the fact that the province with the largest portion of the manufacturing sector had the expected coefficient sign and significant results indicates that education levels may be important in determining a certain level of industry concentration. Moreover, manufacturing industry in Gauteng might be of such a type as to require a labour force with a higher level of education (i.e. be technologically sophisticated or highly service-oriented and so require well-educated labour), while the manufacturing sector in provinces such as North West might be of a relatively low level of sophistication and might not require highly educated labour (results for education level of the population were not significant in this and other provinces). The demand for labour might therefore differ widely across provinces according to the educational requirements of the industry.

The strong positive result in terms of education for Gauteng was because most magisterial districts in the province have a number of establishments, together with some

level of education of the population, ranging from the magisterial district of Johannesburg with 3 121 establishments and 80 per cent of the population with a secondary education or higher, to Westonaria with 16 establishments and 29 per cent of the population with secondary education or higher. The other provinces differed in that the concentration of establishments in the magisterial districts were much lower, in some cases zero while the level of education of the population was reasonable, as in the case of magisterial districts in KwaZulu-Natal such as Ndwedwe which has zero establishments but 37 per cent of the population with a secondary education or higher, Nkandla with no establishments and 34 per cent of the population with secondary education or higher and Newcastle with 167 establishments and 7 per cent of the population with secondary education and higher. The Western Cape also displayed a negative coefficient, with various magisterial districts possessing neither establishments nor a population with a high level of education. This accounted for provinces such as North West with few if any establishments and low levels of education: Ganyesa with no establishments and 2 per cent of the population with secondary education and higher and Klerksdorp with 139 manufacturing establishments and 23 per cent of the population with higher than secondary education.

The skills level of the workforce was found to be negative in two cases (Northern Cape and Northern Province) contrary to expectations. The fact that this result occurred in two of the most extensive, rural and less-developed provinces implies that there might be other factors that influence industry concentration in these areas. It was positive as expected in all other cases but significant in two important instances, namely (t-statistics in parentheses): Western Cape (3.58) and KwaZulu-Natal (2.18). The results for the skills level of the workforce was, on the face of it, surprising given the emphasis in the theory on the role of education and skills in determining the location of industry and the reliance of the manufacturing sector on a supply of skilled labour. However, the significance of the results for Western Cape and KwaZulu-Natal does confirm the theory that industry will locate close to supplies of skilled labour. The results suggest that there might be other factors influencing the concentration of industry in the other provinces. Also, the nature of the manufacturing industry in these provinces might require a highly skilled labour force, while industry in other provinces (e.g. Mpumalanga) might not. That is, the

manufacturing industry in KwaZulu-Natal and the Western Cape might require a more skilled labour force than that in other provinces because it is more technologically- or business service-orientated. This is similar to the result for education level of the population.

The results for KwaZulu-Natal and Western Cape were positive in terms of the sign of their coefficients because where a number of establishments were located, the skills level of the workforce was relatively high, e.g. Hlabisa with 10 establishments and 16 per cent of the workforce skilled. Areas such as Cape Town itself accounted for 1 456 establishments and 36 per cent of the workforce skilled, a high number for both variables. Areas such as Wynberg also host 703 establishments with 31 per cent of the workforce being skilled. This can be contrasted with a province such as Mpumalanga where there was some variation in establishments but very little variation in skills level of the workforce. Most magisterial districts had a relatively small number of establishments and a skills level of the workforce below 20 per cent, i.e. under 20 per cent of the workforce would have some level of managerial or technical skills. An example would be Witbank with 109 establishments (relatively high number of firms versus the rest of the province) and only 10 per cent of the workforce possessing some level of managerial or technical skill. This accounts for the low coefficient and positive result for the province. A province such as Northern Province produced a negative coefficient because of a number of magisterial districts that have very few or no manufacturing establishments at all and a relatively high percentage of the workforce that is skilled, or a number of manufacturing establishments but with a relatively unskilled workforce. Some examples of this in the Northern Province were: Hlanganani with no establishments and 36 per cent of the workforce skilled, Letaba with 77 manufacturing establishments and 9 per cent of the workforce skilled and Soutpansberg with 52 establishments and 10 per cent of the workforce skilled.

Average household incomes yielded the strongest results in that regressions for five of the nine provinces resulted in positive and significant coefficients (t-statistics in parentheses): Free State (3.21), KwaZulu-Natal (4.18), Mpumalanga (5.59), Northern Province (2.54)

and North West (3.26). The result for Gauteng was negative for average household income. The latter result was surprising given the prominence of Gauteng in the Manufacturing sector but could indicate that in a province with a high average household income such as Gauteng, labour could have a location preference away from areas where manufacturing industry was situated because they could afford to have more choice of where they live. The nature of the demand for labour therefore differed between Gauteng and provinces such as North West and Northern Province, the former requiring educated and skilled labour.

Most of the provinces therefore showed positive relationships between manufacturing establishments and household incomes, implying that a significant number of magisterial districts in these provinces had both large numbers of establishments and high average household incomes, or low numbers of both. For example, the Lower Umfolozi magisterial district in KwaZulu-Natal had 147 manufacturing establishments and an average household income of R25 471 per annum, while the magisterial district of Inkanyezi in the same province had no establishments and an average household income of R8 137 per annum. Gauteng province generated a negative coefficient for manufacturing establishments and household incomes (not a significant result), because a magisterial district such as Soshanguve had one manufacturing establishment but nevertheless had an average household income of R24 444 per annum. Other magisterial districts in Gauteng such as Johannesburg indicated 3 121 establishments and an average household income of R81 957 per annum, while a magisterial district such as Randburg indicated 787 manufacturing establishments (25% of the number of establishments of Johannesburg) with an average household income of R72 689 per annum (88 per cent of Gauteng's average). This sheds light on the negative result emanating from Gauteng for this variable.

Urbanisation level of the population showed mixed results, with both positive and negative coefficients, of which three were significant: Western Cape (-2.41), Gauteng (-2.96) and Northern Province (-1.90). This result suggests that the influence of the policy of apartheid might have been considerable in determining where people resided, often

great distances from their places of work and in areas designated as "peri-urban" or "rural". The urban structures within the country would have been strongly influenced by these arrangements even after the demise of apartheid. The results also indicate that labour chooses to reside in areas away from where it is employed.

Results then indicated that the higher the level of urbanisation of the population, the lower the number of manufacturing establishments. The Western Cape, one of only two provinces that generated a significant result albeit a negative one, had magisterial districts such as Hopefield with 2 magisterial districts but 72 per cent of the population living in an urban conurbation (i.e. an area designated as urban), while the Cape magisterial district had a high number of establishments (1 456) and 99 per cent of the population of the magisterial district urbanised, and the Strand magisterial district had 86 establishments and an urbanisation level of 98 per cent. Free State province also produced a negative result but this was not significant. This is explained by the fact that a magisterial district such as Hennenman had 14 manufacturing establishments and an urbanisation level of 81 per cent, while Welkom had 143 manufacturing establishments and 81 per cent of the population residing in designated urban areas. The results indicate that the centres of manufacturing activity were located away from major designated urban areas in some cases, although in several major manufacturing centres the level of urbanisation was high.

Population density was also positive in most cases, negative in two cases and significant in five provinces (t-statistics in parentheses): Northern Cape (2.92), Eastern Cape (6.21), Free State (1.96), Gauteng (2.52) and North West (2.31). Moreover, population density was significant in these four cases where the coefficient was positive as expected. That population density was not significant in provinces such as KwaZulu-Natal could be due to the effects of apartheid on the distribution of population in the country. In certain provinces, manufacturing industry seems to have concentrated in line with population density, to be near the market or source of demand, or near an ample supply of labour. This would indicate that the nature of manufacturing industry in provinces such as

Northern Cape and Eastern Cape is such that it requires relatively unskilled labour that can be sourced simply by locating near concentrations of population.

The results for population density therefore indicated a strong positive relationship with manufacturing establishments. This implies that population densities are key magnets for manufacturing establishments in that they imply markets for the output of those establishments. In the case of the Eastern Cape, this pattern held: Port Elizabeth indicated 659 manufacturing establishments with a population density of 60 persons per square hectare, and a great number of magisterial districts such as Jansenville with 2 manufacturing establishments and 0.25 persons per square hectare. Similarly, the North West exhibited a positive result with Rustenburg magisterial district showing 122 establishments and a population density of 5 persons per square hectare, while Coligny hosted 2 manufacturing establishments and 0.6 persons per square hectare. The findings of areas such as the Northern Province indicated a negative result. This is because a concentration of industry in the province such as Pietersburg showed 137 establishments but a population density of 1 person per square hectare, while the Bolobedu magisterial district possessed 2 establishments and 28 persons per square hectare.

