UNIVERSITY OF CAPE TOWN

SCHOOL OF ECONOMICS

AN INVESTIGATION INTO THE EFFECTS OF LOCATION AND GOVERNMENT REGULATION ON THE PETROL SALES OF RETAIL SERVICE STATIONS IN SOUTH AFRICA.

BY

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ABSTRACT

THE OBJECT OF THIS THESIS IS TO DEVELOP AN ECONOMIC FRAMEWORK IN WHICH TO ANALYSE THE EFFECTS OF REGULATION AND LOCATION ON RETAIL SERVICE STATION PETROL SALES.

The political leaders of most countries in the world today will attempt to ensure the stable, independent and secure growth of their economies. Oil, whether being produced or consumed, will have an undoubted effect on their strategies. This is particularly true of South Africa, which imports all its crude oil from an ostensibly hostile world. Powerful government controls regulate all aspects of the oil industry, right through to final consumption. Retail service stations, the subject of this thesis, are no exception. They are affected by government propagated barriers to entry, price controls, restrictions on selling hours and restrictions on location, *inter alia*... all in an avowedly free enterprise economy.

Additional important factors help to shape the service stations as a unique economic entity. Their customers, according to one writer,* buy petrol as a rent to use their cars. It is an "inconvenience" good. Consequently, locational convenience takes on a special importance.

Part I is essentially a descriptive analysis of the South African service stations. First, their emergence during this century is outlined. Next, the different types are categorised, and their position *vis-a-vis* other bodies in the economy is summarised. A "general scenario" is followed by a closer examination of their pricing structure, demand curves, cost curves, departments, and relations with the supplying oil companies.

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* Levitt, (1962)

Part II provides the theoretical framework for the thesis. A new "purchasing model" is developed in which the money cost of petrol, the costs of travelling, and the benefits, both from the petrol and from all other factors, interact to determine when and where a customer will visit a service station. The literature on shopping models is then examined. The unique characteristics of retail petrol customers as seen in the purchasing model, to a large extent guide the development of "deterrence" and "attraction" sectors for a suitable gravity model.

Next, a survey of the literature on the emerging theories of regulation is made. It is seen that no theory yet exists which can consistently explain the emergence and degree of various governmental regulations. However, the peculiar characteristics of the South African oil industry suggest a new approach, and this is developed into a new theory. The essence of this theory is that regulations will be promulgated in order to benefit those who have a hand in their formation and implementation. A regulation will come into existence if the sum of a variety of benefit measures to this "decision group" exceeds the sum of a variety of cost measures.

Part III consists of the empirical testing of several hypotheses. Computer programmes are developed for both the locational and regulatory models. First, the importance of convenience of location to service station customers is illustrated. The effect of deterrence (ie. the various travelling costs) on customer allocation to service stations is then examined, and there is a description of the total market and its component sales areas. The nature of the competition within and between these sales areas is examined in detail. It is shown how the total market is made up of many small sales areas, and nearly all competition between service stations is within these sales areas, rather than between them.

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The oil companies are likely to find the locational model a useful tool in their market area sales predictions, when varying the numbers or characteristics of service stations. The details of a slightly different model which will likely be cheaper for them to set up are also provided.

On the regulatory side, the first task was to illustrate the high degree of governmental control in the industry. The predictive ability of the new theory was then tested against existing service station regulations, with positive results. A dominant factor in the regulatory scenario is the desire of the government to maintain a high level of involvement in policy making throughout the South African oil industry. Stigler's** interest group theory (the most widely accepted regulatory theory) is shown to be generally inapplicable for South Africa's petroleum regulations. Rather, a series of government objectives, the most important of which are security of supply and protection of local energy industries, are the main forces shaping these government controls.

Lastly, it is shown how the consumer (particularly the private consumer) is paying substantially above world market prices for petroleum products in South Africa. In a test area, the average consumer had to travel more than 75% further than he would have had to under a free market situation, in order to purchase them.

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** Stigler, (1971).

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TABLE OF CONTENTS

AN INVESTIGATION INTO THE EFFECTS OF LOCATION AND GOVERNMENT REGULATION ON THE PETROL SALES OF RETAIL SERVICE STATIONS IN SOUTH AFRICA.

PAGE

PART III: EMPIRICAL ANALYSIS

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LIST OF APPENDICES

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LIST OF ABBREVIATIONS USED IN THE THESIS

ATC	Average Total Cost	See	3.6.2
AVD	Additional Visiting Distance	See	4.3.5
DG	Decision Group	See	5.15.11
GM	Gross Margin	See	3.5.8
IO	Intervening Opportunities	See	4.9
LAC	Long run average cost curve	See	3.10
LDC	Less Developed Country	See	7.5.11
LMC	Long run marginal cost curve	See	3.10
OC	Oil Company		
OPEC	Organisation of Petroleum Exporting Countries		
RG	Relevant Group	See	5.15.11
RSA	Republic of South Africa		
RSS	Retail Service Station		
SA	South Africa		
SAR	South African Railways		
TAA	Trade Area Analysis	See	4.6.3
UROTA	Undue Restraint of Trade Act	See	7.2.2

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1. INTRODUCTION, LIMITS, THESIS OUTLINE AND CONCLUSIONS

1.1 INTRODUCTION

1.1.1 Most of the vast body of research that has been conducted into the oil industry has been completed outside South Africa, and most of it investigates either various technical aspects of the industry, or its "upstream"(1) segments. Relatively little work has been published on downstream oil marketing operations - most of the research that has been completed is the jealously guarded competition between the OC. There is also a tendency to regard such operations as falling under the heading of "general business" and therefore not worthy of separate analysis. An objective of this thesis is to prove the protagonists of such a view wrong.

1.1.2 It is correct to regard RSS as competitive businesses; it may also be correct to analyse their activities in selling tyres, batteries, accessories and soft drinks using the same tools that would be used to analyse their competitors. However, an examination of RSS activities in selling petrol define them as a unique species in the business world.

1.1.3 A tremendous number of factors affect RSS petrol sales and profits. The objective of this thesis is to examine two of the most important: the effects of the location of an RSS; and the effects of a plethora of governmental regulations controlling them. At first glance these two factors seem relatively unrelated, but it will be seen by the end of this study that this two-pronged approach allows a comprehensive description of the economic environment in which the RSS operate.

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(1) "Upstream" refers to activities concerning supply resources. A marketing company in SA would consider all aspects of its crude supply as upstream. "Downstream" refers to marketing operations, primarily to the final customer.

1.1.4 The purpose of this work is not to provide an up to date ready reference of profitable locations in SA, nor to provide a legalistic review of the current regulations affecting RSS. Rather, the tools for the analysis of location and regulation will be developed, and the reader will be provided with a framework in which to tackle his own specific problems. It will be necessary to test several hypotheses empirically; the results will attempt to validate the tools that have been developed, and support the particular framework in which the RSS have been placed in this thesis.

1.2 LIMITS

1.2.1 This section outlines the constraints within which the thesis itself was completed. Firstly and obviously, the title of the thesis closely directs the areas to be researched. Petrol is sold by the OC in SA in a number of markets. (See Ch. 3) - This study will concentrate on the largest of the petrol markets: retail. RSS sell a number of products (see 3.7), however only petrol sales will be examined. There are numerous factors which affect the petrol sales of any RSS; the research will be confined however, to an examination of location and government regulation. Important areas affecting RSS sales which will not be examined in depth include:

a) The effects of differences in the quality of staff between RSS (particularly differences in management quality).
b) The results of variations in management and personnel techniques.
c) Various technical aspects of the RSS, such as the building design, equipment used, and pump layout.

d) Certain "accounting" and financial aspects of the RSS such as debt, credit and liquidity levels, and profitability ratios.(2)

e) Relations between the RSS and the OC will be examined, but only in the context of the thesis title. The effects of tie types (see 3.2), OC strategies, OC assistance and OC finance are largely ignored.

f) The different types of RSS (see 3.2) and their profitability.

g) The effects of "economic" factors, such as interest rates, credit, taxes, labour costs and quality, and other costs such as those in Appendix 14.

1.2.2 There are additional limits aside from those dictated by the thesis title. The time and money available probably represented that of a typical "Masters" student. The research could also have profitably delved into certain "sensitive" areas. Chapters 3 and 7 explain how the National Supplies Procurement Act, and the Petroleum Products Act prohibit the disclosure of a wide range of information.(3) There is one area in particular which it was not possible to investigate because of this restriction: a multiple regression using petrol sales volumes aggregated by region (e.g. Cape Town, or Cape Province, or RSA) as the dependent variable; and factors discussed in 3.8.2 such as population, car registrations, COL index, car engine sizes, petrol price, etc etc, as the independent variables. Such a regression would have revealed much about the nature of the demand curves faced by typical RSS.

1.2.3 An interesting phenomenon observed in many urban areas is the existence of "high concentration areas" of RSS. This concept is discussed in 6.10, but no empirical work has been done, because of the widespread sampling that would be required.

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(2) See Sizer (1969), Ch.4.

(3) Penalties of up to R2 000 or two years or both are provided for.

1.2.4 A final constraint within which the work was completed was that of data accuracy. At times telephone conversations, radio broadcasts or newspapers have been the sole source of information.

1.3 THESIS OUTLINE AND CONCLUSIONS

1.3.1 The thesis first reviews the history of the petrol industry in SA. The evolution of the RSS, and the important developments in the petrol marketing industry are examined; by the end of the chapter the reader is already aware of the importance of government controls in shaping the character of the industry.

1.3.2 Chapter 3 describes the RSS in greater detail, providing a grounding for the remainder of the thesis. It opens by giving statistics which help place the RSS in perspective in the economy. There is then a discussion on the different categories of RSS, and the institutions and groups with which the RSS react are summarised. This background is used for a description of the "general scenario" of RSS operations in RSA

1.3.3 It is important to note that there are certain peculiar economic characteristics of the RSS which distinguish them from the firms of other industries. Chapter 3 continues by introducing some of these differences in the form of an examination of the petrol pricing structure; the important influences of the OCs (effectively wholesalers) in the petrol marketing environment; and an estimate of the importance of economies of scale (based on an RSS sample). Further differences are highlighted by the chapter when factors affecting the demand curves of RSS are examined, and estimates of certain demand elasticities are made. The chapter also contains a short analysis of the RSS as a multi-department firm, and a section on the cyclical nature of RSS sales.

1.3.4 The objective of Chapter 4 is to develop the approach to the analysis of location and market areas used in part III of the thesis. It opens by describing certain peculiar characteristics of the RSS customers (as opposed to "general" shopping customers) and developing new concepts to describe them - search, frame, hunger, additional visiting distance (AVD) and RSS "attractions" enable the development of a model to describe the circumstances in which a customer will purchase petrol. This "hunger cycle" model is not empirically tested in the thesis. Rather, it provides a useful means of approaching the development of an RSS locational model.

1.3.5. The uses, and historical development of mathematical shopping models are then reviewed.(4) The "Huff", and "intervening opportunities" (IO) models evolve as the most likely approaches to the construction of an RSS model. These two models are then derived again using Wilson's "maximum entropy" approach. This allows it to be shown that two apparently different models may be derived using the same technique, depending on the definition of customer deterrence used. A third measure of customer deterrence, distance to next opportunity, is also discussed.

1.3.6 By this stage it will be clear that the "general" shopping models reviewed so far in Ch.4 are not entirely adequate for the special requirements of RSS. There is a discussion on the needs of an RSS model, and new measures of customer deterrence and "attraction" are developed. The chapter closes by describing certain problems encountered in setting up the RSS model: indexing, calibration, and external interaction.

1.3.7 Chapter 5 provides a review of existing regulatory theory, and it develops a new theory of regulation in which to analyse the effects of the government on RSS in SA. The chapter opens with a picture of some of the concepts

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(4) Note that it is shopping location, rather than industrial location models which are appropriate here.

and problems involved in regulatory theory, and a summary of the various costs of regulating. Next, the (sometimes conflicting) theories of regulation are reviewed. At the end of this review it is apparent that there is no generally accepted theory of regulation[5] which will reasonably consistently provide positive empirical results.

1.3.8 The Decision Group (DG) Goal regulatory theory is developed in Chapter 5.[6] In essence, it suggests that a proposed regulation will be implemented if the DG believes that the contributions it makes towards all its goals exceeds the various costs of that regulation throughout the economy. This new theory is particularly applicable to the SA oil industry, because the SA government has some powerful and clear goals it wishes to achieve when it implements petroleum regulations - it was probably this fact that sowed the seeds of the DG-goal approach. Lastly, Chapter 5 assesses the ability of each of the existing theories in explaining RSS/OC regulation.

1.3.9 Chapter 6 is the first of the empirical chapters (part III). It opens by outlining the areas to be examined - i.e. many of the propositions and concepts developed in Chapters 3 and 4. The computer model developed for the chapter is described in detail, along with the limits and assumptions under which it is operated, and the method of setting it up to cover the study area.

1.3.10 The first hypothesis is an evaluation of the importance of locational convenience to customers. The effect on an RSS's sales when all factors other than location are "neutralised" is examined. Sales decreases ranging from 0,1% to 53,0% were obtained depending on the method of "neutralisation" used, and the RSS involved. One can conclude that convenience of location is an extremely important factor in the determination of an RSS's sales.

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(5) Stigler's (1971) "Economic Theory of Regulation" is the most widely accepted.

(6) The reader may find this chapter simpler if the word "government" is substituted for DG.

1.3.11 The results of the second hypothesis again confirm the importance of customer deterrence in determining an RSS's sales. An increase in the average deterrence of one RSS (the others remaining constant) caused a more than proportionate decrease in sales; the majority of customers lost were on the "periphery" of its market area.(7)

1.3.12 The first two hypotheses have suggested that the typical market area covered by the survey's RSS is "small".(8) Small changes in deterrence will cause changes in patronage by peripheral customers. It is therefore logical for an RSS to direct its competitive activities at peripheral customers, if at all possible. These results support Townshend's description of the petrol industry as one in which:

> "The total market is made up of thousands of small market areas where quantities sold are almost entirely independent of sales in contiguous areas. Local market areas consist of clusters of dealers in direct competition with one another".(9)

1.3.13 An important conclusion derived from this description of the RSS market is that if several competitors exist within a given area any one of those RSS will have great difficulty in expanding sales beyond a certain volume, because of the importance of location to the customers being competed for. Economies of scale (discussed in 3.10) are therefore precluded beyond a certain sales volume because they are offset by the costs of competing in peripheral areas. A corollary of this conclusion is that there will be a strong incentive in the industry to erect barriers to the entry of new RSS.

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(7) The hypotheses actually utilise the concept of sales area, rather than market area. (Defined in 6.0.1).

(8) The RSS in the survey are in the "residential" category of 3.2. It is vital to note that the market areas of "national route" RSS will be very large. Certain conclusions in this thesis will therefore not apply to this category.

(9) Townshend, (1972), P.374.

1.3.14 The nature of the competition between RSS is then further examined in the third hypothesis. Townshend's idea of the RSS only being in competition with each other when they are located in the same market areas is supported. This hypothesis examined the effect of a 50% increase in "attraction"[10] of one RSS in the study area when the others were held constant. Once again it was shown that the further away customers are from an RSS, the more inconsistent becomes their patronage of it. Because location is not a variable to the RSS, the components of "attraction" becomes their tools of competition. When RSS are "close" to each other[11] the effects of varying "attraction" by one of them have substantial effects on the others located nearby. Because these RSS "close" to each other are in direct competition for the same customers, such RSS will have a strong incentive to reduce the number of competitors (and erect barriers to entry) in order to achieve considerable potential economies of scale. An important government regulation, the rationalisation plan, is designed to do this. The reader may ask why competition, (and not the rationalisation plan) is not able to limit the number of RSS. The answer is that competition is restricted by a plethora of other government regulations. (Another reason is the high cost of "peripheral" competition mentioned above.) Some of these regulations ensure minimum RSS sizes and facilities[12] (and therefore raise the average cost structure of the RSS). Others restrict the tools of competition, most importantly price competition. A free market would contain a number of small, low facility, lower cost RSS in locations convenient to smaller numbers of customers, in addition to many of the larger RSS that exist today.[13]

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(10) Attraction may be briefly defined here as all factors other than customer deterrence which affect the allocation of customers among RSS.

(11) This is obviously defined more rigorously in the hypothesis.

(12) Certain regulations require, for example, minimum workshop sizes and a full time, qualified mechanic at nearly all RSS. Removal of such regulations would mean that a new type of "small" RSS would emerge. Because maximum profits would be achieved at lower volumes, more RSS could exist, and customer convenience would be greatly improved. (See Ch.8).