The results for road infrastructure density were also mixed overall, but two provinces showed significant results: KwaZulu-Natal (2.52) and Gauteng (2.01). This is an important result, because it shows that road transport infrastructure density was significant in two provinces that are the most developed in the country. The minimization of transport cost put forward in the theory as a rationale for industry concentration would therefore hold. The influence of road density on manufacturing establishments has implications for the investment in infrastructure to support industrial development through, for example, the SDI programme, because it suggests that investment in infrastructure is an important component in the concentration of manufacturing industry.

The results indicated a strong positive influence of infrastructure density to manufacturing establishments in the case of KwaZulu-Natal. This can be explained by the fact that Durban magisterial district possessed 2 121 manufacturing establishments and a

road density of 0.08 kilometres of paved road per square hectare of area. Meanwhile, Vulindlela displayed no manufacturing establishments and zero paved road infrastructure, while Polela had one establishment and likewise no pave road infrastructure. Conversely, Free State generated unexpectedly negative results due to the fact that a magisterial district such as Witsieshoek had 62 manufacturing establishments and 0.001 kilometres of pave roads per square hectare. This can be contrasted to Ficksburg with 17 establishments and 0.01 kilometres of pave roads per square hectare, hence the negative result of the regression analysis.

The results of the decentralisation dummy indicated that the Eastern Cape (t-statistic of 2.48), Free State (1.76), North West (1.86) and Gauteng (-2.48) were significant. This result shows that in a very poorly developed province such as the Eastern Cape, the concentration of manufacturing establishments occurred in magisterial districts included as part of the decentralisation programme. This seems to have been the case in the other provinces such as North West. However, in the case of Gauteng, the most developed province and the one with the highest concentration of manufacturing industry, only one magisterial district featured in the decentralisation programme. The decentralisation programme would therefore seem to have failed in spreading manufacturing industry over the country because the dominant position of Gauteng in the manufacturing industry has continued in the face of the decentralisation programme.

The regression results explored in the preceding paragraphs are fundamentally important in the light of the theory put forward earlier in the study and applied to South Africa. The South African manufacturing sector does seem to have concentrated in line with an educated population and a skilled workforce, as in the case of highly developed provinces such as Gauteng, the Western Cape and KwaZulu-Natal. This implies that the type of manufacturing industry concentrating in these provinces requires a labour force with a higher level of technical skill than that in other provinces. The urbanisation level of the population was significant but negative, indicating that the manufacturing sector might be concentrated away from urbanised populations, possibly due to past policies of apartheid, but also due to a choice of labour to reside away from the workplace as such. The results

for road transport infrastructure densities show a strong relationship between concentration of manufacturing and transport infrastructure. This runs in accordance with the theory when it is argued that industry concentrates in order to exploit increasing returns, large reserves of skilled and educated labour, and to minimize transport costs through infrastructure provision. These explanatory variables are important but only in certain cases and the results are mixed overall. In the case of average household income and population density the results conform to the theory, whereby industry concentrates close to the market or its source of demand. This also indicates that the manufacturing industry in these areas places proximity to population as a source of labour above the educational and technical skills of that labour. The decentralisation programme has also influenced the concentration of manufacturing industry in provinces with a low degree of development, such as the Eastern Cape, and was not effective in cases such as that of Gauteng with a high concentration of manufacturing. The decentralisation programme would therefore seem to have failed in terms of dispersing manufacturing industry throughout the country.

The results obtained from the regressions also contrast with those obtained by Bartik (1985) for education level of the population (state median years of education), population density (population per square mile) and road miles (highway miles per square mile) applied to the location of new manufacturing plants in the U.S.. In the case of education levels, Bartik obtained negative coefficients that were not significant (contrary to his expectations), while his results for population density were also negative and not significant. These results run counter to Bartik's expectations and the expectations and results of this study. The results for wage rates were negative as expected and not significant. The Bartik results for road miles were, however, positive as expected and significant, in contrast to most of the results obtained in this study for South Africa. The results from Schmenner, *et al.* (1987) for education (percentage of workforce completing high school) were also negative (again contrary to expectations) and insignificant, likewise for population density. This contrasts with the results obtained for South Africa. The results for average hourly wages were positive (expected to be negative as firms

would be expected to avoid areas of high cost labour) and only significant when moderated by plant employment.

Weighted averages of slope coefficients were calculated for each of the independent variables as per the decomposition method, with weightings in terms of the proportion of magisterial districts in each province. These results are contained in Table 5.6.

Table 5.6: Weighted averages of slope coefficients: Manufacturing Establishments

Intercept	EduPop	SkillsEmp	AvHldInc	UrbPop	PopDens	RoadDens	DecentDum
94.766	1.623	6.008	0.005	-3.122	2.085	1 908.297	-50.388

The weighted averages of the slope coefficients were all positive as expected, with the exception of urbanisation level of the population and the decentralisation dummy.

5.6.2 Cotton-Neumark decomposition method applied to regression results: Manufacturing Establishments

The Cotton-Neumark decomposition method was then applied to the coefficients determined in the OLS regressions and the weighted averages of the slope coefficients. Owing to the fact that Gauteng province hosts more manufacturing establishments than any of the other provinces (see Table 4.2), the decompositions measure the differences between each province and Gauteng province. The results of the decomposition in terms of Manufacturing Establishments are contained in Table 5.7.

Table 5.7: Decomposition results in terms of Number of Manufacturing Establishments

Decomposition	Attribute-based Difference	Non-Attribute based Difference	Total difference	% difference explained by included attributes
Gauteng-Western Cape	187.28	179.92	367.20	51.0
Gauteng-Northern Cape	309.75	160.13	469.88	65.9
Gauteng-Eastern Cape	379.61	83.53	463.14	82.0
Gauteng-Free State	366.22	97.55	463.77	79.0
Gauteng-KwaZulu-Natal	147.75	255.69	403.44	36.6
Gauteng-Mpumalanga	222.89	233.02	455.91	48.9
Gauteng-Northern Province	104.47	358.02	462.49	22.6
Gauteng-North West	288.59	170.19	458.78	62.9

The decomposition method separates "attribute-based" differences from "non-attribute based" differences. The former are differences that are accounted for by variations in independent variables while the latter are the residuals involved. Added together, these differences sum to the total difference. In all cases, the positive attribute-based differences indicate that Gauteng has more manufacturing establishments per magisterial district than any other province and this can be explained by the attributes of the model. Taking the example of the Western Cape, it

is apparent that a typical magisterial district in Gauteng would have 187 more manufacturing establishments than an average magisterial district in the Western Cape, based on the attributes of the region. By the same token, a typical magisterial district in Gauteng would have 180 more manufacturing establishments than an average magisterial district in Western Cape, based on non-attribute factors. Similarly, attribute-based differences indicate that a typical magisterial district in Gauteng ought to have 310 manufacturing establishments more than its counterpart in the Northern Cape, 380 more than in the Eastern Cape, 366 more than in Free State, 388 more than in KwaZulu-Natal, 223 more than in Mpumalanga, 105 more than in Northern Province and 289 more than in North West. The non-attribute based differences show what the manufacturing establishment differential would be between magisterial districts with identical attributes in different regions of the country.

Therefore, the decomposition results for the model of industry concentration using number of Manufacturing Establishments as the dependent variable indicate that the attribute-based differences are smallest between Gauteng on the one hand and Western Cape, KwaZulu-Natal and the Northern Province on the other. This means that differences in manufacturing sector concentration occurring because of the attributes of the model are the least in the cases of the latter two provinces. The higher attribute-based differences for the other provinces indicate greater variation in industry concentration between these provinces and Gauteng. The highest attribute-based difference occurs in the cases of Northern Cape, Eastern Cape, Free State and North West, the provinces with the lowest average household income, substantial surface area and largest number of magisterial districts. Thus, the attribute-based differences also represent degrees of concentration amongst the provinces. The decomposition results also suggest that the variation in concentration of manufacturing industry across provinces is well explained in terms of the attributes of the model. Therefore, attributes such as education levels, population densities and infrastructure densities do influence the concentration of manufacturing industry across provinces in South Africa.