(13) "...average (RSS) throughput in SA is already the highest in the world, four times more than in the UK, for example." Financial Mail, 1st quarter 1975,P.93. The article also maintains that average SA mark-ups are among the lowest in the world.

1.3.15 The final result is that the typical SA RSS market contains fewer, larger RSS offering more facilities (and therefore with higher average cost), than an unregulated market would. The average distances customers have to travel to reach RSS are considerably increased (8.3.45).

1.3.16 Yet another effect of this considerable dampening of competition is the emergence of certain "high concentration areas" on the main roads in some national route towns and in the corridor roads into cities. (See 6.10)

1.3.17 The fourth hypothesis examines the reallocation of customers among its competitors when an RSS is forced to close. The closest RSS have the greatest customer gains. However, when the RSS are "very" close to each other,[14] the importance of locational convenience to the repatronising customers is superceded by the other "attraction" factors (i.e. customer deterrence is of primary importance in determining the allocation of customers only once a certain low level of deterrence has been passed for such customers. Up to that point, the "attraction" factors are more important).

1.3.18 This hypothesis also confirms the strong incentive to reduce numbers that the existing RSS will have.

1.3.19 The "attraction" factors of the RSS in the survey are examined in 6.8. Unfortunately, the limited size of the survey limited the number of "attraction" components that could be simultaneously examined in the multiple regressions to three. The most important "attractive elements" that emerged were the existence of an attractive amenity close to the RSS, such as a shopping centre, school, club, etc., and the level of customer service (a method of rating service was constructed).

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(14) Obviously defined more rigorously for the hypothesis.

1.3.20 It is also shown that the composite "attraction" of each RSS has a good correlation with how far customers will go out of their way to visit it, measured by the concept of AVD. Indeed, AVD is virtually the definition of "attraction" - see 6.8.6, 6.8.7. It was heartening to see a good correlation (R^2=0.94) between the AVDs derived from the customer survey, and the composite "attraction" variables calculated by the model.

1.3.21 Section 6.8 also discusses how the model's results and the survey support the concepts of frame, search and habit. Customers are portrayed as habitual, and unsearching.

1.3.22 It is apparent that the method of analysis in Ch. 6 is costly, in terms of time and money. The details of a proposed RSS model that will be quicker and cheaper to set up are provided in 6.9 and Appendix 9. The new model is proposed primarily for the OC, which would find it particularly useful in identifying profitable locations, and the most suitable RSS types. The prime advantage from the OC point of view is that many already have the required input information.

1.3.23 Chapters 7 and 8 are concerned with an empirical analysis of government regulation of RSS. Chapter 7 prepares the data required by the computer model in the final chapter. A list of the regulations governing the oil industry is provided, and the DG(15) is discussed and identified. The DG's objectives are isolated and weighted. The procedure is then repeated for the RGs. Finally, the input matrices required by the model are set up.

1.3.24 Chapter 8 opens with an outline of the hypotheses to be tested, and a description of the programme used for evaluation by the new regulatory theory. The first hypothesis examines the degree to which the DG is able to effectively control the SA oil industry. One may conclude that the DG has a very high degree of control over all operations inside SA.

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(15) Decision group (DG) is a concept developed for the new regulatory theory. Another is the relevant group (RG).

1.3.25 The second hypothesis involves an evaluation of each of the RSS regulations, in order to test the predictive ability of the regulatory model. Positive results were obtained for all existing regulations. In addition, a negative result was obtained when the proposal to remove an existing piece of legislation was run on the model. From the results, it can be concluded that the DG has placed a high priority on minimising the policy power of the OCs in the industry, and propagating its own control over the industry. This transfer of control to the DG is desired by them for a number of reasons; the most important is the security of petroleum product supplies. Section 7.5 outlines the position of the OC in SA, in the framework of the DG's security and protection goals. While the international supply network, and the expertise possessed by the OC are still strongly desired by the DG, it is shown that SA is not nearly as lucrative an OC market as it was prior to 1973.

1.3.26 In 6.1 it was asked to what extent the OCs have been able to manoeuvre themselves into a cartel position in SA. By this point in the thesis it will be clear that there is little OC power in many important policy areas in the industry - especially around those variables that a monopolist would vary to maximise profits (price structures in different markets, and the competitive allocation of the various types of RSS over different markets by size and number). The only concession to Stigler's (1971) theory of economic regulation is the government's rationalisation plan which is of benefit to both the OC and the RSS (and also to the DG, of course).

1.3.27 At the end of the second hypothesis, a sensitivity analysis is run for ranges of several of the variables that were developed in Ch. 7. The object of this analysis is to gauge the extent that errors will have affected the second hypothesis. One may conclude from Table 8B that its results are generally valid.

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1.3.28 The third hypothesis tests the assertion that competition in the oil industry (particularly between RSS) is restrained by the DG. It is shown that limits are placed on the important competitive variables of price, product quality and trading hours. It is also shown that there are effective barriers to entry into the RSS market. A test area in Rondebosch contains five RSS - it is shown how the removal of oil industry regulations would probably result in more than eleven RSS locating in the same area (without allowing for the effects of increased competition).

1.3.29 The fourth hypothesis examines SA petrol prices vis a vis world market prices. It is shown that the government will have a strong incentive to protect SA-owned/located petroleum refineries and SA energy industries such as coal, SASOL and nuclear power. It is also shown that high local petrol prices will provide it with a large tax base, and a means of attracting international OC to SA. Certain published information(16) is used to show that SA's petrol prices are at least 71% above world market prices, and probably very much higher.

1.3.30 The last hypothesis tests the effects of government interference on petrol consumers. First, as has already been shown, consumers are paying substantially more than world market prices. Second, the results of the third hypothesis (11 instead of 5 RSS in the test area) are used as input for the <u>locational</u> model, to estimate the increase in average customer deterrence resulting from government regulation. Using a random "position" generator in the programme, the six "new" RSS were automatically assigned random positions 65 times. Average customer deterrence was calculated on each iteration. Depending on the method of weighting deterrence, it was concluded that average customer deterrence has been increased by 76% or 79%.

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(16) See Du Plessis, (1976); and Holden and Holden, (1975).

1.3.31 Third, it is shown that consumer convenience is inhibited by a number of regulations promulgated under the National Supplies Procurement Act, and the Petroleum Products Act. These regulations, which have been termed "consumption curbs", include restrictions on speeding, on the carriage and storage of petrol, and on RSS selling hours, for example.

2. HISTORY OF RSS IN SOUTH AFRICA

2.1 BEFORE THE FIRST RSS.[17]

2.1.1 Kerosine, paraffin and lubricants have been sold in South Africa since the beginning of the 1860s. The first Shell products in South Africa were actually sold by a competitor, the Vacuum Oil Company (established in SA in 1897). It introduced Shell lubricants and paraffin in 1901, obtaining the product in drums from passing oil steamers from the East, and selling them to the public.

2.1.2 In 1902 Julius Weil and Co. were appointed agents for South Africa, and they distributed through the local firm Niven, Mitchell and Cotts. In 1905 the "Shell" agency was taken over by the Vacuum Oil Company of SA (which did little for Shell sales!) and in 1907 the Mitchell Cotts and William Cotts companies took over the agency. In 1912 the "Cotts" companies cut their link with Julius Weil & Co. in London, and became the South African representatives of the newly formed British Imperial Oil Company in London. In 1913, 4 000 cars were imported into South Africa, almost doubling the car population, and sales of "Shell Motor Spirit" increased rapidly. Agencies and depots were established at the major centres, and the first travelling salesmen were introduced.

2.1.3 Product distribution was crude by today's standards, however. All product was "packed" (i.e. in tins or drums) ensuring high storage, handling and wastage costs. Customers purchased (mostly) non-returnable drums, and were required to dangerously and wastefully pour the product from them into their cars or machinery.

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(17) The dearth of information on the history of South African RSS has necessitated a heavy reliance upon the work of Rosenthal, and upon personal interviews with the OCs. This in turn has meant that the chapter has concentrated to a large extent upon the Shell company. Fortunately, in an historical context, Shell has proved to be the most innovative of the SA OCs.

2.1.4 Although facilities did not exist for widespread bulk (as opposed to packed) distribution at this stage, it was appreciated that bulk handling at the ports would have been a cost saver. In 1902 Rowbotham & Co. applied to the Port Elizabeth Municipality on behalf of "Shell" for a licence to store bulk paraffin. The same year the Durban branch of Mitchell and Cotts applied to erect bulk facilities in Durban, and it became a general policy to attempt to erect such storage at all the ports of entry. These applications however, were unsuccessful, because neither the municipalities nor the general public were convinced that these facilities were desirable or safe.

2.1.5 The outbreak of war in 1914 affected sales severely, and also upset many of the administrative and communications procedures. There was a deterioration of the shipping delivery dates, and increased losses because of evaporation and poor quality controls. Tariffs and duties on oil products were increased to help pay for the war effort. The price of petrol rose to 5 shillings and sixpence a gallon in SA, and to as much as 10 shillings and sixpence a gallon in Rhodesia.

2.1.6 In 1914 Shell purchased its first vehicle, primarily for its sales representatives. In the same year, the first bulk tanks in South Africa were installed in the Cape Town docks. Up to this date, all product had been handled in cases of 4 times 2 gallon tins. In 1914, 8 gallon drums were introduced, and soon afterwards the 40 gallon drums in which all products were distributed from the bulk storage, until the late 60s when bulk handling became more widely introduced.

2.2 THE EARLY RSS.

2.2.1 In 1919 the first "filling site" was established in Cape Town, and in 1921 the first RSS (as we know them today) opened in Johannesburg (both Shell's). The concept was an American one. Cars drew up alongside a petrol pump, and were supplied from underground storage. Free air and water were supplied, and petrol, oil, tyres and accessories were sold. By 1924, RSS were located in all the major centres, although the majority of petrol was still sold in drums.

2.2.2 In 1922 the first bulk lorry in SA was purchased and used by Shell in Durban. The "fleet" expanded slowly, and in the late 20s Shell had only one bulk lorry in the Cape. It was filled from drums at the Shell depot, and when the message was received that a petrol pump needed replenishing, the truck would set off, hoping to be ahead of any competitors.

2.2.3 In 1923 Shell had three sales representatives, two cars, and no advertising material. Prices varied considerably, but had generally decreased from the wartime high by about one shilling per gallon. Petrol had an octane rating of around 60. In the late 20s, diesel fuel was introduced to SA. Over the years, the price of petrol remained virtually constant, and in 1960 was only 3 shillings 3½d./ gallon.

2.2.4 In 1923 the first bulk rail truck was commissioned by the SA Railways to supply Johannesburg with motor spirit from Durban. The same year a tank installation was erected at Island View in Durban, and a tin-making plant was established there. Within a short period a total of six rail wagons had been imported, and the SAR refused to allow the OC to employ their own bulk transport on the same routes. There was considerable competition among the oil companies for the use of the rail fleet. By 1926, twelve rail tank cars were employed by the SAR.

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2.2.5 In 1930 the Motor Carrier Transportation Act was promulgated with the object of restricting private road transporters (and hence certain of the SAR's competition). Originally, it put varying constraints upon the distances which delivery lorries were allowed to travel from their "home" depots, eg. 10 miles from the centre of Pietermaritzburg, and 30 miles from the centres of Johannesburg, Benoni and Pretoria. It was then amended to a uniform 48 km radius and in 1977, after long-standing pressure from the OC, was increased to an 80 km radius.

2.2.6 During the early 30s, the price of petrol fell to 1 shilling and seven pence per gallon at the coast, and in 1932 during a price war this fell as low as 10d./gal. The number of RSS was increasing rapidly, although much product was still sold through general dealers and hotels. Even today, there are approximately 2 000 general dealers selling petrol and other petroleum products in the rural areas.

2.2.7 In the late 20s and early 30s as the car population increased, many workshops discovered the selling of petrol to be a profitable adjunct. At first, it was common to have only one pump (and therefore represent only one OC), but as demand further increased, the multi-pump (and multi-brand) RSS emerged in the 30s.

2.2.8 In 1926 the Shell Company of SA Ltd. was registered in the UK, being the original British Imperial OC. A local head office was set up in Greenmarket Square, Cape Town. In 1929 Shell finally separated from the Mitchell Cotts company.

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2.2.9 In 1928, The Consolidated Petroleum Company, jointly owned by Shell and Anglo Persian (BP) took over the marketing subsidiaries of Shell and Atlantic (BP) in SA. In 1972, a trade equalisation exercise was conducted prior to the splitting of the Shell and BP consolidated operation in SA. Some 25% of Shell's business was transferred to BP in this exercise.[18]

2.3 THE SETTING OF TODAY'S RSS ENVIRONMENT

2.3.1 In the early 1950s, only Shell, Mobil (formerly Stanvac), Caltex and Atlantic were operating in SA. In 1954, BP took over the Atlantic refining company, and in 1959 commenced marketing under the BP name. Total commenced marketing in SA in 1956, and were particularly strong in the agricultural and government contract sectors. Trek Petroleum was launched in 1968 with Shell and BP each having a 17,5% interest. This was primarily a strategic move with the object of containing competition (especially from the national marketer, Sasol) by setting up a locally-owned OC.

2.3.2 Esso re-entered the SA market in 1963 (having relinquished its former assets to Mobil at the Stanvac break-up) and concentrated upon the Reef and Durban areas. Today they are represented in most major centres, but because their activity has been constrained by the Retail Rationalisation plan (see below), and lack of distribution facilities and skilled manpower, their total market share is under 3%.

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(18) A service company was established in 1967, owned equally by Shell and BP. Its object was to free the two companies of those functions not directly concerned with selling, and to reduce costs and improve efficiency by combining these functions, such as finance, management, supplies, personnel, distribution and planning. This company was disbanded, and the companies went their own ways in 1976.

2.3.3 In 1956, Sasol commenced marketing. It is a wholly-owned subsidiary of the government-owned SA Coal, Oil and Gas corporation. By agreement with the government, Sasol petrol is sold at RSS tied to the OCs in most parts of the Transvaal and Northern Orange Free State. Sasol have agreed with the industry that their petrol market share in SA and SWA will be limited to a maximum of 8,33%, As this figure has not been reached, and because Sasol is a government-owned company, it is likely to grow considerably in the future.

2.3.4 SONAREP entered SA in 1965, drawing products from their Lourenco Marques refinery. Lack of resources limited their market share to approximately 1%, mainly in the Transvaal, and in 1972 they sold out to Mobil.

2.3.5 Other names such as Castrol, William Penns and Duckhams are confined to sales of lubricants only.

2.3.6 In 1950, the Undue Restraint of Trade Act came into force. Its object was to eliminate the monopoly on the setting up of RSS that the OC had, by forcing the OC to supply an RSS that met certain minimum standards. (See Ch. 7).

2.3.7 Another development starting in the early 50s was the strict control by municipalities and provincial administrations on the siting of RSS. Today, (aside from the Rationalisation Plan), the municipalities exert a major influence on RSS location. Various sites are allocated rights for general business, service stations and residence, or a combination of these rights, for example. The OC attempt to locate their RSS on the most profitable sites within these municipal constraints (and other constraints). This is also discussed in Ch. 7.

2.3.8 In late 1950, Shell introduced the first "solus" RSS, i.e. introduced a contract with an RSS tying it exclusively to the Shell brand, in exchange for an exclusive dealing rebate, and possibly additional financial assistance on favourable terms. In 1951, there was a scramble by the OC towards the solus system, which rapidly evolved from the complex multi-brand structure. Today there are very few multi-brand sites remainining. This signified the first clear emergence of the OC's *retail* markets, as opposed to the other classes of markets that were emerging, such as the distinct commercial, government, agricultural, mining, industrial, civil engineering, aviation and fuel bunkering markets. The retail market is defined as consisting of those customers who are resellers of products.

2.3.9 In 1964, a similar exercise was conducted by the OC in SA in the other classes of markets, with the object of securing the remaining "open" business by contracts, using the incentive of bulk discounts. This had the effect of integrating the classes of markets. (See 3.2). One OC, for example, had seven classes of markets during the early 60s, and three after this "security of trade" exercise. These three were retail (RSS only); agricultural, commercial and aviation; and mining, industrial and civil engineering. In 1973, this was reduced to two classes of market, consumer and retail, and today the distinction between these two is becoming less clear as the resources employed in one market are frequently "borrowed" by the other.