In all but three cases, Mpumalanga, Northern Province and KwaZulu-Natal, the attribute-based differences comprise the largest part of the total difference in manufacturing establishments, with some variation. This ranges from the Northern

Province and KwaZulu-Natal where attribute-based differences account for 22.6 per cent and 32.6 per cent of the total difference respectively, to Eastern Cape (82%) and Free State (79%). Therefore in most cases, attribute-based differences give Gauteng an advantage over the other provinces. Non-attribute based differences have the same effect, as can be seen from the positive values for non-attribute based differences. This means that the average magisterial district in Gauteng would have 358 more manufacturing establishments than the average magisterial district in Northern Province or 256 more establishments than KwaZulu-Natal based on non-attribute based factors (i.e. if all attributes were the same between regions). For some provinces such as Eastern Cape and Free State, the non-attribute based difference is substantially less, only 84 and 98 manufacturing establishments respectively.

Therefore, the fact that the non-attribute based differences are, in most cases, substantially lower than the attribute-based values indicates that the attributes of the model do successfully explain the variation in manufacturing establishments across provinces in this country. The variation in manufacturing establishments across provinces when compared to Gauteng that can be attributed to other factors is therefore relatively small, except in the case of the Northern Province. The latter case can be explained by the fact that the Northern Province absorbed several former homelands and self-governing territories (e.g. Bophuthatswana) when these were reincorporated into South Africa proper post-1994. These territories might have brought with them manufacturing enterprises that owed their existence to the system of incentives available under the decentralisation programme and that were still operating at the time of the Manufacturing Census in 1996. The components of the model would not be able to explain the presence of these manufacturing enterprises because the Northern Province has a relatively low average household income, low level of urbanisation, low population density, low level of infrastructure scattered over a fairly wide area of land. Provinces such as KwaZulu-Natal also absorbed former homelands and self-governing territories (e.g. KwaZulu) but the province was relatively more developed economically and the overall impact was comparatively less.

Finally, the decomposition results also indicate that the policy of industrial decentralisation did not succeed. The substantial differences in number of

manufacturing establishments between Gauteng on one hand and the other provinces on the other show, to greater and lesser extents, that the manufacturing sector in South Africa is extremely concentrated. That this pattern is apparent so soon after the demise of the decentralisation policy in 1991 reinforces the suggestion of failure of the decentralisation policy. If it had been more successful, the differences between Gauteng and the other provinces ought to have been far less. The results also support the notion of the industrialised core and de-industrialised periphery as advocated by Krugman (1998) and Krugman and Venables (1995) in the context of the South African economy. The industrialised core in this case would be Gauteng and to some extent the Western Cape and KwaZulu-Natal, while the deindustrialised periphery would be the remainder of the provinces.

5.6.3 Conclusions of results of analysis: Manufacturing Establishments

The regression results across provinces for the model have been reasonably strong in terms of either explanatory power in terms of adjusted R^2, the signs of the coefficients and the significance of the results. Although each of the explanatory variables featured in at least one case as a significant variable and were not significant in all cases every time, the results do indicate the importance of variables such as education, skills and infrastructure in the cases of highest concentration of manufacturing industry, i.e. Gauteng, KwaZulu-Natal and the Western Cape. Other variables such as average household income were important in less developed provinces such as North West. This shows that manufacturing industry in provinces such as Gauteng, KwaZulu-Natal and Western Cape must be technically more demanding in terms of the education and skills attributes of the labour it requires. Manufacturing industry in other provinces was shown to concentrate more in line with incomes and population density, implying the importance of the market and the need to be close to a source of (relatively unskilled) labour. Again, this indicates the type of manufacturing industry in these provinces to be different from that in provinces such as Gauteng and this is carried through in terms of its labour requirements.

The results are broadly in line with the theory outlined in the study. The results obtained for level of education of the population and skills level of the workforce

conform to the theory of industry location in that they indicate that manufacturing industry concentration in South Africa has followed the supply and quality of labour in terms of education and skills. This was especially so in the case of Gauteng, KwaZulu-Natal and Western Cape. The results for average household income and population density reflect the need for manufacturing industry in South Africa to concentrate in some cases near to the source of demand or the market for products, and follow the theory of the New Economic Geography (see for example the Northern Province and North West), as well as that of agglomeration theory and importance of cities put forward by Henderson. The negative results obtained for urbanisation levels as such might have been affected by the unique urban arrangements forced upon South African cities by apartheid spatial planning (see results for Gauteng and Western Cape), as well as indicating an element of choice in residential location away from work location. The results for road transport infrastructure conform to the prediction of theory of location to minimize transport costs put forward by Weber, Marshall and the New Economic Geography propounded by Krugman, as manufacturing industry concentration was linked to this variable in Gauteng and KwaZulu-Natal. The results indicate that there is benefit to be gained from investing in infrastructure.

The decomposition results do indicate, however, that the manufacturing sector in South Africa is indeed concentrated in Gauteng and, to lesser extents, KwaZulu-Natal and the Western Cape. In doing so, they not only indicate a level of concentration of the sector but also point to the failure of the industrial decentralisation policy to disperse South African industry, of which the manufacturing sector is a core element, the significant amounts of funding directed at the associated incentives notwithstanding. In terms of the theory, they also endorse the core-periphery notion in an interregional context (see Krugman, 1998 and Krugman & Venables, 1995). The decomposition results also show that the attributes of the model, or the variables included in the model, successfully explain the greater part of the variation in manufacturing industry concentration across provinces in South Africa.

The results also have implications for government policy directed at the attraction of industry to certain areas that is the basic objective of the current policy of SDIs. Education levels, skills levels and road infrastructure densities have been shown to

generate important results in key provinces. Different results were obtained from average household incomes and population densities. This implies that it cannot be taken as a given that industry will gravitate to SDIs scattered across the country simply because there happens to be an educated population or transport infrastructure in the area. The results indicate that the concentration of industry will require almost a "case by case" approach taking into account the current situation in the area and the requirements of the manufacturing sector in the area. This means that the policy employed ought to take account of the specific characteristics of the region concerned because this will influence what type of manufacturing industry could be attracted to the area.

5.7 ANALYSIS OF RESULTS: MANUFACTURING OUTPUT

This section analyses the decomposition results obtained for Manufacturing Output using the same explanatory variables as previously for Manufacturing Establishments. The objective of this section is to distinguish between the concentration of firms in the manufacturing sector together, represented by the number of Manufacturing Establishments, and the variations in the output and size of firms in the manufacturing sector represented by Manufacturing Output. The argument is that industry size would be largest in areas where the manufacturing sector was most concentrated.

5.7.1 Regression results: Manufacturing Output

In terms of the methodology, a regression was run on each of the provinces individually, using Manufacturing Output per magisterial district as the dependent variable. The adjusted R^2 values for each of the regressions per province are contained in Table 5.8.

Table 5.8: Regression results per province, using Manufacturing Output as dependent variable

Province	Adjusted R^2
Northern Cape	0.757
Northern Province	0.695
North West	0.665
Gauteng	0.653
Western Cape	0.629
Free State	0.586
Eastern Cape	0.581
KwaZulu-Natal	0.528
Mpumalanga	0.298

The regressions across provinces for Manufacturing Output generated a range of results. This included a reasonably high R^2 in the case of the Northern Cape (0.757), to slightly lower results for Northern Province (0.695), North West (0.665), Gauteng (0.653) and Western Cape (0.629). Results for Free State (0.586), Eastern Cape (0.581), KwaZulu-Natal (0.528) were reasonably strong, while that for Mpumalanga were weak (0.298). For the model explaining industry size, the results indicated a good fit, with the explanatory variables explaining a substantial portion of the variation in the dependent variable.

The results for each of the regressions are shown in Table 5.9. The coefficients obtained for each variable are contained in the table. The relevant t-statistics are included in parentheses below the coefficients. Results significant at the 10 per cent level are shown in bold.