2.3.10 Up to the early 50s, all RSS were privately-owned. At this time, the OC began purchasing their own sites, and also leasing sites which they then rented out again. Today, there are four distinct categories of sites: company-owned, company-leased, dealer-owned and UROTA (See Ch. 3).

2.3.11 Other milestones in SA's oil industry development were: 1953 - the first bulk supplies to farmers were introduced. The OC lent tanks to the farmers, who were then supplied by bulk lorry. 1956 - the lubricant oil blending plant was opened in Durban. 1965 - the Durban-Rand pipeline was opened.

2.3.12 During the early 1960s, the OC became concerned about the rapidly increasing numbers of RSS in the country. Within the given market size, an increasing number of RSS meant that the average sales of each was becoming smaller. The OC and the Motor Industries Federation (MIF) persuaded the government to control this proliferation within a rationalisation plan,(19) which was formulated as an agreement rather than an act, to avoid the publicity and rigidity that might otherwise ensue. This plan is updated every five years (or more frequently if the minister dictates) at a meeting of the government, the OC and the MIF. It is discussed in detail in Chapter 7.

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(19) Financial Mail Survey of Oil Industry, P.47. 1st quarter, 1971.

3. CLASSIFICATION OF RSS, AND DESCRIPTION OF THEIR ENVIRONMENT

3.1 INTRODUCTION

3.1.1 The objective of this chapter is to introduce the RSS to the economist. It will briefly describe several institutions concerned with the oil industry, the market and pricing structures, and certain features of the RSS cost and demand curves. This will provide a grounding for the locational and regulatory analyses of Parts II and III.

3.2 THE RSS TYPES

3.2.1 In 1973, there were 6 680 "garages" in RSA, employing 32 480 artisans and apprentices[20] and 60 000 pump attendants.[21] Of these garages, 4 250 sold petrol, and are therefore defined as RSS for the purposes of this thesis. The typical RSS today has total sales ranging from R50 000 through to R5m. The average fuel volume sold was approximately 1 200 cubic metres pa in 1973.[22]

3.2.2 RSS are operated as competitive businesses. Their profits may be derived from a number of departments (see 3.7), with fuel sales typically earning up to 50%.[23] Petrol is supplied to the RSS by eight OC in RSA, normally through a tied contract (see below). All other supplies to the RSS are obtained by them on a competitive basis -- the tying of supplies of non-petroleum products with the RSS is prohibited,[24] as with any other retailers in the economy.

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(20) NPI Survey, 1973-4, P.12

(21) Financial Mail, 2nd quarter 1973, P. 894.

(22) *Ibid.*

(23) Financial Mail, 2nd quarter 1975, P.775.

(24) Regulation of Monopolistic Conditions Act.

3.2.3 A set of trading and profit and loss accounts, and a balance sheet are provided in Appendix 14 for the average SA non-company-owned RSS in 1970. The figures were obtained by taking the totals for all non-company-owned RSS, and dividing by their number.

3.2.4 Oil is regarded as a strategically important commodity by the SA government. This importance contributes towards the following oil industry characteristics:

a) There is constant surveillance by the government at all levels of the oil industry. The burden to provide information rests primarily on the OC.
b) Many of the operations of the oil industry, especially at the "higher" end of the market, are secret. The National Supplies Procurement Act provides for penalties of up to R2 000 or two years or both, for the disclosure of a wide range of oil related statistics. The Petroleum Products Act provides for additional penalties.
c) A range of regulations have been promulgated which give the government the legal right to almost complete control of the oil industry. (See Chs. 7,8).
d) Alongside these "controlling" regulations, certain limited exemptions have been made from other Acts. For example, provision is made in the Regulation of Monopolistic Conditions Act for the OC to be able to "tie" RSS fuel sales; and provision has been made for limited delivery exemptions from the Motor Carriers Transportation Act.

The result is that the RSS are operating in a unique environment. Chapter 7 will concentrate upon these regulations.

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3.2.5 It is useful to classify RSS according to several criteria. Firstly, they may be grouped by their relationship to their supplying OC.

a) Company-owned RSS - all its assets are owned by an OC. Normally, such a site is leased to an operator, who operates it for his own account, paying the OC a "going-rate rental".

b) Company-leased RSS - this type of RSS exists when the OC holds the primary (head) lease. The OC will normally sub-lease to an operator, who again conducts the business for his own account, while paying the OC a "going-rate rental".

These first two categories may be called "company-controlled RSS", because the OC has considerable influence over the operations of such RSS, either through clauses in the contract, or because the OC may refuse to renew the contract with the incumbent dealer when it expires (a typical contract period is 5-10 years).

c) Dealer-controlled RSS. This is an RSS either owned by an operator, or one for which he holds the head lease. Such an operator has a greater security of tenure; and independence from the OC.

d) Roster sites. This is a dealer-controlled RSS which no OC wishes to tie, either because it is uneconomic, or because they do not wish to deplete their rationalisation plan quotas (see 7.2). Such an RSS then has the right, according to the rationalisation plan, to be supplied by an OC chosen at random by the government. The OC so chosen has no obligation to such an RSS, other than to supply products at specified prices.

e) Oil ties. This is not actually an RSS, but rather is a garage or workshop which has contracted to buy oils from a single OC. Note that the rationalisation plan prohibits an oil tie at an RSS where petrol is tied.

3.2.6 At the end of 1976, the total number of RSS in RSA were allocated among the OC as shown in Table 3A.[25]

TABLE 3A. South African RSS Network by OC.

	Caltex	Mobil	BP	Shell	Total	Sasol	Trek	Esso	Sonap	TOTAL
Total Ties	943	939	827	820	513	-	207	91	63	4403
Roster	42	39	40	33	46	-	21	13	24	258
Grand Total	985	978	867	853	559	-	228	104	87	4661

3.2.7 A second useful classification of RSS may be made according to their locations. Firstly, all RSS could be inserted into one of the exclusive categories:

a) High density residential area.
b) Low density residential area.
c) Central business district.
d) Industrial area.
e) Rural area.
f) Special areas with expected future growth.

3.2.8 Once the RSS has been classified as above, the additional options below could be appended:-

i) National or tourist route.
ii) White or non-white area.
iii) Special amenity (eg. shopping centre, car park, station, sports ground, school, etc.)

3.2.9 The last important classification of RSS is by its selling departments. Certain RSS may, for example, have a franchise to sell new cars, or they may sell used cars. Others may have a spares shop, or even a "general" shop. This is discussed in detail in 3.7.

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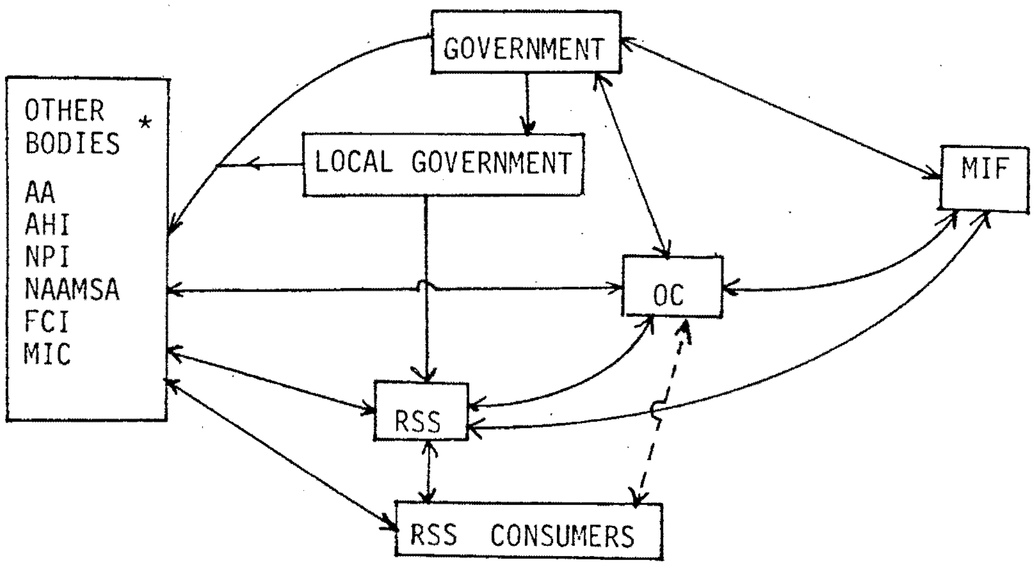
(25) Financial Mail, 3rd quarter 1977, P.337.

3.3 RELATED INSTITUTIONS

3.3.1 Diagram 3A illustrates the relationships of the important institutions in the South African oil industry. The "central government" and the OCs are the two most important institutions affecting the RSS, and are discussed in Chapter 7. One of the major hypotheses of this thesis is that it is the government (which includes state departments and public agencies), influenced by the various pressure groups within the economy, which primarily shapes the economic environment in which the RSS operate.

DIAGRAM 3A. The Institutional Framework



* ABBREVIATIONS

MIF Motor Industries Federation

AA Automobile Association

MIC Motor Industries Council

AHI Afrikaanse Handels Instituut

NPI National Productivity Institute

FCI Federated Chamber of Industries

NAAMSA National Association of Automobile Manufacturers of SA

3.3.2 The MIF is a trade association, and an entirely voluntary organisation. It has approximately 6 000 members in total (RSS, repair garages, car sellers etc.).[26] Traditionally, trade associations have provided services such as data collection, setting standards, public relations, education and other low profile activities. Many modern associations, however, are now standing between government and business, interpreting the actions of each for the other. The national director of the MIF is in weekly contact with the Department of Commerce, and he also serves on the Prime Minister's Economic Advisory Council. The MIF tends to be providing both the traditional and modern trade association services to its members, although, as some believe, not very effectively.[27]

3.3.3 NAAMSA (instituted in 1935) is regarded as the mouthpiece of the motor manufacturers, and it is also a research and information centre. Its position has enabled it to become a voice in the oil industry.

3.3.4 Various other bodies are in contact with the oil industry in their normal operations. The AA provides a small lobby for the RSS consumers, as well as an information and research centre. The MICs monitor employment by the RSS in terms of the Industrial Conciliation Act. The NPI has been commissioned to study certain aspects of the oil industry.[28] The AHI is a voluntary trade association of Afrikaans businessmen from commerce, industry, mining and finance. Its objective is to serve the interests of its 7 000 members through the provision of information and advice, and by acting as a spokesman for them. It is usually consulted by the government before new regulations are promulgated.[29] The FCI was formed in 1917 as a single mouthpiece to express the views of industry to government. Its objective is the:

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(26) According to Mr Meiring of the MIF, 13 Dec.78. He claims that 80% of RSS in SA are MIF members.

(27) See G.R. Cross, (1972), P.82.

(28) NPI survey, 1973-1974.

(29) Standard Encyclopaedia of SA.

> "... promotion and protection of the interests of all manufacturers at a national level".[30]

3.3.5 It is important to note that there are only three organisations in the private productive sector which have the privilege of special access to the parliamentary lobby in Cape Town; they are the FCI, the AHI and the Chamber of Mines. At the local level, the AHI is made up of Sakekamers - groups which retain the AHI's right of special access to parliament.

3.4 GENERAL SCENARIO

3.4.1 Each RSS in SA will be operating in its own best interests (the maximisation of profits, subject to their long term security) under varying degrees of control from the government, and from their supplying OC. It will be argued in part III that some of these constraints have been imposed in order to improve the profitability of the oil industry, particularly that of the OC. Their general effect is to inhibit competition between the RSS, and between the OC.

3.4.2 An important characteristic of the RSS industry, which is primarily a result of the multiplicity of regulations controlling them, is that entry into the industry is highly restricted. The rationalisation plan (7.2) limits the number of RSS an OC may tie by imposing a quota upon each company. The few individuals who wish to open RSS upon their own initiative are not restricted in the same manner, because they have recourse to UROTA (7.2) which allows them to open an RSS providing that certain standards are maintained. The OC, selected by the government on a roster system, are obliged to supply such RSS.

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(30) Standard Encyclopaedia of SA.

3.4.3 The total market demand in SA consists of several thousand small and sometimes overlapping sales areas (6.0.1). Quantities sold in one sales area are almost entirely independent of sales in contiguous areas (6.7). Should there be more than one RSS in any one of these sales areas, then the RSS within that area will be in competition with each other. The entry of a new RSS, or the expansion of sales of an existing one (*ceteris paribus*) can only be at the expense of others in the same sales area; their actions will be interdependent (6.7).

3.4.4 The price of petrol throughout SA is controlled. Where there are a number of RSS in the same sales area, there is therefore non-price competition between them. This competition takes the form of each RSS attempting to differentiate both iself and its product from the others in its sales area. This will be done by advertising, and by variation of the products and services offered by each RSS.

3.4.5 The products offered by all the RSS are virtually homogeneous. Competition between the different brands under a rationalised and price controlled situation (Ch.7) ensures that each of the three octane ratings of the different brands will be very similar. The different OC in fact acquire their fuels from the same refineries within the same areas; the addition of a small quantity of "additive" is the only factor differentiating one brand's petrol from the others.

3.4.6 Sasol fuel, derived from coal and marketed in the Sasol supply area[31] is an exception. Sasol does not own any RSS, but by an agreement with the OC, it sells its petrol through the OC's RSS network within the Sasol supply area. It is often perceived by the public as an inferior petrol, probably because of its different smell and colour, and possibly performance.

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(31) Most parts of the Transvaal and northern Orange Free State.

3.4.7 It is important to note that there are no direct substitutes for petrol, lubricants and other petroleum fuels.(32) If petrol prices rise, a motorist can only use less fuel, or change his mode of travel. Thus, there is an inelastic industry demand curve for petrol (See 3.9). Other causes of inelasticity are: the degree to which petrol is used in our everyday activities; and the fact that the total cost of all fuels represents only 4% of the average urban white, and 8% of the average urban black household's budget in RSA.(33)

3.5 PETROL PRICING STRUCTURE

3.5.1 Details concerning the imports and sales of petroleum fuels in South Africa are not published. However, it is estimated that during 1976, SA consumed 15-20 million tons (approximately 105-140m barrels) of crude oil(34), with the best estimate possibly closer to 15 million tons.(35) Assuming an average price of $12,70 per barrel in 1976 (Table 7B), this means SA paid R1 330m for its crude oil imports.(36) Between 1976 and 1978, OPEC increased crude oil prices by approximately 8%. Given that SA imported 115m barrels in 1978,(37) SA therefore paid R1 575m for its crude oil imports.

3.5.2 In 1976, petrols accounted for 5,2 million tons of SA's crude oil imports. At 1978 crude prices, this represents approximately R500m. 90% of the petrol produced from this crude is sold through RSS, of which 70-80% is taken by the private motorist.(38) The RSS petrol sales volume in 1977 was approximately 5 500 million litres.(39)

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(32) Townshend, (1972), P.372.
(33) UNISA Bureau of Market Research, Nos. 58,65.
(34) Petroleum Economist, Feb. 78. P.56.
(35) Financial Mail, 2nd quarter 1976, P.1135.
(36) Petroleum Economist, Feb. 78. P.56.
(37) Financial Mail, 1st quarter 1979, P.469.
(38) *Supra*, 2nd quarter 1976, P.1135.
(39) *Supra*, 1st quarter 1977, P.562.

3.5.3 Prior to 1973, the growth of petrol sales in SA was 10%-12% p.a.,[40] during 1973 growth slowed to 8% p.a., and with the imposition of further oil conservation measures in 1974, the growth rate slowed to 5% p.a. in early 1975.[41] This rate continued to fall, and in 1976 petrol sales did not grow.[42] In 1977, petrol sales fell.[43] In early 1978, the Ministry of Economic Affairs estimated that petrol conservation measures had resulted in a "22% savings".[44]

3.5.4 Note that the OC gross margin (see 3.5.8) has remained constant for the sixteen years up to June 1975,[45] when the OC were asked to bear 0,4 c/l from their agreed margin.[46] In summary, therefore, the industry has changed from one with a revenue growth of 10-12% p.a. prior to 1973, to an industry whose revenue has declined by around 25% in 1976 because of this margin cut, and the sales volume fall.

3.5.5 South Africa is divided into thirty-five grids for the purpose of pricing petrol around the country. These grids radiate outwards from the major coastal installations - Durban, Port Elizabeth, East London, Mossel Bay and Cape Town. All petrol prices within a grid are uniform, but prices rise as the grids move inland. The price differences between grids are essentially based upon railage costs.

3.5.6 Within each grid, different prices are applied to different sectors of the economy. Private motorists (i.e. the RSS prices) pay the most per litre in each case.

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(40) Financial Mail, 1st quarter 1976, P.923.

(41) *Ibid*, 2nd quarter 1975, P.1158.