Table 5.9: Regression results for Manufacturing Output, coefficients with t-statistics in parentheses

Province	Intercept	EduPop	SkillsEmp	AvHldInc	UrbPop	PopDens	RoadDens	DecentDum
Western Cape	1 026 481.9 (0.72)	**-101 054.9 (-1.73)**	**274 230.8 (3.04)**	47.439 (1.34)	**-48 986.1 (-2.16)**	**15 341.7 (2.57)**	19 895 477.3 (0.78)	1 185 670.9 (1.60)
Northern Cape	-95 554.9 (-1.05)	3 327.9 (0.51)	-448.48 (-0.86)	2.486 (0.55)	362.36 (0.48)	**66 908.8 (4.01)**	-2 348 816.8 (-0.25)	61 067.1 (1.17)
Eastern Cape	-1 130 334 (-3.14)	NA	NA	53.558 (1.37)	2 706.01 (0.52)	**105 493.3 (5.67)**	-17 655 536.9 (-0.41)	**1 728 516.1 (3.32)**
Free State	-1 762 873 (-4.85)	**-62 660.5 (-2.11)**	51 138.7 (1.59)	**136.09 (4.90)**	-2 691.67 (-0.54)	4 408.86 (1.07)	**60 146 787 (2.77)**	**-1 039 094 (-3.37)**
KwaZulu-Natal	-4 367 487 (-4.45)	-44 854.9 (-0.59)	79 816.7 (1.54)	**306.76 (3.82)**	-25 367.5 (-0.95)	-1 990.89 (-0.45)	**81 885 817 (1.92)**	611 235.5 (0.53)
Gauteng	12 945 358 (0.60)	**265 356.1 (2.15)**	**525 653.9 (1.66)**	-159.85 (-1.27)	-184 913.9 (-0.78)	2 656.96 (0.30)	30 162 542 (0.69)	-9 162 380 (-1.12)
Mpumalanga	-2 288 395 (-2.33)	38 085.2 (0.63)	11 326.1 (0.31)	56.907 (1.44)	**18 040.3 (1.91)**	42 047.2 (1.55)	14 791 835 (0.34)	-851 966.8 (-1.14)
Northern Province	-367 305.6 (-2.87)	160.968 (0.03)	2 226.5 (0.82)	**23.713 (3.81)**	-3 404.79 (-1.47)	-3 643.16 (-0.74)	8 050 504 (1.06)	**154 751.1 (1.94)**
North West	-572 520.3 (-2.90)	-5 836.5 (-0.58)	5 415.3 (0.46)	**34.938 (2.92)**	-2 414.2 (-0.73)	**36 508.8 (1.79)**	**43 432 529 (2.39)**	68 407 (0.34)

Note: Results significant at the 10 per cent level are shown in bold.

The regression results obtained for Manufacturing Output were mixed, with a substantial amount of variation in the significance of some variables across provinces. The results for education level of the population were mostly positive as expected, with three important exceptions: Western Cape, Free State and KwaZulu-Natal and significant in three provinces, Gauteng (t-statistic of 2.15) which was positive as expected, while that for Free State (t statistic of –2.11) was significant but not positive as expected, as was the case for Western Cape (-1.73). Again, t-statistics are shown in parentheses. As in the case of manufacturing establishments, education level of the population could be important in attracting manufacturing industry of a type that requires a higher level of education because of its technical sophistication. It may also be important in attaining higher levels of manufacturing industry concentration, i.e. a measure of beneficiation and linked industries, as well as in influencing the size of manufacturing industry in the areas concerned.

The results were positive and significant for only one province, Gauteng, and negative for a number of others. The positive results for Gauteng were because high levels of education of the population were associated with high levels of manufacturing output. For example, manufacturing output in Pretoria amounted to R13.691 billion with 43 per cent of the population possessing secondary education or higher, while a magisterial district such as Heidelberg had R1.017 billion and 19 per cent of the population with above secondary education. Provinces such as Free State produced negative results because Sasolburg magisterial district showed an output of R6.029 billion and 27 per cent of the population with higher than secondary education, while Virginia magisterial district produced R108 million with a level of education above secondary school of 28 per cent. A negative coefficient emanated from North West province, with Klerksdorp magisterial district indicating an output of R886 million with 23 per cent of the population with a secondary education and higher, while Bafokeng magisterial district produced an output of R14 million with 24 per cent of the population with above secondary school level of education.

The skills level of the workforce was found to be positive in all cases as expected, except for the Northern Cape. It was, however, significant only in the case of Western Cape (3.04) and Gauteng (1.66). This overall result could be attributed to the nature of the demand for labour by manufacturing industry in Western Cape and Gauteng because it might require more educated or skilled labour than industry in Northern Province for example. The result also implies that skills level of the workforce is an important factor in a province (Western Cape) geared towards export activity as the RILS study indicated. This points to variations in the demand for labour based on variations in the nature of the manufacturing industry across provinces.

The Western Cape produced a positive result, with skills level of the workforce increasing and decreasing with manufacturing output. An example of this would be the magisterial district of Vanrhynsdorp with manufacturing output of R36.2 million and 9 per cent of the workforce with the stated level of skill. This then becomes R7.743 billion in the case of Bellville magisterial district that has 28 per cent of the workforce with some level of managerial and technical skill. This result is joined by a number of provinces with similar positive but insignificant results. The Northern Cape province produced a negative result, due to magisterial districts such as Hay with manufacturing output of R1.7 million and 22 per cent of the workforce skilled. In contrast, Kimberley showed R593.58 million and 0.78 per cent of the workforce skilled. Similarly, Gordonia produced R212.6 million and 0.96 per cent of the workforce in the district possessing a level of skill.

Average household incomes yielded reasonably strong results in that regressions for four of the nine provinces resulted in significant coefficients (t-statistics in parentheses): Free State (4.90), KwaZulu-Natal (3.82), Northern Province (3.81) and North West (2.92). This indicates that in some provinces at least (including some of the least developed), manufacturing output and industry size is concentrated near to the sources of final demand for that output. In the case of Gauteng, the negative result could be explained by the fact that a great deal (24.5%) of Gauteng's output is demanded for intermediate

purposes within the province, so this could influence location away from average household incomes.

The Eastern Cape showed a positive result influenced by magisterial districts such as Steytlerville with R0.75 million and average household income of R17 317 per annum. This increases in the case of East London, with R8.024 billion and household income of R35 872 per annum. Gauteng displayed a negative result in the case of Wonderboom, with manufacturing output of R9.939 billion in output and average household income of R50 352 per annum , while Roodepoort produced R2.689 billion but with an average household income of R59 730 per annum. A positive result emanated from North West province, with magisterial districts such as Rustenberg with manufacturing output of R1 248 billion and average household income of R25 909 per annum, and Lichtenburg with manufacturing output of R0.932 billion and average household income of R19 838 per annum.

Urbanisation level of the population showed mixed results, with both positive (as expected) and negative coefficients, of which only two were significant: Western Cape (-2.16) and Mpumalanga (1.91). Only three results (Northern Cape, Eastern Cape and Mpumalanga) generated the anticipated positive sign. This unexpected result might be explained in terms of apartheid policies of dispersing populations away from some of the main centres of business that has created a divergence between areas of urbanised population and manufacturing output. The level of urbanisation was negatively related to manufacturing output because of magisterial districts such as Simonstown with manufacturing output of R0.252 billion and level of urbanisation of 99.6 per cent, while areas such as Wynberg indicated manufacturing output of R4.093 billion and 99.7 per cent of the population urbanised. The results indicate that people have chosen to reside in urbanised areas away from larger concentrations of the manufacturing industry.

Population density was also positive in the majority of cases while negative in two cases, and significant in four provinces (t-statistics in parentheses): Western Cape (2.57), Northern Cape (4.01), Eastern Cape (5.67) and North West (1.79). These significant

results did, however, have the expected positive sign. The results for population density can again be attributed to past settlement policies and practices and the urban land use adopted that led to dispersed populations which might not have been matched by manufacturing sector development. That is, population density in the Western Cape and Northern Cape occurred together with larger industry size. Population density and manufacturing output were shown to be positively related in several key provinces. In the Eastern Cape, a strong positive coefficient was generated because of areas such as Port Elizabeth, with manufacturing output of R12.6 billion and a population density of 60 persons per square hectare. Similarly, magisterial districts such as Bedford indicated output of R0.069 billion and population density of 0.46 persons per square hectare. In provinces such as Eastern Cape and Northern Cape, industry size has occurred with population density as the only determinant, either to be near the market or near a supply of labour in large provinces with few other attractions. The type of manufacturing industry in these provinces would also not attach as much importance to attributes such as education and skills as to ready supplies of labour per se. This indicates that the manufacturing industry type and size is dependent upon relatively unskilled labour than was the case in Gauteng and Western Cape.

Results for road infrastructure density were also mixed, with two provinces producing negative results, against expectations, Northern Cape and Eastern Cape. However, three provinces presented significant results with the anticipated sign of the coefficient: Free State (2.77), KwaZulu-Natal (1.92) and North West (2.39). Road infrastructure density generated positive coefficients in several cases, with the strongest being in North West. This was due to magisterial districts such as Potchefstroom that generated R1.2 billion manufacturing output and had a road infrastructure density of 0.017 kilometres per square hectare, while areas such as Brits produced R1.9 billion in manufacturing output and indicated 0.02 kilometres per square hectare. The linkage between Manufacturing Output and road density implies that the minimization of transport cost has been a primary factor in the location of the Manufacturing sector in these provinces. The results also show that road transport infrastructure and industry size are linked in these areas. This has implications for investment in transport infrastructure envisaged in the SDI programme.

The results for the decentralisation programme were mixed, with all coefficients positive as expected, except for three provinces, Free State, Gauteng and Mpumalanga. Three provinces generated significant results (t-statistics in parentheses): Eastern Cape (3.32), Free State (-3.37) and Northern Province (1.94). This is important because it shows that for two provinces characterized by high levels of poverty, Eastern Cape and Northern Province, the programme does seem to have been important in terms of manufacturing industry concentration and industry size, while for provinces such as Gauteng and the Western Cape it was not significant for industry size at all. The sign of the coefficient of the decentralisation dummy in the case of manufacturing output for Free State was also negative as opposed to the positive sign in the case of number of establishments. This implies that the demise of the decentralisation programme might have affected establishments positively through an increase, but output negatively. This means that industry size (output) might have contracted, while the number of establishments increased when the manufacturing industry restructured after the demise of the programme.

These results are similar to those obtained for Manufacturing Establishments and can be contrasted with the results of studies such as Bartik (1985) and Schmenner, *et al.* (1987). The results for education level of the population, skills level of the workforce, urbanisation level and road density were again mixed, with significant results for only one province in each case. The results, however, for average household income level and population density were again stronger and significant for at least four provinces in each case. This is important because it shows that the manufacturing sector in South Africa concentrated more in terms of demand-side factors than being close to an educated labour supply or to minimize transport costs. This showed that the South African Manufacturing sector conformed to the theory of industrial concentration inasmuch as being in proximity to the market if not attempting to minimize transport costs or exploit increasing returns.

Weighted averages of slope coefficients were calculated for each of the independent variables, with weightings in proportion to the magisterial districts in each province. These results are contained in Table 5.10.

Table 5.10: Weighted averages of slope coefficients: Manufacturing Output

Intercept	EduPop	SkillsEmp	AvHldInc	UrbPop	PopDens	RoadDens	DecentDum
-578 743.2	-8 139.7	85 342.6	87.3	-19 949.5	34 801.7	27 793,159.9	-170 193.4

The weighted averages of the slope coefficients all had the same signs as expected, with the exception of urbanisation level of the population and the decentralisation dummy.

5.7.2 Cotton-Neumark decomposition method applied to regression results: Manufacturing Output

The Cotton-Neumark decomposition method was then applied to the coefficients determined in the OLS regressions and the weighted averages of the slope coefficients. Owing to the fact that Gauteng province hosts more manufacturing establishments than any of the other provinces, the decompositions measure the differences between each province and Gauteng province. The results of the decomposition in terms of Manufacturing Output are contained in Table 5.11.

Table 5.11: Decomposition results in terms of Manufacturing Output (R000s)

Decomposition	Attribute-based difference	Non-Attribute based	Total difference	% difference explained by included attributes
Gauteng-Western Cape	3 343 453.6	1 286 243.0	4 629 696.6	72.2

Decomposition	Attribute-based difference	Non-Attribute based	Total difference	% difference explained by included attributes
Gauteng-Northern Cape	5 472 672.0	290 149.6	5 762 821.6	95.0
Gauteng-Eastern Cape	6 700 955.3	-1 261 587.1	5 439 368.2	123.2
Gauteng-Free State	6 322 237.5	-738 082.9	5 584 154.6	113.2
Gauteng-KwaZulu-Natal	3 939 832.6	713 114.8	4 652 947.4	84.7
Gauteng-Mpumalanga	4 819 785.2	273 782.3	5 093 567.5	94.6
Gauteng-Northern Province	3 632 099.7	2 052 756.1	5 684 855.8	63.9
Gauteng-North West	5 852 749.8	-307 608.9	5 545 140.9	105.5

In terms of the attribute-based differences, the average magisterial district in Western Cape had an output level R3.3 billion less than its counterpart in Gauteng. The results also indicate that the average magisterial district in Gauteng had an output of R3.6 billion greater than in the Northern Province and R3.9 billion greater than the same in KwaZulu-Natal. Differences between Gauteng and other provinces were substantially larger. The average magisterial district in Gauteng generated a manufacturing output of R4.8 billion more than that in Mpumalanga, R5.4 billion greater than Northern Cape, R5.8 billion more than the average magisterial district in North West, R6.3 billion larger than that in the Free State. Finally, in terms of attribute-based differences, the largest difference was again in the case of the Eastern Cape (R6.7 billion for the average magisterial district). This result indicates that manufacturing output representing industry size was highest for

the developed provinces of Gauteng, KwaZulu-Natal and Western Cape, while being lowest for less developed provinces such as the Eastern Cape. Therefore, attribute-based differences explained relatively large differences in manufacturing industry size between Gauteng and the Eastern Cape and Northwest, versus smaller, albeit substantial, differences in size between the manufacturing sector in Gauteng and KwaZulu-Natal and Western Cape. The non-attribute based differences show what the manufacturing output differential would be between magisterial districts with identical attributes in different regions of the country. The size of the non-attribute based components was substantially smaller than these results, but a number of negative values tended to pull the total differences closer together, in the case of Eastern Cape, Free State and the North West.

The attribute-based differences comprise the largest part of the total difference and contain values higher than was obtained for the analysis of Manufacturing Establishments. Indeed, the lowest value was for Northern Province where attribute-based differences accounted for 63.9 per cent of total differences. In the other provinces, the attribute-based differences were larger, accounting for 72.2 per cent of differences in Western Cape, 84.7 per cent in KwaZulu-Natal, 94.6 per cent in Mpumalanga and 95 per cent in Northern Cape. In all cases, attribute-based differences work to the advantage of Gauteng province. The attributes in the model such as education and skills levels, together with population density and infrastructure density are shown to be quite useful in explaining variations in manufacturing industry size across provinces in South Africa.

Moreover, like the decomposition results for Manufacturing Establishments, non-attribute based differences in the case of Manufacturing Output did indicate an overall dominance of Gauteng province. However, in three provinces results for the non-attribute based differences were negative: Eastern Cape, Free State and North West, indicating that the typical magisterial district in these provinces would have higher manufacturing output than the typical magisterial district in Gauteng if the attributes amongst them were the same (in terms of non-attribute based differences only). However, the attribute-based differences were sufficiently large to completely overshadow the non-attribute based differences in these cases. Although the results indicate the dominance of Gauteng, they

also point to a slight underperformance of the manufacturing industry in Gauteng in that decreasing returns may be setting in in terms of industry size in Gauteng. Industry size may have reached its optimal level in the province with other provinces such as North West performing slightly better in terms of industry size due to other attributes (negative non-attribute based differences).

Again the results support the Krugman notion of the industrialised core and the deindustrialised periphery with the dominance of Gauteng in the manufacturing sector. The core of the economy is changing, however, with provinces such as Western Cape and KwaZulu-Natal relatively industrialised. The remaining provinces comprising the periphery (e.g. Northern Province) are not so much deindustrialised as "non-industrialised". The negative results attained in the three cases of Eastern Cape, Free State and North West for non-attribute based differences indicates that these provinces performed better than Gauteng because of attributes other than those in the model. This suggests, furthermore, that the core and periphery of the economy might also be changing with these provinces becoming more important in terms of manufacturing industry size.

5.7.3 Conclusions of results of analysis: Manufacturing Output

The results of the output analysis again point to the importance of education level of the population, skills level of the workforce, urbanisation level of the population and road density in explaining variations in Manufacturing Output and therefore industry size across provinces in South Africa. This implies that these variables do not in all cases determine variations in output or the size of firms in the manufacturing sector in South Africa, similar to the results for Manufacturing Establishments. For the more developed provinces such as Gauteng, education level of the population was still an important determinant, as was the case with KwaZulu-Natal with skills levels of the workforce. These results indicate that manufacturing industry drawn to these areas attaches a great deal of importance to attributes such as education and skills levels because of the nature of the industry and this determines the size of the manufacturing industry in these areas.