(42) *Ibid*, 2nd quarter 1976, P.1135.

(43) *Ibid*, 3rd quarter 1977, P.337.

(44) *Ibid*, 1st quarter 1978, P.70.

(45) *Ibid*, 1st quarter 1976, P.923, and 4th quarter 1975, P.432.

(46) *Ibid*, 4th quarter 1975, P.432.

Lower prices are set by the Minister for agricultural users, mines, commercial enterprises, certain aviation users, industry and civil engineering works, and, of course, the government itself. All the larger contracts in these sectors negotiate rebates of varying sizes with the OC, in addition to their basic price advantages over the private sector.

3.5.7 Table 3B illustrates the price of petrol since 1970 and in Table 3C a partial breakdown of these prices is given.

TABLE 3B. SA Grid 1 98 Octane Petrol Prices

Date of increase[47]	Current Price c/L[47]	COL index[48]	1970 Price c/L
June 1970	8,4	100,5	8,4
April 1971	9,1	105,2	8,7
July 1972	9,4	113,2	8,3
December 1972	9,6	117,4	8,2
October 1973	11,1	127,4	8,7
February 1974	13,8	131,1	10,5
December 1974	14,5	147,3	9,8
February 1975	16,5	150,4	11,0
October 1975	19,6	162,4	12,1
April 1976	22,1	170,9	12,9
January 1977	26,1	183,8	14,2
July 1978	27,2	219,8	12,4
January 1979	30,3	228,4	13,3
February 1979	36,3	229,7	15,8

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(47) Date of increase, and current price obtained from the Argus newspaper, 23/2/79.

(48) Cost of Living index, all items for SA, issued by the SA Department of Statistics and published monthly in the Government Gazette.

TABLE 3C. Breakdown of 93 Octane Petrol Prices: Cents/Litre [49]

DATE:	3/71		3/76	10/76	3/77	10/77	12/78
Middle East f.o.b.:	1,3	cif ex refinery	10,6	10,6	11,9	11,77	11,77
Freight & landing :	0,4						
Duties & levies :	3,2	Duties & levies	5,4	7,9	9,9	10,40	10,40
OC margin :	1,7	OC margin	1,7	1,7	1,7	1,415	1,415
RSS margin :	0,7	RSS margin	1,17	1,17	1,86	1,86	1,86
		SALES TAX	-	-	-	-	1,10
Grid 1 price :	7,3	Grid 1 price	18,9	21,4	25,4	25,4	26,5
RAILAGE :	1,3	RAILAGE	2,2	2,7	2,7	3,2	4,0
		SALES TAX	-	-	-	-	1,2
JOHANNESBURG PRICE:	8,6	JOHANNESBURG PRICE	21,1	24,1	28,1	28,6	30,6

Sources: Financial Mail, 1q 1971, P.23s; 1q 1976, P.923; 3q 1976, P.1135; 1q 1977, P.562; 3q 1977, P.337

3.5.8 The government, through its control of the prices and operations of the oil industry (see Part III), is able to control the gross margins of the OC and the RSS. This control of margins is the simplest method of controlling the average profits of the OC and RSS (as opposed to a controlled rate of return on capital or assets employed). Gross margin (GM) control is relatively easy to administer and is relatively flexible and fast to change. Its prime advantage, however, is that it provides the OC with a strong incentive to operate efficiently. In 5.6, Averch and Johnson's article illustrating the inefficiency of a regulated rate of return based on capital employed is discussed. They show that under such circumstances, firms will maximise their profits by increasing the amount of capital in their resource mix above the socially optimal level.

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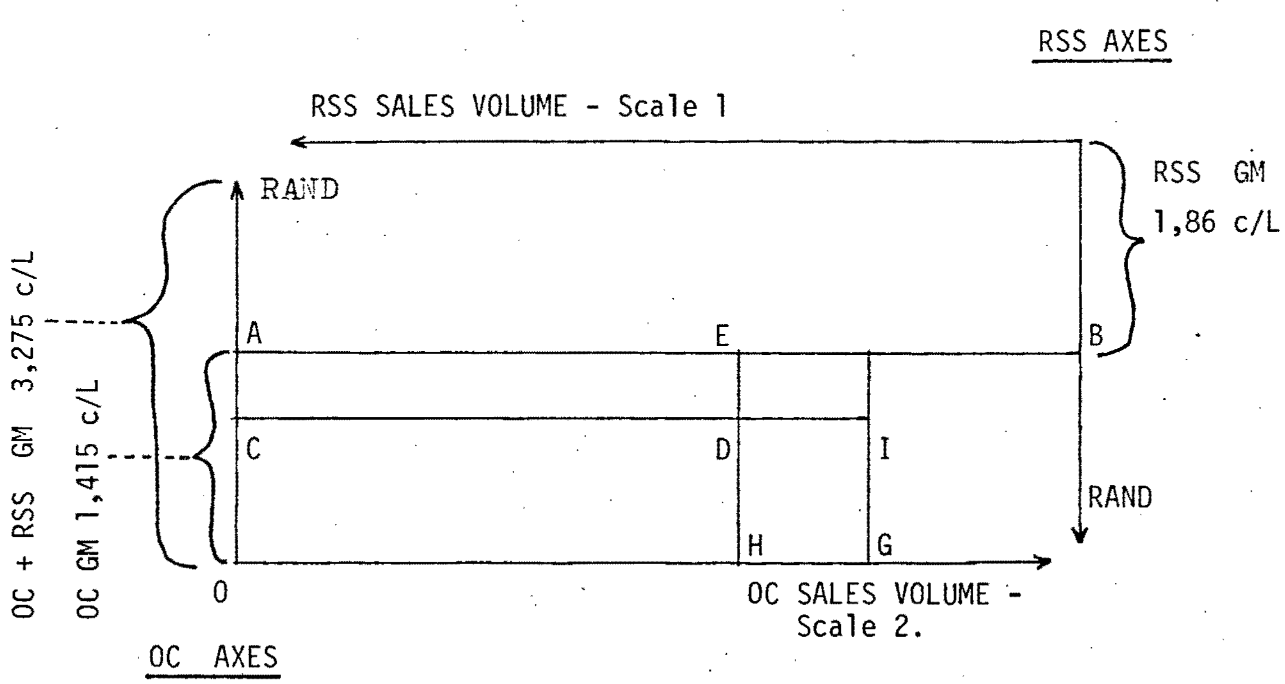
(49) The SABC News, 15/3/79, quoted Minister Heunis as saying the RSS gross margin has been increased to 2,51 c/L.

3.5.9 Under a controlled GM situation, each OC will have the incentive to minimise its average costs, and to maximise its sales (See 3.6). Table 3C shows how any RSS selling a litre of 93 octane petrol in Johannesburg will receive 30,6 cents for it.(50) Of this 30,6 cents, all but 1,86c is immediately earmarked for its costs. For the purposes of this analysis, it may therefore be said that the average and marginal revenue to any RSS from the sale of a litre is 1,86c.(51) Similarly, the average and marginal revenue to any OC from the sale of a litre of petrol is 1,415c. This will provide both the RSS and the OC with pressures to simultaneously minimise costs and maximise sales. It will be seen in 3.10 that both the RSS and OC are operating on falling sections of their LAC curves, and therefore have policies of volume maximisation.(52)

DIAGRAM 3B. OC and RSS GMs.



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(50) December 1978.

(51) December 1978. Note that this was increased by 35% in February 1979 to 2,51 c/L.

(52) The Financial Mail, 1st quarter 1975, P.93, maintains that the average SA RSS has the highest throughput, and one of the lowest mark-ups in the world.

3.5.10 Initially the government regulates petrol prices in Diagram 3B, so that the OC GM is 1,415 c/L, and the RSS GM is 1,86 c/L. Each has the jurisdiction to operate as it wishes within those margins. For example, an OC (obviously) may not raise the line AB, but it may lower it if it wishes, and give a portion of its GM to the RSS. This is often done by the OC, by giving rebates to the RSS as a "reward" for achieving a certain sales volume.

3.5.11 It can be seen that the size of the downward movement of the line AB (i.e. the size of the rebate to the RSS), is a matter for OC decision, for each of the RSS tied to it. The primary factors affecting the size of this movement will be:

(a) The competition between the OC for the tie with that particular RSS, particularly if it is profitable, and its contract is due for renewal.

(b) It will be used as an incentive to the RSS to increase sales volumes.

(c) It may be used for various marketing strategies. For example, if an OC expects a site to be more profitable in the future, or if it wishes to increase its representation in a particular area, it may increase its RSS rebates.

3.5.12 The size of the rebate (the downward movement of AB) allowed by the OC to the RSS will depend upon the gains the OC believes it will receive. Assume the OC initially has a sales volume OH at the GM level A. It will lower its own GM to C (and thus increase the RSS GM by an identical amount) if it believes that the increased sales "revenue" DIGH exceeds the revenue rebated to the RSS, AEDC.

3.5.13 It is maintained[53] that the average RSS GM in SA including rebates, is approximately 2,16 c/L. This makes an average rebate of 0,3 c/L.

3.5.14 The government, through using the GM technique to control oil industry profits, is able to separate the effects of

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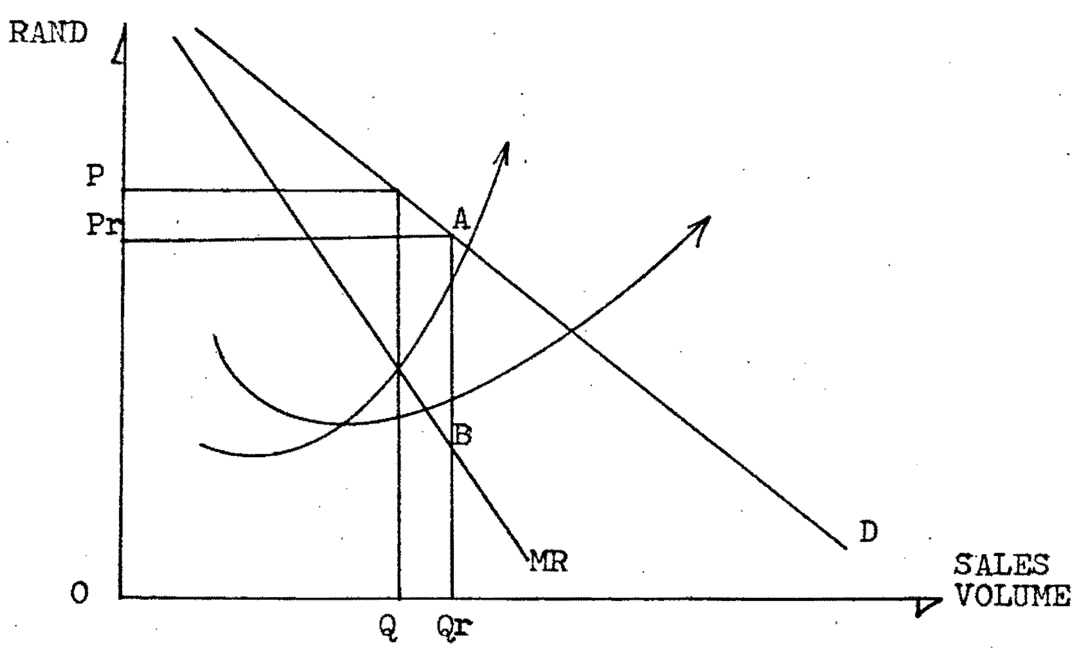
(53) Financial Mail, 3rd quarter 1977, P.337.

cost changes exogenous to the OC and RSS from pressures within the SA industry. For example, if crude oil, or railage costs raise the costs of petrol by 1 c/L, the government can simply change the price of petrol by 1 c/L. OC and RSS profits will fall little, because of the inelastic industry demand curve (3.9) However, if OC and RSS profits were based on a % rather than absolute margin, these profits would normally increase along with a petrol price increase. It is interesting to note that with the price of petrol having increased at a rate of 20% each year since 1972, the MIF is strongly in favour of a 10% profit margin for the RSS, rather than a fixed margin![54]

3.6 THE OC -- ESSENTIAL CHARACTERISTICS

3.6.1 Diagram 3C illustrates a typical OC -- it faces an inelastic demand curve DD (see 3.9) and operates on a downward sloping portion of its ATC curve (see 3.10). Its unrestrained equilibrium position would be at price P and sales volume Q. However, the government regulates price at Pr. The average and marginal revenue curves for that OC now become PrAD and PrABMR. OC super profits are reduced, and quantity supplied is increased.

DIAGRAM 3C. Essential OC Curves



(54) Financial Mail, 2nd quarter 1976, P.1135.

3.6.2 It can be seen that because of the downward sloping ATC curve and the regulated price, any rightward shift in DD will result in an increase not only in absolute profits, but also profits per unit sold. Hence the proverbial volume maximisation policies followed by the OC. An additional incentive will be given to the industry as a whole to increase sales volumes, in that the industry GM remains constant, no matter what the ATC level. Thus it is likely that the industry would still wish to increase sales volumes even when the ATC is rising. (ie. for the industry the line Pr remains a constant level above ATC).

3.6.3 A diagram similar to 3C could be developed to describe a typical RSS, and to explain the volume maxismising policies they adopt.

3.6.4 An OC has several means of influencing the operations of an RSS tied to it. As already mentioned, its power over company-owned and leased sites will be considerably greater than that over dealer-controlled sites. The most important of these areas are:

(a) OC fuel deliveries to the RSS. A typical OC-RSS contract will provide for the payment in cash, or payment over a short (eg. 30 day) period for fuel delivered. It therefore becomes advantageous for an RSS to take more frequent, but smaller deliveries, especially as the OC pricing structure normally does not penalise an RSS for doing this (the OC will bear the cost of the more frequent deliveries). The frequency and size of deliveries therefore become a matter for negotiation between the OC and RSS.

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b) Finance provided by the OC. In addition to the terms of payment for fuel deliveries, and the rents paid for company-leased/owned sites, an OC may provide finance to an RSS tied to it. Such finance may be in the form of advance monies (grants, loans or guaranteed finance such as rebates in advance on projected fuel sales). Advance monies are being used less frequently today.
OCs may provide preferential lease or purchase terms for specific equipment, such as a car wash or spares counter. Note, however, that all finances provided by an OC, preferential or not, will be provided by the OC on the expectation that it will ultimately profit from increased sales.

c) Information and advice are provided by the OC in a number of areas, both on a discrete and a continuous basis. Such advice will be given with the ultimate objective of benefitting the OC, but normally it will, of course, be of benefit to the RSS. Areas covered are setting up of the RSS (location, size, layout), visual manifestations (emblems, colour schemes, etc.), advertising and sales promotion, operating and merchandising, investment analysis, accounting and general training.

3.6.5 The OCs will have a strong incentive to maintain "orderly marketing" among themselves, and among their tied RSS. It was illustrated above that each OC and RSS will have a strong incentive to maximise volumes. In addition, in Chapter 6 of this thesis, it is shown that most RSS are operating in a competitive "oligopoly" situation, and that price or non-price competitive action by one RSS will be strongly felt by others operating in the same sales area. A cut in selling price by one RSS will automatically involve its host OC, and will, therefore, often spread to other sales areas.

3.6.6 Because there are only eight OC operating in SA, and because of their strategic importance and close relationship with the government, all the parties will have a strong incentive to maintain "orderly marketing", and avoid unrestrained competition which might disrupt the generally profitable environment. This is discussed in detail in part III. Essentially, there is a given "cake" or potential volume of fuel sales in the SA economy. Each OC will have the objective of getting the largest, and most profitable, slice of it. To do this, each could:

a) Open as many new RSS as possible. However, this would result in numerous low volume, high average cost RSS, and possibly decreased standards and service in the industry.

b) Cut prices.

c) Agree that all OC will limit the number of new RSS opened; and that certain standards of service will be maintained by all RSS. Competition is then concentrated upon obtaining the "best" of these limited numbers of RSS.
The most effective method of limiting RSS numbers is to include the government in any such agreement, and this was therefore done. The primary costs, in the form of decreased convenience, are upon the consumer. (See Chapter 8).

3.6.7 The petrol market shares of the OC have been estimated as follows:(55)

Caltex 17-19%, Mobil 20%, BP 18-20%, Shell 18-19%, Total 12-13%, Sasol 7%, Trek 4-5%, Esso 3-5%, Sonarep 1-2% (Mobil-owned).

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(55) Financial Mail, 2nd quarter 1976, P.1123.

3.6.8 Typical OC objectives are likely to be:

a) To maximise profitability of the existing RSS network.
b) To increase the existing share of the market and maximise sales volumes.
c) To emphasise cost efficiency and control (because of the fixed gross profit margin).
d) To actively pursue rationalisation.
e) To identify and secure the most profitable RSS for company ownership.

<u>Policies</u> to achieve these objectives will typically be:

a) To identify key undeveloped locations for the development of company-owned RSS, and to identify and obtain superior operators for company-owned RSS.
b) To identify high growth areas for future RSS development.
c) To disinvest the low profit RSS.
d) To selectively convert dealer-controlled RSS into company-controlled.
e) To identify and eliminate low profit products and areas (especially non-OC activities such as show rooms for car sales).
f) To improve brand image.
g) To provide profit producing facilities (eg. shops, restaurants) superior to those offered by competitors.
h) To eliminate non-profitable financing to RSS.
i) To maximise cash generation.
j) To increase RSS sales volumes to above the industry average by giving them volume incentives.

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3.7 THE DEPARTMENTS OF AN RSS

3.7.1 Most RSS derive their profits not only from the sales of fuels, but also from several other "departments". Typically, petrol sales will provide up to 50% of an RSS's profits,[56] with the balance of profits being earned by the workshop, the sales of new and used vehicles, the sales of spares, a general shop, a car wash, a restaurant, or by some other type of business attached to the RSS. Certain RSS exist primarily on the profits from their fuel sales,[57] whereas others have been known to use fuel sales as a "loss leader".[58]

3.7.2 Accurate accounts by department are not kept by many RSS; those that do keep them were not prepared to divulge profit figures. Table 3D, however, shows profit rates, and sales %s, by department for a sample of thirty-one garages in the NPI survey (Page 4). Note that most of the garages examined were "large" (twenty-three had sales in excess of R3m p.a., and nine had sales in excess of R6m p.a. in 1973-74), and that ten of them did not sell petrol and oil.

TABLE 3D. Net Profits, and Sales Breakdowns for an RSS Sample

	Weighted net Profit on Sales (before Tax)	Sales %
Workshop	7,54%	50,00 %
New vehicle sales	2,03%	9,12 %
Spares	1,70%	20,00 %
Petrol and oil	0,94%	11,76 %
Used vehicles	0,24%	9,12 %
		100,00 %

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(56) Financial Mail, 2nd quarter 1975, P.775.

(57) For example, Cottage Motors and Cliffords Garage in the Cape peninsula.

(58) See NPI Survey, 1973-1974, pp.58-63.

3.7.3 A theory will now be developed concerning the size and number of departments in an RSS, which will provide a useful insight into the value of fuel and oil sales to the typical multi-department RSS.

3.7.4 In commerce generally, it can be seen that there are two different types of shops which might sell the same product. For example, a "specialist" shop may sell new, and reconditioned car batteries, and little else; whereas a hypermarket may sell new (but not second-hand) batteries among its range of thousands of items. The factors determining these two extremes are:

a) The size of the market into which the particular shop is selling. There must be a "large" market before the demand for a single item can justify a "specialist" shop. Such a shop must be able to provide convenience and expertise to a large enough portion of the market to be able to draw those customers away from other types of shops.

b) The "specialist" and "general" shops aim at different types of market. The general shop will sell to the customer who does not need expert advice on what he is buying. Such a customer is also likely to find it inconvenient to visit a separate shop to purchase the specialist item. On the other hand, the specialist shop will aim at those customers who need expert advice along with their purchases, or who want to purchase an item, or service, that only the specialist shop would stock.

c) It is possible that a shop may sell a limited range of items because its resources are limited. The most obvious example is when land and buildings preclude the expansion of activities. Another example is the shortage of management expertise required to move into a new area.

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3.7.5 The optimum diversification for an RSS can be shown symbolically. A firm will expand output to the point where total revenue less total costs is maximised, i.e.:

$$(TR - TC) = G \text{ is maximised.}$$

If there are N departments, the profit G for each department K may be subscripted G_k. One would deduce that a shop would allocate its activities such that:

$$G_1 = G_2 = G_3 = \ldots = G_k$$

3.7.6 In this situation, total profits would be maximised providing all activities are entirely independent and do not affect the others, and providing that each department costs the same. Because it is highly likely that different departments <u>will</u> affect each other, the maximum profit specification must contain a variable allowing for the effects of each department upon each of the others. Let B_k be the sum of all positive and negative effects upon each department other than K, as the result of the operations of department K.

3.7.7 B_k will be the sum of two positive and two negative effects;

a) Customers that visited the firm with the intention of purchasing from department K may purchase from other departments.
b) The existence of department K may mean that certain resources will become available to the other departments, eg. management or expertise, advertising facilities, customer facilities and larger scale administration.
c) Department K may, however, draw customers away from other departments.
d) It may also compete resources away from other departments.

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3.7.8 Each department is also weighted by its total costs, TCk. The optimal Department sizes will then be:

$$\frac{G1 + (B2+B3+B4 \; \dots \; +Bk)}{TC1} + \frac{G2 + (B1+B3+B4 \; \dots \; +Bk)}{TC2} + \dots$$

$$= \frac{Gk + (\sum_{K=1}^{k-1} Bk + \sum_{K=K+1}^{K} Bk)}{TCk}$$

3.7.9 A typical RSS, when opening a new department, will carefully consider the effects of the existing departments upon the potential new department; and the effects of the new department upon those already existing, i.e. it will desire to maximise the B values in each case. An OC, however, would be interested in a new department primarily because of its B value effects upon its fuel and oil sales.

3.8 THE DEMAND FUNCTION FOR AN RSS

3.8.1 In Chapter 4, equation (E87) provides the structure for an RSS model - it can be used to predict the number of customers who will flow from zones, i to RSS, j. If the predicted customer flows are multiplied by their average RSS expenditures, Ei, a demand figure for each RSS in the study area is obtained.

3.8.2 Ei is affected by the following:

a) The number of cars in zone i.
b) The per capita disposable income in zone i.
c) The number of persons per car in zone i.
d) The average age of cars in zone i.
e) The average engine capacity of cars in zone i.

f) The travelling requirements of the average customer in zone i, as determined by the following:
   i) The geography of the zone.
   ii) The infrastructure of the zone.
   iii) The occupation of workers in the zone. (A customer will tend to spend more at RSS when the economic activities in which he is involved are spread over a wide area; there are natural impediments to travel, such as mountains and lakes; the roads are few, in poor condition and indirect; his home to work travelling distance is high; and he has an occupation which requires much travelling) (eg. some sales jobs).

   Ei may be lower, and more elastic, if substitutes for the car are available in the zone. For example, commuter train and bus services may be well developed in the zone.

g) Expenditure by customers will be related to the state of the economy, aside from disposable income. Most customers will decrease their RSS expenditures in a depression, because their marginal propensity to save at a given level of income will increase.[59]
   In RSA the appeals by the government to use less fuel may have a greater effect in depressed times, because of the impact of the depression on the consumer, and his desire to correct the situation. (Of course, self interest will normally predominate, but in these circumstances, self interest and austerity may well be synonymous).

3.8.3 Price was not explicitly determined as a variable in the model in Ch. 4. This is because in RSA the product is sold at the same price by different RSS, and a price function in the model would be meaningless. (See 3.5).

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(59) Personal savings increased by 35% in 1977, against a decrease of 8½% in 1976 - see discussion in Barclays Business Brief, May 1978.

When the government does allow a price change, all RSS vary their prices simultaneously by the same amount. Should it be desired to know what the effect of an independent variation in price by one RSS would be, one of the components of equation E83 in Chapter 4 may be devoted to price. The parameter for this factor would have to be estimated using data obtained in a country were prices are free to vary (eg. UK, USA). Estimates of price elasticity for SA are, however, made later in this chapter.

3.8.4 The demand function for an OC is simply the summation of the demand functions of the individual RSS tied to it, and the industry demand function is the summation for all the RSS. The OC and industry demand curves therefore depend upon the number of RSS involved, and the shape of each of their individual curves. Factors which affect the demand of a single RSS will also, (to a pro rata degree) affect the demand of its OC (unless such factors simply cause the change in demand at one RSS to be offset by the change in demand at another tied to the same company. However, most SA OC have the policy of not locating their own RSS in competition with each other).

3.8.5 It is unlikely that any individual RSS or OC will be intent upon increasing the industry demand curve. This would only create a poor relationship with the government, which is attempting to minimise fuel consumption (See 7.7). The energies of the RSS and OCs are, therefore, directed towards maximising their market shares by competing for existing customers; and cutting costs to increase profitability.

3.9 DEMAND ELASTICITY

3.9.1 The selling price of petrol in RSA is fixed. (3.5). However, there are a few instances of unilateral price cuts by individual RSS in South Africa, and there is also a case in which many of the RSS tied to one OC were involved in price cutting. These cases are examined below.

3.9.2 The individual RSS market demand curve. The first case is when an individual RSS changes its petrol price, and the prices of other RSS remain constant.

3.9.3 On 18/7/77, Vic Proctor's Motors, Cape Town, unilaterally cut the selling price of its petrols by 1c/Litre (to 24,4c/L for 93 octane for example) and advertised it on billboards on its site. During the next three days, sales volumes increased by 33%. On the third day, the government price controller ordered that prices be increased to their previous levels. (It is interesting to note that Shell was "happy to supply" petrol during this period). On resumption of the old, higher prices, sales still remained approximately 20% above their previous levels.[60]

3.9.4 From the above, it can be estimated that the short term, *ceteris paribus* elasticity of demand for that single RSS was approximately:

$$\frac{\text{\% change in quantity}}{\text{\% change in price}} = \frac{33}{4,52} = 7,3$$

3.9.5 The price cutting attracted customers to that RSS who had never visited that site before. Using the terminology of 4.2, it can be seen that Vic Proctor's was established on the frames of a number of new customers, and a large portion of them from then on decided that this RSS was the most convenient one to visit under certain circumstances. Hence the continuation of additional sales even after prices had returned to their old levels.

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(60) Telephone conversation with Mr Proctor, 16/8/78.

3.9.6 Note that a unilateral price cut by an RSS is most unusual, and hence this case attracted a large amount of free additional publicity. For example, the RSS manager was interviewed on a peak hour radio programme.(61)

3.9.7 Mr Proctor maintained he did not cut prices in competition with the Esso RSS that were doing this at the time, but rather because he was copying the example of other price cutting cases in Pietermaritzburg and in the Transvaal.

3.9.8 There is little available evidence with which to consider price cutting in the long term by a single RSS. The RSS sited next to certain hypermarkets (eg. Pick 'n Pay, Brackenfell) are selling petrol at small discounts (ie. ½ c/L, during 1978). However, the OC believe that such discounts are not "meaningful" enough to attract many additional customers, especially as the discounts are often provided only on production of a coupon to be obtained at the hypermarket next door.(62)

3.9.9 A less direct example of long term price cutting by a single RSS may again be seen in Vic Proctor's Motors. In December, 1977, this RSS obtained the sole right in the area of Cape Town to indirectly cut its prices by giving away a particular trading stamp.(63) On 16/8/78, it was still the only RSS in the Cape area selling these "hotel stamps". During August 78, the sales volumes of this RSS were 26% above the target calculated using the previous year's performance. An elasticity calculated from these figures

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(61) SABC Radio Today, 0730 hrs, 19/7/77.

(62) Telephone conversation with the regional sales manager of a large OC, 15/8/78.

(63) On purchasing R10 worth of petrol, the customers receive one stamp. Twenty-five of these stamps will buy the customer a bed-night for two at one of sixty hotels around the country. Cost of the stamps to the RSS are 6,67 cents each. Thus, for those customers who partake of the scheme, and who buy exactly R10 worth of petrol, the price reduction provided by the RSS is 0,67%. Obviously, it may be argued that the value of the reduction to the customer is greater than this, because he will be receiving an additional discount from the hotels through the scheme.

would be misleading, because of the unquantified hotel-value to the customers. Suffice it to say that the demand curve faced by this RSS alone is elastic in both the long and the short term, providing that rival RSS do not retaliate.

3.9.10 It will be argued that should several RSS at different points around the city cut prices, the resulting increases in sales for each will not be as great as in the case discussed above. This is because a large portion of the increase in Vic Proctor's sales was made up of a small number of "special offer seekers", ie. a limited number of customers in the general area who are prepared to travel long distances to obtain the discounted prices. (This was confirmed by Mr Proctor). Once several RSS start cutting prices in this way, they will only obtain a small portion of the "special offer seekers", and further increases will have to come from more "normal" customers.

3.9.11 In the absence of price controls, and of the orderly marketing objective of the OCs, the demand curve faced by the RSS is likely to have the "kink" suggested by P. Sweezy.[64] This is confirmed by R. Cassidy Jr.[65] in which he describes the US market in the 1940s and 1950s - a market with no formal price controls.

3.9.12 Throughout 1977, "many" of Esso's RSS (there is conflicting data as to what proportion of the total) cut their petrol prices by ½ c/L below the industry regulated level. Esso believed that its RSS faced elastic demand curves, and that these price cuts would enable it to expand its sales - which are only 3-5%[66] of the total retail market.

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(64) Sweezy, (1939).

(65) Cassidy, (1954).

(66) See 3.6.7.

It believed that the other OC, in spite of the loss of sales that they would suffer, would not match these price cuts, because the cost of the matching in the remaining 97% of the market would be too great.

3.9.13 Esso was corret in its prediction that none of the remaining OC would match its price cuts (except for limited periods with individual RSS). However, all the OC were extremely concerned about Esso's action, not only because of the losses of sales suffered, but also because it represented a departure from "orderly marketing". The maintenance of "orderly marketing" between the OCs is one of their specific objectives; (see 3.6.8) although it may be argued that the OC with small market shares (Esso and Trek) will be strongly tempted to enlarge them by deviating from this principle. The danger is that departure by one OC from the status quo could rapidly deteriorate into a widespread and highly damaging war for all concerned.

3.9.14 It seems, however, that Esso over-estimated the elasticity of its combined market demand curve. It is believed[67] that the sales volume increase was less than expected, especially in the long term, as "marginal" customers came to realise the true value of a ½ c/L price reduction when measured against their loss of convenience. Had Esso offered a greater price cut (1 c/L was suggested), and had they advertised these cuts effectively (the only ads used were billboards at the RSS), they may have made large market gains.

3.9.15 It is not understood why the price controller did not more obviously discipline Esso during the year. Perhaps the government-OC informal price agreement allows Esso this limited price cutting.

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(67) Telephone conversation with regional sales manager of a major OC, 15/8/78.

3.9.16 The industry demand curve, unlike the RSS and OC demand curves, is likely to be inelastic. The primary reason is that when prices in the industry are changed, the consumers have no opportunities to avoid the price changes by switching between RSS.

3.9.17 Townshend[68] maintains that the main feature of the market demand for petrol as a whole is that it is price inelastic, and he makes a "guestimate" for Britain of 0,2. The main reason for the low elasticity, he says, is the absence of direct substitutes for petrol. His second reason is that petrol only accounts for a portion of the cost of running a car. (A 10% increase in the price of petrol would result in a 5% increase in total car running costs in South Africa, for the average consumer at the end of 1978).

3.10 ECONOMIES OF SCALE OF AN RSS

3.10.1 Economies of scale may be defined as the causes of the downward sloping part of the long run average total cost curve of a firm. Viner (1952) distinguishes external and internal, and real and pecuniary economies of scale. The most likely causes of economies of scale for an RSS are:

a) Technical: labour may become more efficient because changing between jobs is avoided. A medium sized RSS may have ten pump attendants, a cashier, a lube bay attendant, a spares assistant and a manager, instead of one or two men performing all these functions. Similarly, larger land and buildings will allow more specialisation.
More cost efficient equipment may be used, eg. a 9000l tank costs R807 (9,0 c/L) and a 23000l tank costs R1410 (6,1 c/L).[69]

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(68) Townshend, (1972), P.372.

(69) Distribution, Shell 16/8/78 Smallest and largest tanks used by their RSS.

b) Managerial: The larger an RSS, the higher the quality of the management it can afford. Also, a small RSS may not make full use of a manager's time in a management capacity.

c) Financial: A large RSS may be able to obtain money more cheaply because of its larger needs, and because of the greater interest of the parent OC in it. (3.6.4).

d) Transport: A delivery of 2000L over 20 km to an RSS will cost R11,10 (0,55 c/L) and a delivery of 22 000L over 20 km will cost R37,40 (0,17 c/L).(70)

e) Advertising costs per litre sold will likely be lower for a large RSS.