The results for average household incomes and population density were more important in explaining variations in the concentration of different sizes of manufacturing firms across provinces. These results were in line with the theory of the New Economic Geography at least to some extent because they suggest that the South African manufacturing sector is concentrated in close proximity to the sources of demand for its output, i.e. its domestic market. The results also show that the type of manufacturing industry concentrating in a province and the size of industry involved varies substantially according to the degree of education and skill required. In certain provinces, the size of manufacturing industry is not dependent upon a skilled labour force but on attributes such as proximity to concentrations of population because it does not require a particularly skilled workforce.

The results also point to the core-periphery dichotomy amongst the provinces in South Africa, supporting Krugman (1998) and Krugman and Venables (1995).The core of the economy is largely Gauteng, and to a lesser extent Western Cape and KwaZulu-Natal in terms of industry size, but the decomposition results also indicate that other areas such as North West might be performing better with a shift in advantage from the core to the periphery as described in the theory.

The results of the analysis of manufacturing output and therefore industry size shows that the attraction of labour for industry, in terms of educated and skilled labour held in Gauteng and Western Cape. The demand-side factors of income and population density as expressed in the New Economic Geography also contributed to industry size in cases such as KwaZulu-Natal and Northern Cape. Road transport infrastructure density was also identified as important and confirmed the importance of transport cost advocated by Weber, Marshall and more recently by Krugman, especially in cases such as North West where it was shown to be positively linked to industry size. Therefore, the variables indicated in the theory did, in various cases, support the notion that in the manufacturing industry in South Africa concentration is related to industry size. That is, industry size was largest in the areas in which the manufacturing industry was most concentrated.

5.8 CORRELATIONS OF X-REGRESSORS

Correlations of the X-regressors used as explanatory variables in the regression analysis were undertaken to explain the high R^2 values and low t-statistics obtained for the individual regressions run for each province (in the case of both manufacturing establishments and manufacturing output). The results of these correlations are contained in Appendix 1. The cross-correlations of X-regressors in the case of Gauteng and Western Cape provinces exhibit the strongest evidence of multicollinearity because they are higher (above 0.70) for most variables than is the case in other provinces. The provinces of Gauteng and the Western Cape are also the provinces with generally higher levels of education, skills, income and infrastructure, hence the high correlations of edu/pop, skills/emp, income and road/ha in the regression results. It must be noted that with the Cotton-Neumark decomposition method applied after the initial estimation of cross-sections for each province, the actual t-statistics and their significance are less important than including the necessary coefficients (avoiding bias) and constructing the decompositions. This was also a feature of all previous studies that have used the Cotton-Neumark approach.

5.9 VARIABLES DISCARDED FROM THE ANALYSIS

A number of variables were included in the regressions and evaluated in terms of their contribution to explaining industry concentration in South Africa. Those that were examined in the analysis and then discarded included per capita output as a dependent variable representing manufacturing industry size. The regression results yielded low adjusted R^2 values for the same explanatory variables as used in the preceding analysis and therefore this option was discarded.

Employees per establishment were also included as a dependent variable representing industry size with the same explanatory variables but the regression results produced extremely low adjusted R^2 values, with few variables yielding significant coefficients.

Output per worker was then introduced as a dependent variable but was also found to produce extremely poor regression results. Finally, output per establishment was used, but this likewise failed to produce useful results, due to the poor fit of the regressions.

In terms of explanatory variables, a dummy representing the magisterial districts in the SDI programme were excluded from the analysis because the initiative has only been in operation since 1997 so would not have affected the manufacturing sector in 1996, the latest date for which data on the manufacturing sector (i.e. the Manufacturing Census) is available in South Africa.

A variable representing average manufacturing wages was also included as an explanatory variable, as was manufacturing employment. The results produced overshadowed all other explanatory variables but were excluded because the direction of causality between them and manufacturing establishments and output was uncertain, and could shed no light on the location of manufacturing industry in South Africa.

Interactive variables were also introduced in the form of urbanisation level multiplied by infrastructure and population density multiplied by average household income, with manufacturing as dependent variable. These variations did not improve the results already obtained.

5.10 COMPARISION OF RESULTS OF THE MODELS

5.10.1 Comparison of goodness of fit (adjusted R^2)

A comparison of the regression results from both models in terms of goodness of fit (adjusted R^2) reveals that in all but one case (Mpumalanga) all regressions were well explained in terms of the variables used in the model and produced adjusted R^2 of over 0.56 (see Tables 5.4 and 5.8). This indicated that in most provinces well over 50 per cent of the variations in manufacturing industry establishments (representing concentration)

and manufacturing output (representing industry size) respectively could be explained by variations in the explanatory variables across all provinces. In both models, Gauteng produced comparatively high R^2 results, indicating that variations in manufacturing industry concentration and industry size were well explained in terms of the stated explanatory variables. The North West province also showed similar results in terms of the fit across the two models.

While the R^2 for Mpumalanga was high in the case of the model for manufacturing establishments, it was extremely poor in the case of manufacturing output. This result indicated that while the model could explain the spread of establishments in the province, it could not account for the size of the industry. This suggested that other factors might determine the size of manufacturing industry in the province.

In the case of the results for the Western Cape, Free State, Eastern Cape and KwaZulu-Natal, the results across the models were comparatively similar in terms of the ranking of these provinces. They all showed reasonable R^2 values and the same ranking in terms of goodness of fit, indicating that the variables were good at explaining variations in both manufacturing establishments and output.

5.10.2 Comparison of regression results in terms of significance of variables

The regression results for the two models are compared across provinces in terms of the sign of the coefficients and significant variables and reported in Table 5.12. The results for Manufacturing Establishments are denoted by E, while those for the model of Manufacturing Output are denoted by O, followed by the sign of the coefficient.

Table 5.12: Comparison of regression results in terms of coefficient signs and significant variables

Province	Explanatory variables						
	EduPop	**SkillsEmp**	**AvHldInc**	**UrbPop**	**PopDens**	**RoadDens**	**DecentDum**
Western Cape	O (-)	E (+) O (+)		E (-) O (-)	O (+)		
Northern Cape					E (+) O (+)		
Eastern Cape					E (+) O (+)		E (+) O (+)
Free State	O (-)		E (+) O (+)		E (+)	O (+)	E (+) O (-)
KwaZulu-Natal		E (+)	E (+) O (+)			E (+) O (+)	
Gauteng	E (+) O (+)	O (+)		E (-)	E (+)	E (+)	E (-)
Mpumalanga			E (+)	O (+)			
Northern Province			E (+) O (+)	E (-)			O (+)
North West			E (+) O (+)		E (+) O (+)	O (+)	E (+)

Table 5.12 shows that the regression results for both models, establishments and output, were significant for both education levels and skilled labour in the provinces of Gauteng, KwaZulu-Natal and Western Cape. These factors were, therefore, important for concentrating large size technically-advanced manufacturing industry to these provinces. The results for average household income suggest that manufacturing industry concentration and industry size tracked one another in the cases of Free State, KwaZulu-Natal, Northern Province and North West. In these provinces, average household incomes were important in determining industry concentration and size, implying that the

manufacturing industry in these cases was of such a nature that the education and skills levels of labour were not as important as the cost of labour. Manufacturing industry was attracted to these areas because the labour required was cheaper and need not be as educated or skilled as that required by more sophisticated parts of the manufacturing industry in provinces such as Gauteng.

The results for urbanisation levels of the population were negative overall for manufacturing establishments and inconsequential for output. Nevertheless, for the provinces of Western Cape and Gauteng, the results indicate that manufacturing industry was concentrated away from urbanised areas either due to the "accident of history" of apartheid spatial planning or due to the fact that in these major provinces populations choose to live away from their places of work, or indeed work in other economic sectors, e.g. business services as opposed to manufacturing industry.

The results for both models held for the cases of Northern Cape, Eastern Cape and North West, suggesting that the manufacturing industry in these areas was of such a nature that it was more labour-intensive than in other areas and was attracted to these areas because of access to a supply of labour or relatively large market. Road transport infrastructure density was found to be significant in both models only in the case of KwaZulu-Natal. It was also shown to be significant in the case of Gauteng for establishments because of the high concentration of industry in the province. Moreover, it was important in determining the size of industry in Free State and North West, with both provinces located inland and away from major markets.