3.10.2 Note that economies of scale will also apply to the OC, and of particular importance will be b, c, and d above. A doubling of the sales of an RSS will not require a doubling of RSS administration costs by an OC, nor will the retail marketing staff need to be doubled. The costs of financing a large RSS are also likely to be more effective on a per rand basis.

3.10.3 The actual monthly rents and annual rates and taxes paid by a sample of 41 company-controlled RSS in Cape Town city, its southern suburbs, and its northern area, were used as the basis for an economies of scale calculation, the results of which are shown in Table 3E. Curves were regressed to enable predictions at the intervals specified in the Table. A major OC supplied the data required for the estimation of the remaining rows.(71)

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(70) Transport, Shell 15/8/78.

(71) See Table 3E's notes.

TABLE 3E: RSS ECONOMIES OF SCALE

Rand per month attributable to Petrol Sales

	MONTHLY SALES M3						
	10	50	100	150	200	250	500
Site Costs	70	80	100	150	250	370	630
Buildings	100	200	200	240	280	350	400
Pumps, Tanks, Canopy, Sign	70	90	180	240	290	330	480
Pump Attendants	160	160	320	480	640	800	960
Other Personnel inc. Manager	-	350	450	500	600	700	800
Overheads	170	240	300	330	360	400	650
Rates and Taxes	60	70	160	180	210	230	350
TOTAL PETROL SALES COSTS	630	1190	1710	2120	2630	3180	4270
(cents per Litre)	6,30	2,38	1,71	1,41	1,32	1,27	0,85

TABLE 3E: NOTES

1. It is assumed that the 10 and 50 kl p/m RSS have no workshop.
2. The costs may be interpreted as those for an established RSS at the end of 1978. The actual rents for a sample of 41 RSS in Cape urban areas were used as a basis for the table.
3. Variations of over 100% from Table 3E were found in the sample. The Table must be interpreted with particular caution not only because of this variation, but also because profits earned by the different departments of different RSS vary considerably. An RSS which survives primarily on petrol sales obviously must make a profit in that department, whereas a multidepartment RSS need not (see 3.7). A regression of the Table's results indicates a break even sales volume of 98 kl p/m, but numerous RSS actually exist with sales lower than this.
4. 50% of land, building, management and overhead costs, rates and taxes were apportioned to all RSS except the 10 and 50 kl p/m categories; these received 100%.
5. The 10 kl p/m category assumes a single operator only.
6. A typical 250 kl p/m RSS canopy costs R15 000; to instal 2 duo pumps the costs are approximately: 23 kl tank R1 500, 2 duo pumps R4 700, pipes, electrics and installation R2 100.
7. A canopy is assumed only for the 150 kl p/m RSS and above.
8. A typical pump attendant in Cape Town earns R160 p/m, and he sells around 50 kl p/m.
9. Overheads include advertising, bank costs (primarily a petrol overdraft), insurance, legal and accounting, electricity, water, stationery and phone.

3.10.4 The Table shows only those RSS with volumes exceeding 98 m^3 p/m to be making petrol profits.(72) It must be remembered that because of the variations from the Table, certain small RSS will be profitable; in addition, although some RSS may be making a loss on petrol, they may be compensating in other departments (3.7).

3.10.5 An important point, examined in Chs. 7 and 8, is that governmental regulation has increased the operating costs of many RSS. Building standards, minimum physical sizes, and minimum services to be provided have all increased costs.

3.10.6 It will be shown below that in practice competition between RSS will preclude the enjoyment of economies of scale beyond a certain output. Because convenience to customers is so important a factor in determining the sales of an RSS (Ch. 4), the "natural" or unregulated number of RSS in any area is "high" (Ch. 8). The marginal cost of additional sales volumes for any RSS rapidly increases once it is supplying a high proportion of its own sales area,(73) because it can only gain further volumes in competition with other RSS in other sales areas. (See 6.7 for empirical evaluation). If all competition could somehow be suppressed, an RSS could expand substantially and great economies of scale would result. In practice, one method by which an RSS can expand is to increase its "attractiveness" factor (See Ch. 4) by adding additional facilities and generally becoming a more complex and costly operation.

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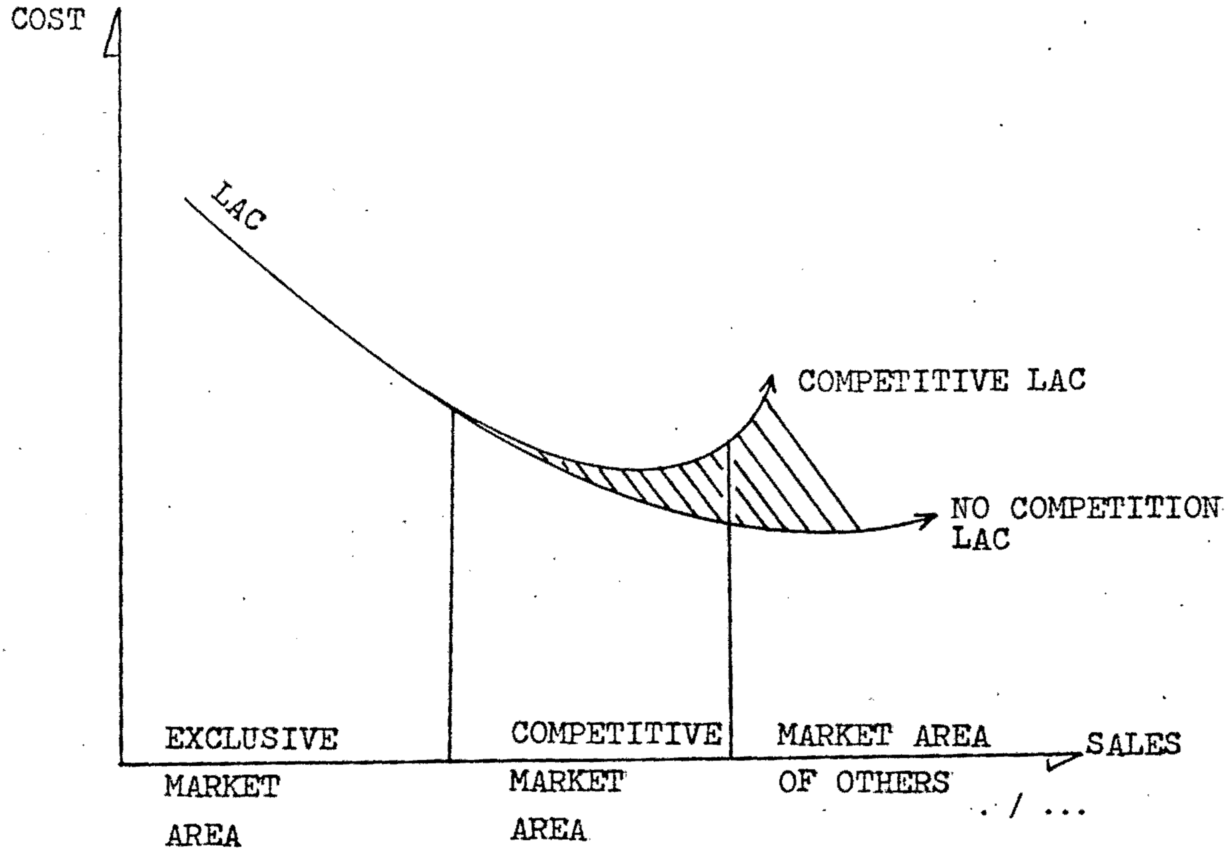
(72) In February 1979 the RSS GM was increased by 35%, to 2,51 c/L. Break even volumes should then average less than 50 m^3p/m.

(73) See 6.0.1 for definition of "sales area".

3.10.7 Diagram 3D illustrates this argument. At sales volume to the left of A, the RSS is able to expand its sales to new customers within its sales area, and will enjoy economies of scale in doing so. However, should it continue expansion beyond A, the effects of competition will be increasingly felt, and at B it can be seen that the average costs are rising rapidly because of the costs of competition. In an unregulated market, any expansion beyond B is nearly impossible. The "no competition curve" shows the economies of scale that could occur without competition; the shaded area between the two curves represents the cost of competition (or the savings to be gained from eliminating competition).

DIAGRAM 3D: RSS Competition and Economies of Scale



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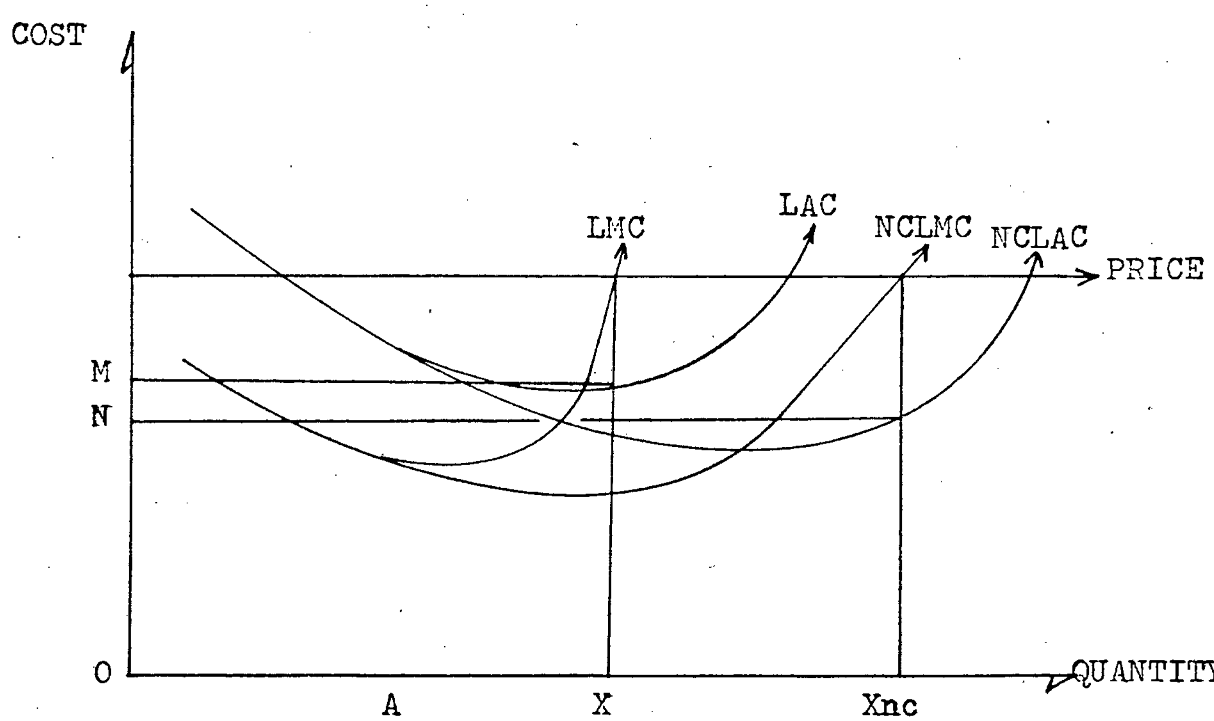
3.10.8 Diagram 3E expands this argument. The actual LMC and LAC curves for an hypothetical RSS are shown in the diagram, and also the same curves, should no competition exist (NCLMC and NCLAC). The essential feature of the NC curves is that the RSS will not have to incur costs in drawing customers away from competitive RSS as it expands output. Up to output A, the actual and NC curves are identical.

DIAGRAM 3E: The Effect of Eliminating Competition



3.10.9 The output of the RSS, with unrestricted competition will be X and profits X(P-M). However, if competition were eliminated, the equilibrium point for the RSS would expand to Xnc, and profits would increase to Xnc (P-N). Chapters 7 and 8 will examine the OC and RSS policies, and legislation enacted by the government, to limit competition and reap the benefits of economies of scale illustrated above.

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3.10.10 An important party has been excluded from the discussion so far - the customer. An increase in RSS volume beyond X in Diagram 3E implies that the locational convenience so valued by the customer is being denied to him. As sales volumes increase, the market area of the RSS is obviously expanding, and the newly acquired customers will have further to travel to that RSS (assuming that they were previously satisfied by some closer RSS). Alternatively, the new and convenient RSS that certain customers desire, and that the free market would create, will not be built. An estimate of these costs suffered is made in Chapter 8.

3.11 CYCLICAL SALES

3.11.1 Most RSS do not face a steady level of demand during their selling hours. On a daily basis, there will normally be sales peaks roughly coinciding with the times customers in the area travel to and from their workplaces. Certain days of the week, and months of the year, will regularly have higher sales than others. Table 3F illustrates the hourly and daily fluctuations in sales for a sample of eight RSS.(74)

TABLE 3F: CYCLICAL SALES - INDICES

Time	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
Sales Index	100	135	119	124	139	139	181	151	203	357	346

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Day	MON	TUES	WED	THURS	FRID	SAT AM
Sales Index	100	97	102	106	211	134

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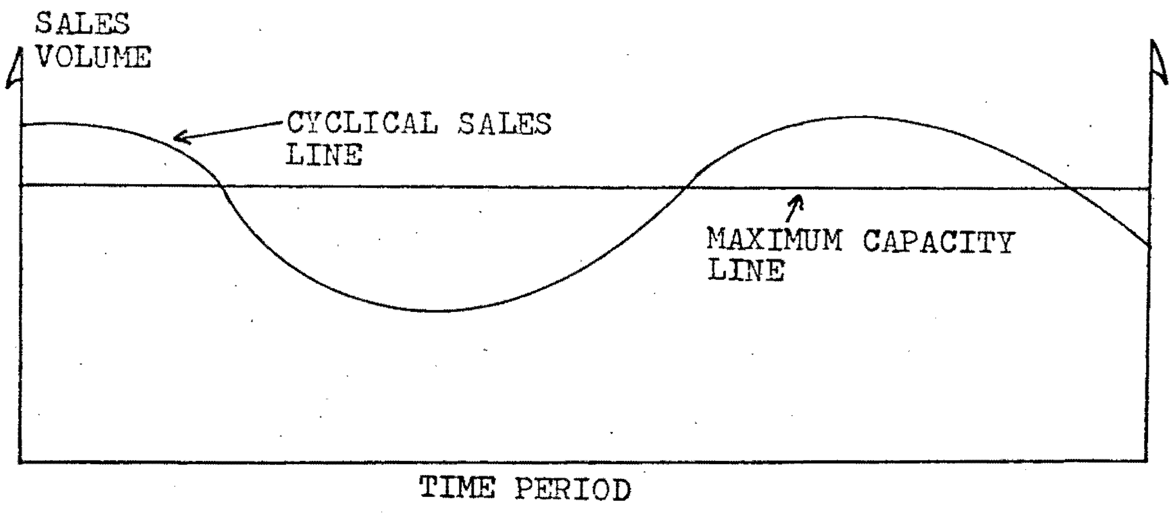
(74) Comprising RSS from the high and low density residential categories, and industrial category.

3.11.2 Every RSS will desire to be able to satisfy all customers who wish to make a purchase. However, it is possible that certain RSS may not be able to accommodate potential customers' purchasing requirements at peak cyclical sales periods, because of inadequate RSS facilities (capacity). A trade off therefore exists between the cost of additional RSS capacity, and unsatisfied demand (in terms of customers who do not visit that particular RSS, or customers who have to bear the costs of queueing.) An RSS should therefore increase its capacity until an additional rand of capacity cost is just matched by the net present value of additional sales generated by the marginal addition to capacity. (The discount rate to be used is the RSS's cost of capital for capacity expansion).

3.11.3 This is shown diagramatically in Diagram 3F. The capacity of the RSS is a straight line showing the maximum sales volume the RSS can handle at any one time.

DIAGRAM 3F: CYCLICAL SALES



3.11.4 It is losing sales, and therefore profits whenever the sales line deviates (above or below) from the maximum capacity line. In the one case, the RSS is not satisfying demand, in the other case there are unused facilities at the RSS. These deviations can be combatted either by attempting to increase demand during the slack periods (for example, by lowering price or having special offers during these periods), or by attempting to increase the RSS's capacity during the peak periods, (for example, by engaging extra staff).

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4. LOCATION AND DEMAND

4.1 INTRODUCTION

4.1.1 There is a broad rule circulating among the retail marketing men in the South African OC which says that 70% of the attraction of any RSS to its customers is based upon its location. The importance of location as a factor affecting RSS customer patronage has been confirmed by several writers.(75)

4.1.2 A customer will be prepared to incur costs in searching and travelling when he is buying a large and infrequently purchased article, and he believes he will obtain a better buy from one seller than another. However, petrol is a relatively small and frequent purchase, and one for which it is not widely believed that there are large differences in product quality,(76) particularly in SA where the different brands are sold at uniform prices in similar grids. Levitt has considered that motorists buy petrol as a rent for keeping their cars upon the road. For these reasons, the typical SA customer will not be prepared to incur high searching and travelling costs to buy petrol. It takes a special effort to select among brands because of their differing locations, and therefore he often does not want to believe that there are differences among brands.

4.1.3 The most valuable resource at the lower end of the oil industry is therefore the right to sell petrol at certain locations. The key factor in profitability development from the OC point of view must be an attempt to find and hold these prime RSS.

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(75) Townshend, (1972); Winer, (1967), Pp.55-59; Levitt, (1962), Pp.51-63; Cox and Alderson, (1950), P.327.

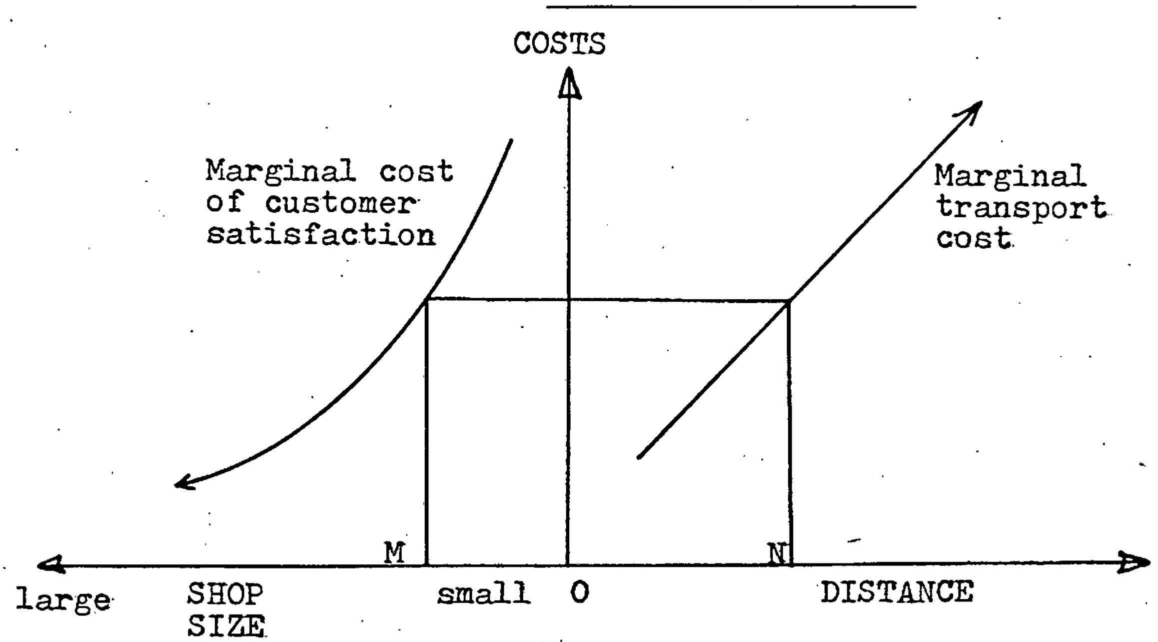
(76) Levitt, *Ibid.*

4.1.4 The objective of this chapter is to build a framework for the analysis of the effect of location on RSS profitability. Various locational theories will be examined, and a specific RSS locational model developed. It will then be used for the empirical evaluation of several hypotheses in Chapter 6.

4.2 THE RSS-CUSTOMER STRUCTURE

4.2.1 Hayes[77] maintains that the size and distribution of most shops in a given area will depend upon two broad factors. These are the consumer's desire for convenience of the shops, and the ability of the shops to satisfy his purchasing desires. The first of these implies shops which are close to the consumer's location, and the second implies the economies of scale and variety which are usually associated with large shops. The size and distribution of shops will depend upon the magnitude of these two opposing forces, which in turn will depend on the frequency and cost of purchases made. Small and frequently purchased goods will give rise to numerous smaller shops, and vice versa. Hayes' thinking has been developed into Diagram 4A. The customer will obtain more satisfaction from a rand of spending as the shop's size increases, but the customer's total transport costs to the store will rise as shops become larger and more dispersed.

DIAGRAM 4A. Shopping -- Benefits from size and Costs of Travel



(77) Hayes, (1968), Pp.8-10.

4.2.2 Any customer will desire to minimise the sum of the total selling prices at a shop, and the total cost of getting to it. Or taking a marginal approach, a customer will not spend an additional cent in travelling to a larger shop if his extra satisfaction from that particular shop will be less than one cent. The points M and N in Diagram 4A indicate firstly, the equilibrium size of shop, and secondly the equilibrium shop distance, for the particular consumer for whom that graph applies. This approach assumes that the consumer is rational, and that he is making the trip only to do the shopping at one shop.

4.2.3 The above approach may be used to show the distance from which a shop will draw its customers. The lower are the prices the shop charges the customers for their satisfaction, and the lower are the costs that the customer faces in getting to the shop, the greater will be the market area of that shop.

4.2.4 The discussion will now be more specific to RSS: the RSS market is one in which the importance of convenience to the customer dominates the customer's economies of scale factor. A casual examination of many of the urban areas in RSA will indicate a proliferation of RSS nearly as great in number as the cafes and convenience shops in the same area. (The typical small cafe is a shorter distance from the customer than the large supermarkets, and charges higher prices than them - an example of a "convenience" type shop). Each RSS will have a small market area in which quantities sold are almost entirely independent of sales in contiguous areas. Local markets consist of clusters of dealers in direct competition with one another.[78]

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(78) Townshend, (1972), P.374.

4.2.5 Let us assume that in any given area there are a certain number of RSS of given types, at a point in time. Such RSS will have fixed locational and non-locational attractions. When someone first becomes a potential customer in an area, he will incur costs in *searching* for the most convenient and attractive RSS available to him in the areas in which he will normally travel. Those RSS he finds during his search will become his *frame*;[79] i.e. the RSS he will select to patronise under various circumstances in the future.

4.2.6 Once a customer has established his frame, he will reduce his search costs to virtually zero. He will only modify his frame if:

(i) by chance he sees or hears of a new RSS which he comes to believe should be on his frame;
(ii) an RSS, through advertising, is able to convince him that it should be on his frame;
(iii) he believes that savings from frame modification will more than justify search costs.

4.2.7 Thus a new RSS, upon setting up in an area, (or an existing RSS attempting to expand its market area), has to break into the frames of customers in the area. It has to identify potential customers, contact them, and inform them of its convenience and other attractions. This informing process must convince the potential customers that they should incur costs (in terms of time, effort, and change itself) in changing their frames to include it.

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(79) Frame is a concept developed for this thesis, analogous to the frame concept in statistical sampling.

4.2.8 The concept of a frame can be used to explain the apparent *ignorance* of many customers, and also why customers *habitually* frequent a less than optimally located RSS. As explained above, a customer will spend a limited amount of resources in setting up his frame. It is possible that certain RSS which should be on his frame will be excluded, and this will later manifest itself as the ignorance of the customer. In addition, because most customers will have a frame of limited size, their patronisation of those RSS on their frames will appear to be habitual. This will be seen to be even more so when (as discussed in 4.3 and below), RSS visits are combined with other regular trips such as weekly shopping.(80)

4.2.9 The *hunger* of a customer is an important factor affecting RSS patronisation. When a customer has a full fuel tank, he has no desire to fill up (he feels no hunger). When his tank is empty, he will on the other hand be starving, and will be prepared to incur substantial costs to appease himself. There are additional factors, apart from fuel tank ullage, upon which hunger depends:

(i) The habitual "feeding time" of a particular customer. Most customers normally adopt the practical approach of waiting for "meal times" before "feeding". "Meal time" might be the opportunity to fill on a regular shopping or work trip. In RSA, a customer who knows that he will be particularly hungry at some stage in the future (but out of regulated selling hours) will get a filling permit, if he is able to.

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(80) The manager, Porter Sigma, Cavendish Square, commented that when Saturday petrol hours were reintroduced on 1/3/78, he had hoped to have a large gain in petrol sales. This was because customers that he had lost when the restrictions were originally introduced would return. Such customers would once again find it convenient to combine their Saturday morning shopping and their RSS purchases. However, he was disappointed -- the reason being that many such customers had now established filling routines at what were now less convenient RSS. Another example may be seen in Vic Proctor's Motors (See 3.9) which cut its prices and substantially increased its number of customers in a few days. When prices returned to normal, sales remained 20% higher than previously.

(ii) The customers expected product usage until the next filling opportunity.

(iii) The expected opportunities to fill before the customer's tank runs dry.

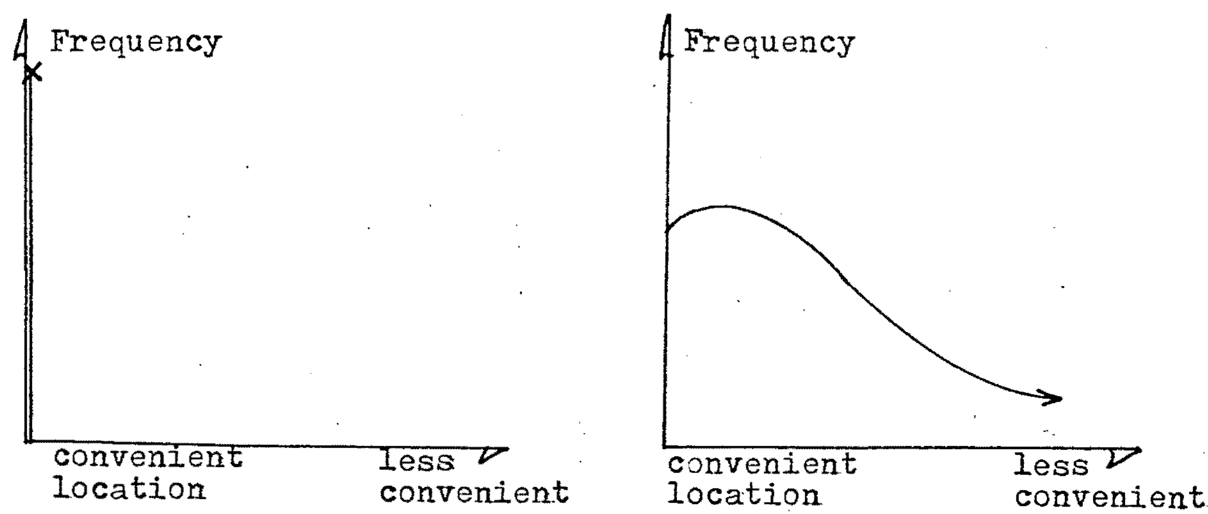
(iv) A customer will be hungrier for higher quality fuels, better service, etc. (See 4.5)

(v) Customers with uneconomical cars will generally be hungrier than those who can go further and longer on a fill-up.

(vi) Rich customers will tend to be hungrier than poor.

4.2.10 The selection by a customer of any single RSS from his frame will depend upon his hunger, his wealth, and his location at the time. If convenience of location was the only factor affecting RSS patronisation, all customers would be as portrayed in the left hand graph of Diagram 4B.

DIAGRAM 4B: Convenience and Visiting Frequency



Factors which will cause the graph to move away from the vertical axis are:

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(a) The non-locational attractions of less convenient RSS. (See 4.5).
(b) Ignorance of the most convenient RSS.
(c) Habit, locking consumers into less convenient patterns (frames).
(d) The customer's hunger at the time of purchase. Hungry customers are prepared to go to less convenient locations.
(e) Wealth. Rich customers may be less concerned with the pecuniary costs of travel.

4.2.11 Customers will have a greater incentive to incur search costs when their graphs are dispersed to the right. The potential savings from their search costs will also be higher, the higher are their expenditures at RSS. In theory, a rational customer should attempt to minimise the net present value of his search costs plus his future RSS expenditure.

4.3 CUSTOMER ACTIVITIES

4.3.1 The typical customer will make a certain number of trips in his car, for business, pleasure or whatever, during a given time period. It can be assumed that the customer will route these trips optimally, in order to minimise all the costs of such travelling (subject to achieving his travelling objectives). At all times, the customer will be feeling some degree of hunger, ranging from starving up to full, which is as he leaves an RSS. (A customer may even feel hungry when he leaves an RSS when, for example, he might wish to carry some additional petrol in cans in his boot, but is prevented from doing so).

4.3.2 A customer will also have the opportunity to travel to an RSS from wherever he is. There will be a cost associated with such travel; it will range from virtually nil, when the customer happens to be passing an RSS on a trip he is already making, to a high cost, such as when a customer has to make an expensive trip solely to go to an RSS.

4.3.3 It can be seen that these two factors (hunger and location) will determine *when* a customer will visit an RSS, i.e. a customer will visit an RSS at any stage that his hunger exceeds the cost of getting to that RSS. If he is not particularly hungry, for example, but only has to drive an additional 100m. on a given trip, in order to fill up, he may well do so. Where there are high additional travelling costs involved in reaching an RSS however, the customer will normally be very hungry every time he arrives at the RSS to fill up.

4.3.4 To be able to use these two concepts in practice, it is necessary that they can both be measured. The obvious measure for both is money. It would then be possible to say that if a customer's hunger cost is greater than the cost of the additional travelling to visit an RSS, he will visit it; otherwise not.

4.3.5 The concept of the additional travelling is defined as the *additional visiting distance, (AVD)*, which is the cost of the additional travelling over and above that which the customer would have incurred without any RSS purchases. Should a customer make a trip solely to visit an RSS, the AVD is defined as the cost of that trip. Should he make a trip with the objective of visiting an RSS and a shopping centre which are right next to each other, the cost of that trip must be divided between shopping costs, and AVD cost. Several methods of dividing the cost of such a trip may be proposed. For example:

(a) total trip cost is divided in proportion to expenditure by the customer on the shopping, and at the RSS;
(b) total trip cost is divided in proportion to time spent by the customer at the shopping centre, and at the RSS;
(c) the AVD cost is taken as the cost of getting to the most convenient RSS, had the shopping/RSS trip not taken place.

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4.4 THE HUNGER CYCLE

4.4.1 For the purpose of the analysis below, hunger may be defined as the cost a customer is prepared to incur at a point in time to enjoy the benefits of appeasement and other attractions (exogenous and endogenous -- See 4.5) offered by the RSS on his frame. Diagram 4C illustrates hunger. The horizontal axis shows both hunger, and the satisfaction to be obtained after incurring costs; both on the same scale. The vertical axis, also on the same scale, shows costs. A 45^{o} line has been inserted to indicate the points at which a customer will believe that the costs incurred in visiting an RSS and purchasing product are exactly balanced by the benefits from doing this. These benefits will be the enjoyment from consuming the product, and also all the other pleasures involved in visiting the RSS concerned. At any point to the left of the 45^{o} line, the customer will count the costs of visiting an RSS greater than the benefits. At any point to the right of the 45^{o} line, the customer will have a consumer surplus equal to the horizontal distance from the 45^{o} line.

4.4.2 The horizontal line C represents the cost of the amount of product which will give him maximum satisfaction; (because of price control in RSA, this cost may be drawn as a straight line). The optimum quantity of product is determined by the six factors affecting hunger mentioned above.

4.4.3 Each of the RSS on a customer's frame must have an AVD, and each of these AVD may be measured as a cost. For a particular point in time, each of these RSS can be represented on Diagram 4C as a dot. The distance of a dot above C represents its AVD cost. Obviously, all RSS must be located on or above this line. The distance of a dot from the vertical axis represents the satisfaction a customer would gain from the RSS. A vertical line L has been drawn to represent the satisfaction gained by a customer from purchasing the product from an RSS from which he obtains no additional satisfaction. RSS to the right of this line, therefore, have additional attractions to offer, over and above the product that they sell. RSS to the left of this line offer the product in a way such that a customer derives a dissatisfaction when buying it.