The decentralisation dummy generated positive results for both models in a number of cases, such as North West, Northern Province and Eastern Cape, all of which include areas that were part of the industrial decentralisation programme. However, it is in the case of Gauteng that the result for establishments is negative, indicating that manufacturing industry in Gauteng concentrated away from the areas included in the decentralisation programme. In the case of Free State, the sign of the coefficient obtained for manufacturing establishments was positive, whereas the result for output was

negative. This suggests that with the demise of the industrial decentralisation programme in 1991, the number of establishments may have increased as industry reorganized itself, but output or industry size fell as incentives disappeared.

5.10.3 Comparison of decomposition results

In terms of the decomposition results per model (see Tables 5.7 and 5.12), the smallest attribute-based differences occur between Gauteng on one hand and Western Cape, KwaZulu-Natal and Northern Province respectively on the other. For the first two provinces, this is explained because they have relatively large concentrations of manufacturing industry, but the Northern Province industry is clustered around the few concentrations of population and the relatively small number of magisterial districts in the province.

The decomposition results of both models show that the attribute-based differences between first Gauteng and then Mpumalanga and then Gauteng and North West are next largest as the attribute-based differences in manufacturing industry concentration and industry size become larger. Finally, both decomposition models show a group of provinces comprising Northern Cape, Free State and Eastern Cape with the largest differences overall.

In both decompositions, the non-attribute based differences were generally much smaller than the attribute-based differences, ensuring that the latter were the greater part of the total differences between the provinces. This also implied that the attributes of the models were very good at explaining differences between Gauteng and the other provinces in terms of manufacturing industry concentration and industry size. However, in the cases of Eastern Cape, Free State and North West, non-attribute based differences were negative for the output decomposition. This was not the case for the establishments decomposition. All three of these provinces contain magisterial districts that were part of the industrial decentralisation programme and the differences in manufacturing output

between them may be due to factors linked to the programme but not contained in the model.

5.11 CONCLUSIONS FROM THE EMPIRICAL ANALYSIS

The results of the analysis dealt with in this chapter are extremely important for policy analysis in the context of industrial policy in South Africa. In terms of industry concentration as measured by Manufacturing Establishments and variations in output and industry size as measured by Manufacturing Output, labour attributes such as education and skills levels were important determinants for manufacturing industry in Gauteng, Western Cape and KwaZulu-Natal. Meanwhile, demand-side factors such as household income and population density were significant variables in a number of other provinces. This implies, therefore, that the manufacturing industry in Gauteng, Western Cape and KwaZulu-Natal is quite different from that in other provinces such as Northern Cape or North West in terms of its technical nature and, in turn, its demand for labour.

In terms of labour-orientated determinants, education levels and skills levels were found to influence concentration of the manufacturing sector and industry size, in line with location theory. These factors were still significant in the case of developed provinces such as Gauteng and Western Cape which, between them, host the greater part of the manufacturing sector in South Africa: 61.9 per cent of establishments and 54.7 per cent of output. Therefore, it could be argued that these elements are important in terms of determining manufacturing industry concentration and size where the industry is technically demanding, thereby indicating the increasing returns advocated by Krugman. Demand-side variables such as income and population density were also found to be significant in some cases, which again supports the theory (see Krugman, 1991a). That is, it can be concluded with confidence that the manufacturing sector in South Africa concentrates close to its market, thereby conforming to the theory of industry location and concentration in terms of conventional location theory and the New Economic Geography.

Road infrastructure density was found to be important as a determinant in the concentration of the manufacturing sector in South Africa in line with location theory and the reduction of transport costs. The results for these variables were broadly similar for manufacturing establishments as well as manufacturing output, implying that manufacturing industry size was largest in areas where manufacturing sector concentration was highest. This situation is assisted by investment in infrastructure.

The analysis also indicated the importance of the decentralisation programme in the concentration of manufacturing sector in South Africa. For certain provinces that were relatively less-developed, e.g. Eastern Cape, the decentralisation programme did influence the concentration of industry. However, for the more developed provinces such as Gauteng, the programme did not influence the concentration of manufacturing.

The decomposition results indicate that the South African manufacturing sector is concentrated, especially in Gauteng but also Western Cape and KwaZulu-Natal to some extent, forming an industrial core of the economy. The differences in establishments and output can be explained largely in terms of the attributes included in the models such as education levels and population and infrastructure densities. Assuming the attributes to be identical highlights the dominance of Gauteng in the case of manufacturing establishments and manufacturing industry size, but there were indications that this core-periphery dichotomy in the country's economy might be changing.

The results of the analysis have critical implications for industrial policy in this country. Just as the analysis points to manufacturing industry concentration in South Africa and the failure of the industrial decentralisation policy, so it also has implications for current initiatives such as the SDI programme. If industry is to be attracted to certain areas, the results indicate that the specific attributes of each of the areas designated as SDIs must be taken into consideration because they will determine the nature and size of manufacturing industry growing in that area. The tendency of the SDIs to be dispersed poses concerns arising from the results of the analysis in this study because the industrial decentralisation

policy was not successful in ensuring the dispersal of the manufacturing industry in the country.

Finally, the results indicate how funds might be allocated across functions in South Africa to encourage industry concentration. That is, the quality of labour can be enhanced through education and skills programmes, while transport infrastructure density can be improved through capital investment. Policies aimed at improving average household incomes will assist in creating the demand-side or market attraction for manufacturing industry. Policies that encourage increased population density, e.g. through housing policies, also have potential for concentrating manufacturing industry in the country.

CHAPTER 6

CONCLUSIONS AND POLICY RECOMMENDATIONS

This study examined the principal determinants of industry concentration in South Africa using Manufacturing Establishments as a measure of concentration of the manufacturing industry in the country. Manufacturing Output was also used to represent variations of manufacturing industry size. This was done to determine whether manufacturing industry size occurred together with concentration.

Economic literature covering the topics of industry location, agglomeration and concentration was examined, beginning with the work of Marshall through to that of Krugman and the New Economic Geography. The development of manufacturing industry in the country was examined, including the decentralisation policy of the apartheid era and the spatial development strategy of the democratic era.

Determinants of manufacturing industry concentration tested in a cross-section analysis included: level of education of the population, skills level of the workforce, average household income, level of urbanisation of the population, population density, road transport infrastructure density and the industrial decentralisation programme employed in South Africa during the apartheid era. The determinants of manufacturing industry concentration in South Africa were assessed in terms of the Cotton-Neumark decomposition method. This was undertaken to determine whether and to what extent differences in industry concentration amongst the provinces of the country could be explained in terms of the attributes of the provinces versus the location of the provinces *per se*.

The results of the analysis indicate that, while all the variables used in the model were significant in at least one province, the concentration of the manufacturing industry in South Africa is determined by explanatory variables used in the analysis. Variables relating to labour, such as education levels of the population and skills level of the

workforce, were found to be significant in the case of provinces such as Gauteng and the Western Cape. Meanwhile, variables on the demand-side or market, such as average household incomes and population density, were significant in relatively less developed provinces such as North West and the Eastern Cape. These results point to variations in the type of manufacturing industry across provinces in that some would require technically skilled and educated labour, while others would not. Road transport infrastructure density was found to be significant in the case of high concentrations of manufacturing, again in Gauteng. This suggests that industry in Gauteng requires labour that is educated versus that in North West where other factors are important.

The regression results imply that manufacturing industry concentration in South Africa is determined across provinces mostly by the variables used in the analysis. Although the variables generated results that varied extensively, they did indicate the relative strength of the variables in different provinces in driving industry concentration: level of education of the population in Gauteng; skills level of the workforce in KwaZulu-Natal and Western Cape; average household income in Free State, Mpumalanga, Northern Province and North West; level of urbanisation in the Western Cape; population density in Northern Cape, Eastern Cape, Free State and Gauteng; road infrastructure density in Gauteng; and the decentralisation programme in the Eastern Cape.

The results of the decomposition analysis indicate that differences in manufacturing industry concentration between Gauteng province on the one hand and the other provinces on the other hand are substantial and can be explained in terms of the attributes of the provinces. Differences in concentration are smallest between Gauteng and the Western Cape and KwaZulu-Natal, and greatest between Gauteng and the provinces of Northern Cape and Eastern Cape. The decomposition results therefore indicate that the notion of the core and periphery holds in the case of South Africa, but could be shifting away from Gauteng slightly.

The regression results for Manufacturing Output and therefore manufacturing industry size were also mixed overall. Again, there was substantial variation of results amongst the

provinces. Level of education of the population was significant in the case of Gauteng; skills level of the workforce significant in Western Cape; average household income in KwaZulu-Natal, Northern Province and North West, level of urbanisation of the population in Western Cape; population density in Western Cape, Northern Cape and Eastern Cape; road infrastructure density in Free State and North West; and the decentralisation programme in the Eastern Cape and the Northern Province. Regression results were weaker than expected and showed different signs of the coefficients (in level of urbanisation of the population), but this was apparent from previous policies that leaned heavily towards establishing separate places of residence and that attempted to entice industry to those areas. It could also be due to the fact that in these provinces, labour has a choice of where to reside and it does not necessarily live close to its places of work. It could also be because they have a highly skilled workforce but work in other industries than manufacturing, e.g. business services.

Results for the decomposition exercise again indicated that there were substantial variations in output across provinces and industry size and these differences could be explained in terms of the attributes of the provinces. Differences in output/industry size were greatest between Gauteng and less developed provinces such as the Eastern Cape and smallest between Gauteng and Western Cape and KwaZulu-Natal. In three cases non-attribute based differences in the case of output as dependent variable were negative, implying that output would be greater than in Gauteng if all the attributes between the provinces were the same. This last result suggests that the balance could be shifting slightly from the core to the periphery, i.e. away from Gauteng to some of the other provinces. However, these differences were appreciably smaller than those for the attribute- based differences.

The decomposition results for Manufacturing Establishments and output showed plainly that when attributes of the provinces are nullified, differences were still apparent between the provinces due to the location of the provinces. The dominance of Gauteng in terms of greatest concentration of manufacturing industry and larger manufacturing industry size was shown to be still strongly apparent.

The results also show that certain variables are strong determinants of industry concentration in different provinces. This implies that industry concentration should be approached almost on a "case by case" basis, in terms of the nature of the manufacturing industry and its demand for labour.

Given the results of the empirical analysis, a number of policy recommendations can be put forward. Efforts to promote the concentration of industry in South Africa to capitalize on agglomeration affects and increasing returns should focus on programmes that enhance the quality of the labour force, such as education levels and skills levels. Variables reflecting market size and demand are also important, so improvements in average household incomes and population density ought to attract the manufacturing sector. Investments in infrastructure are also likely to assist industry concentration.

Although the regression results were mixed overall, they were still broadly in line with key aspects of location theory and the developments in the New Economic Geography. That is, there is evidence that the manufacturing sector in South Africa industry has concentrated close to its market or its sources of demand in terms of the relationship between Manufacturing Establishments and average household incomes and population density. Likewise, in the case of concentration close to sources of skilled and educated labour. Transport costs have also sought to be minimized with concentration close to transport infrastructure.

The concentration of the manufacturing industry that is apparent in the study indicates the failure of the decentralisation policy employed during the apartheid era to disperse industry within the country, thereby moving industry to the concentrations of labour rather than *vice versa*. The results in this regard are especially important because they show that although firms and employment opportunities did relocate to the IDPs for the duration of the RIDP, they did so in many cases only for as long as the decentralisation programme and its incentives remained in place. The demise of the scheme and its

incentives was enough to persuade many firms to move back to the traditional areas of manufacturing, e.g. Gauteng.

The implications of the results for current and future industrial policy are also important. If the SDI programme is focused on traditional sectors of the economy, it might not be able to concentrate industry in the areas of the SDIs without investing in the most important determinants selectively. It will be critical to assess each of the SDIs on its own merits and the attributes of the region concerned.

Finally, possible extensions of the research in future could also involve the use of additional dummy variables to take account of the region's access to international trade through a port, railway or border post.

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Appendix 1: Correlations of X-Regressors

Western Cape

	EduPop	*SkillEmp*	*AvHldInc*	*UrbPop*	*PopDens*	*RoadDens*	*Decent Dum*
EduPop	1	0.87	0.76	0.66	0.64	0.82	0.08
SkillEmp	0.87	1	0.8	0.72	0.5	0.78	-0.02
AvHldInc	0.76	0.8	1	0.69	0.49	0.75	-0.09
UrbPop	0.66	0.72	0.69	1	0.52	0.67	0.17
PopDens	0.64	0.5	0.49	0.52	1	0.81	-0.17
RoadDens	0.82	0.78	0.75	0.67	0.81	1	-0.18
Decent Dum	0.08	-0.02	-0.09	0.17	-0.17	-0.18	1

Northern Cape

	EduPop	*SkillEmp*	*AvHldInc*	*UrbPop*	*PopDens*	*RoadDens*	*Decent Dum*
EduPop	1	-0.22	0.78	0.3	0.25	-0.11	0.58
Skill/Emp	-0.22	1	-0.33	0.28	0.02	0.46	-0.15
AvHldInc	0.78	-0.33	1	-0.05	0.19	-0.32	0.52
UrbPop	0.3	0.28	-0.05	1	0.22	0.38	0.29
PopDens	0.25	0.02	0.19	0.22	1	0.68	0.38
RoadDens	-0.11	0.46	-0.32	0.38	0.68	1	0.18
Decent Dum	0.58	-0.15	0.52	0.29	0.38	0.18	1

Eastern Cape

	EduPop	*SkillEmp*	*AvHldInc*	*UrbPop*	*PopDens*	*RoadDens*	*Decent Dum*
EduPop	1	NA	NA	NA	NA	NA	NA
SkillEmp	NA	1	NA	NA	NA	NA	NA
AvHldInc	NA	NA	1	0.65	0.3	0.76	0.59
UrbPop	NA	NA	0.65	1	-0.01	0.42	0.38
PopDens	NA	NA	0.3	-0.01	1	0.57	0.24
RoadDens	NA	NA	0.76	0.42	0.57	1	0.49
Decent Dum	NA	NA	0.59	0.38	0.24	0.49	1

Gauteng

	EduPop	*SkillEmp*	*AvHldInc*	*UrbPop*	*PopDens*	*RoadDens*	*Decent Dum*
EduPop	1	0.84	0.84	0.34	0.11	0.79	-0.16
SkillEmp	0.84	1	0.94	0.15	0.07	0.71	-0.05
AvHldInc	0.84	0.94	1	0.24	0.08	0.72	-0.16
UrbPop	0.34	0.15	0.24	1	0.46	0.49	-0.83
PopDens	0.11	0.07	0.08	0.46	1	0.26	-0.18
RoadDens	0.79	0.71	0.72	0.49	0.26	1	-0.23
Decent Dum	-0.16	-0.05	-0.16	-0.83	-0.18	-0.23	1

Mpumalanga

	EduPop	*SkillEmp*	*AvHldInc*	*UrbPop*	*PopDens*	*RoadDens*	*Decent Dum*
EduPop	1	-0.21	0.79	0.58	-0.5	0.31	0.32
SkillEmp	-0.21	1	-0.16	-0.49	0.35	-0.24	0.19
AvHldInc	0.79	-0.16	1	0.56	-0.35	0.21	0.36
UrbPop	0.58	-0.49	0.56	1	-0.48	0.29	-0.15
PopDens	-0.5	0.35	-0.35	-0.48	1	0.01	0.08
RoadDens	0.31	-0.24	0.21	0.29	0.01	1	0.04
Decent Dum	0.32	0.19	0.36	-0.15	0.08	0.04	1

Northern Province

	EduPop	*SkillEmp*	*AvHldInc*	*UrbPop*	*PopDens*	*RoadDens*	*Decent Dum*
EduPop	1	-0.4	0.89	0.7	-0.51	-0.1	0.39
SkillEmp	-0.4	1	-0.4	-0.65	0.36	0.03	-0.2
AvHldInc	0.89	-0.39	1	0.64	-0.43	-0.08	0.39
UrbPop	0.7	-0.65	0.64	1	-0.53	-0.15	0.29
PopDens	-0.51	0.36	-0.43	-0.53	1	0.66	-0.01
RoadDens	-0.1	0.03	-0.08	-0.15	0.66	1	0.07
Decent Dum	0.39	-0.2	0.39	0.29	-0.01	0.07	1