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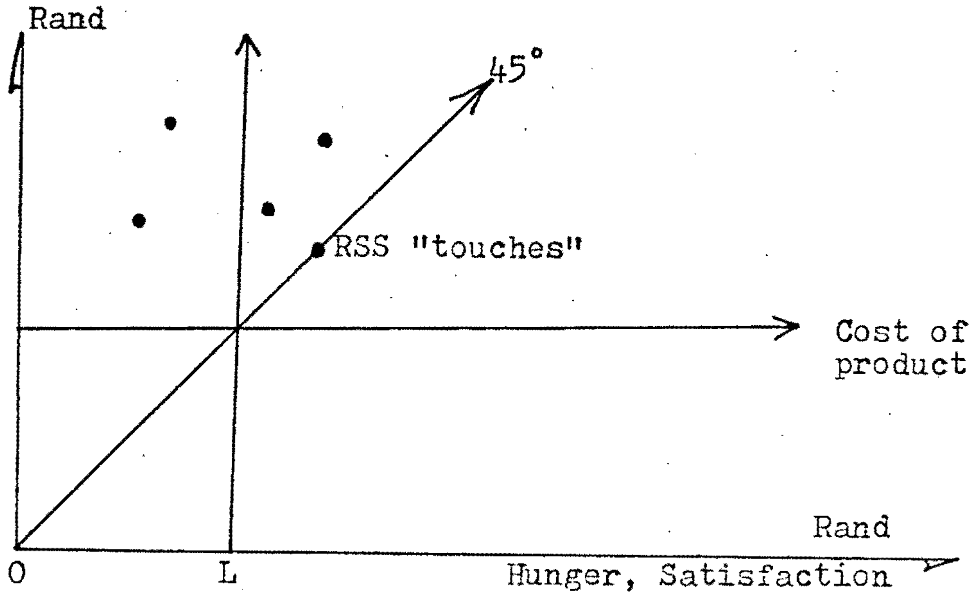
4.4.4 The line L has been drawn at the point where the 45^{0} line crosses C. This is because it is only here that the cost of product is equated to the benefits associated with that product, and nothing else.

DIAGRAM 4C. RSS Hunger and Costs



4.4.5 The hunger cycle will now be discussed. Initially, assume that the hunger of a particular customer is low, and on his diagram all the RSS in his frame will be located close to the vertical axis. As hunger increases, the RSS will shift to the right, some faster than others. Eventually, one RSS will touch the 45^{0} line. The customer will then visit that RSS and appease and satisfy himself. Once again, with the customer now full, all the RSS will now shift leftwards back to the vertical axis.

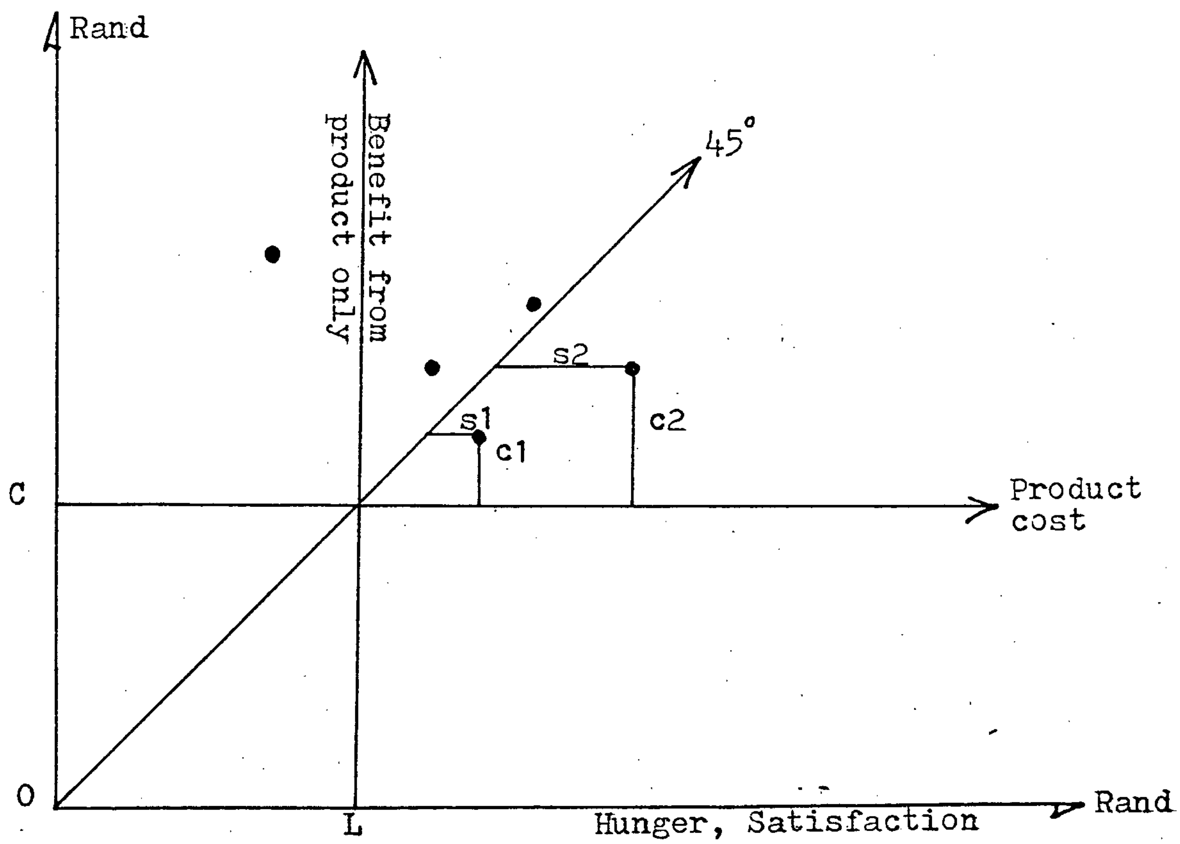
4.4.6 It is important to note that this is a static analysis with regard to customer's location. In a dynamic situation, the RSS in the diagram would vary their positions, depending upon the customer's location and circumstances. For example, the above analysis will give different results from the point of view of the customer's home, and from the point of view of his work. In addition, this analysis assumes that the same amount of product will be purchased at each RSS. It can be seen that if the analysis is repeated under constant conditions, an optimal RSS will emerge which will habitually be patronised.

4.4.7 A second situation will now be discussed. This is when a customer is particularly hungry, and more than one RSS happens to be on the right of the 45^{0} line, as in Diagram 4D. In this case, the customer must select only one of them.

4.4.8 Let s be the horizontal distances between the RSS and the 45^{0} line, and c be the vertical distances between the RSS and the C line. The customer will then select that RSS for which the ratio s/c is the highest. This must be so, because if all RSS were shifted leftwards, this RSS would be the last to touch the 45^{0} line. Note that if two RSS has the same s/c ratio, the customer would be indifferent between them. s/c represents the satisfaction to cost ratio.

4.4.9 Upon filling, once again the RSS would slide back to the vertical axis and compress against it.

DIAGRAM 4D: The Hunger Cycle



4.5 THE "ATTRACTIONS" OF AN RSS

4.5.1 In 4.2.10, five factors were listed which might cause a customer to go to an RSS, other than the RSS with the most convenient location. One of these was the non-locational "attractions" of an RSS. In addition, the definition of hunger given above included a qualitative aspect -- the customer will be hungrier for an RSS that provides "good food" in the form of product or service that is perceived as better than that offered by other RSS, i.e. the customer's hunger will be increased by the non-locational attractions of an RSS.

4.5.2 The non-locational attractions of an RSS may be classified as exogenous or endogenous. An exogenous attraction is one which will draw customers to a particular area (the RSS's area), rather than to the RSS itself. Endogenous factors are attractions of the RSS itself.

(a) The distance of an RSS from a customer's place of residence or work (irrespective of AVD). The smaller this distance is, the more likely a customer is to have the psychological desire of a customer to have his car "nearby" when he is having it serviced, etc.

(b) The existence of a shopping centre or some other amenity next to the RSS. It may be argued that this is not an exogenous factor if the customer would have gone shopping at the centre had the RSS not been next door to it. In such a case, however, the RSS simply has a low AVD on a trip the customer makes. If the customer would not have visited the shopping centre had the RSS not been there, then each has acted as an exogenous attraction for the other.

(c) The general surroundings in which the RSS is placed. Customers will prefer to visit clean or scenic areas, and will generally prefer to avoid polluted, slum, or otherwise unattractive areas.

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(d) The distance to the next RSS that the customer could go to. The greater is this distance, the more attractive the first RSS.

4.5.3 Endogenous factors comprise:

(a) The service available at an RSS. This is related to the courtesy and efficiency of the staff, and possibly to the equipment that the RSS has.

(b) The time a customer perceives he will have to wait before being served. This is related to the RSS's efficiency, as well as the number of pump attendants, pumps, and the general layout of the garage. The longer the time a customer estimates he will have to queue, the less attractive will be that garage.

(c) The prices charged by an RSS, compared to its competitors. Petrol prices in South Africa are controlled, (see Part III). However, the servicing, repairs and aftermarket prices do vary considerably between different RSS. Customers are likely to move out of their normal RSS frames when they have a large repair to be performed -- i.e. they will incur high search costs to find the best value for money for a large repair.
Outside South Africa, many RSS compete via fuel price competition. Townshend (1972) maintains that price competition is very localised -- customers will only be drawn from nearby rivals. For the sake of a few cents savings, most customers are not prepared to incur search costs to change their frames.

(d) The reputation of an RSS.

(e) The brandname of an RSS -- customers may perceive certain brands as relatively superior or inferior.

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(f) The range of items and services available at an RSS. The greater the range of items sold (fuels, diesel, oils, B.P's multiblend pump, spares, aftermarket, insurance) and services available (repairs, tuning, safety checks, and credit etc.), the more attractive will be that RSS.
Credit is likely to be a particularly important attraction. When the new selling hours regulations were introduced in March 1978,the provision of credit to petrol customers was also forbidden. Porter Sigma, Cavendish Square, estimates that it immediately lost 15% of its regular customers, who now no longer had the incentive to go out of their way to obtain the facility.

(g) The physical design and appeal of the RSS can attract customers. The emblems, colours, building design, cleanliness and age of an RSS, can serve to make it more or less appealing. It is important that the RSS be clearly visible to customers. The ease of access into the RSS, the road frontage, and the ease of parking and manoeuvering once inside will also affect customer patronisation.

(h) The size of the RSS. It is not clear whether a large RSS is more or less appealing to customers. To some customers, size may affect positively or negatively the attraction of an RSS listed above.

4.5.4 The government regulates a wide range of areas which influence the attractiveness factors listed above (See Chs. 7,8). Controls include opening hours, services that may be provided, prices, numbers of RSS, standards and safety. The imposition or withdrawal of these controls will tend to change the relative attractions of different RSS.

4.5.5 Advertising itself will not make one RSS more attractive than another. What it will do is change the customer's perception or knowledge of one or more of the above factors. It tries to tie a particular brand name, or a particular RSS to certain attractive factors.

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4.6 INTRODUCTION TO RETAIL MODELS

4.6.1 A mathematical model is defined as a representation of some aspects of the real world using numbers, symbols, and the language of mathematics. The models that will be examined aim to reproduce the main locational features of the retail system under study, without including all the complexities of individual consumer's behaviour.

4.6.2 The objectives in building an RSS model are:

(i) to describe the effect upon the demand of a hypothetical RSS of different locations of that RSS;

(ii) to calculate the area from which an RSS will draw its customers;

(iii) to estimate the effect upon one RSS of the entry or exit from its market area of another RSS;

(iv) to estimate the effects of changes in the following upon an RSS:
- (a) population
- (b) average incomes
- (c) proportion of income spent at RSS
- (d) the exogenous and endogenous attractions of an RSS
- (e) the locational convenience of an RSS (eg. as the result of building a new road).

4.6.3 These types of questions have previously been answered subjectively, or by using methods such as trade area analysis (TAA). Before 1930, marketing studies concentrated on problems dealing with individual shops or classes of goods, and their market areas. Advances in marketing techniques soon allowed whole areas to be analysed, instead of just individual outlets. In this approach, known as TAA, trade areas are delineated, and consumer expenditures allocated to individual shopping centres. An hierarchy of centres is

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postulated, and the size of the trade area is assumed to vary with the size of the centre. The centres are evaluated individually in a time-consuming and judgemental procedure. TAA is costly, slow and lacking in precision and detail.

4.6.4 In comparison, retail models have the following advantages: Firstly, they allow for the evaluation of an almost unlimited number of opportunities at low cost. Secondly, their objective approach delimits the effects of weak estimates or poor judgement. Thirdly, a model is able to cope with large numbers of factors.

4.6.5 The essential variables to be taken into account in an RSS model are:

(a) A measure of the sales at RSS in given zones j originating from consumers located in given zones i.

(b) A measure of the RSS purchasing desire of consumers in zones i.

(c) A measure of the consumer attractions of RSS in zones j.

(d) A measure of the friction of movement between i and j.

4.7 CENTRAL PLACE THEORY

4.7.1 Christaller (1933) and Losch (1941) observed that an integrated pattern of settlement sizes will occur over an area large enough to have several market centres. There will be an hierarchy of market settlement sizes, regularly spaced, and in regular sequence. Central place theory is based upon the following postulates:

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(a) For a given type of business, there exists a threshold of demand below which a good cannot be offered for sale; i.e. there is a minimum market size required to support a good.

(b) Each centre has a range, or a maximum distance that consumers are willing to travel to it.

(c) The size of trade areas depends upon the type of good.

(d) Centres are classified into hierarchies according to the size of their trade areas (or equivalently, by the types of good offered at the centre).

(e) High ranked centres duplicate the functions of low ranked centres, and also provide additional marketing functions.

(f) Free entry and exit of businesses produces a contraction of trade areas to their minimum size.

(g) If it is assumed that the population is uniformly spaced over a plain, the market areas will be a set of regular hexagons with shops located at the centre of each hexagon.

4.7.2 There is evidence to suggest that these ordered structures exist[81] in which a large centre will duplicate all the functions performed by smaller centres, and smaller centres will be arranged around the metropolis, with all operating at the limits of their thresholds and ranges. The smallest market areas will be around convenience and general stores where small and frequently purchased items such as food are sold, and the larger market areas will be around the big supermarkets and specialist stores located in the large centres. Diagram 4E illustrates the classical central place layout where seven contiguous hexagonal trade areas for one good provide the basis for the hexagonal trade area of another higher ranking good.

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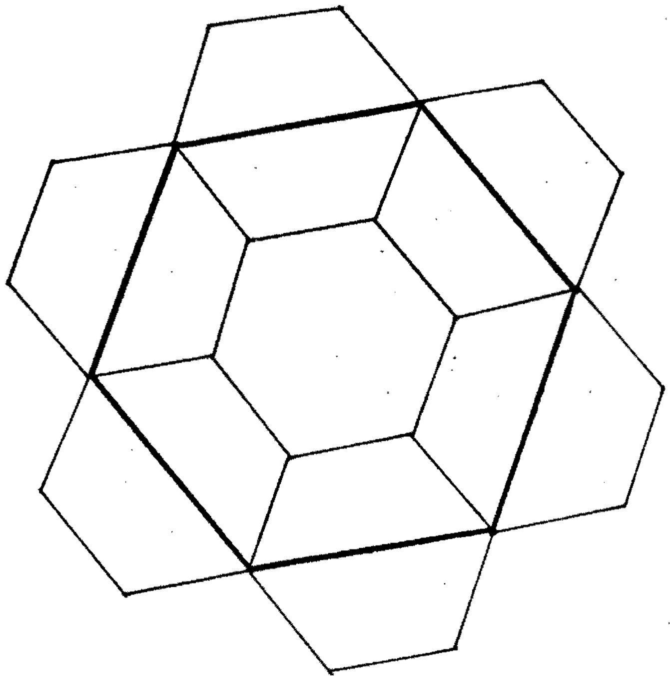
(81) Carruthers (1967), Thorpe (1968).

DIAGRAM 4E: Central Place Theory



4.7.3 The approach of researchers such as Carruthers and Thorpe has been as follows:

(a) To define an hierarchy of the centres in the area under study. This is ideally done using sales figures by centre, but where these are not available centres have been ranked using a series of indices giving points for criteria such as type of shop and transport services.[82]

(b) Trade areas are then defined for each centre, and for each class of good, (remembering that the larger centres will repeat the activities of the smaller centres). This is done subjectively, or based upon consumer surveys.

(c) Sales are described in each trade area, using a series of regression equations. Projected changes in population and expenditure are then able to give predicted changes in sales. In the long term, possible changes in the population structure, or in the infrastructure may require a forecast of changes in the trade area or

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(82) Carruthers, (1962), Smailes and Hartley, (1961).

in the hierarchical classifications themselves.

4.7.4 The early retail models did not reveal why observed irregularities occurred in observed shopping patterns, and neither were the actual sales at many shopping centres in line with what the accepted theory predicted.[83] "Empirical studies in urban areas using customer shopping surveys indicated that consumers did not appear to discriminate among choices perfectly",[84 for example, not appearing to select one alternative consistently. In addition, this type of approach had non-overlapping market areas, another characteristic not in accord with reality.

4.7.5 Another shortfall of CP theory is its inability to predict the existence of many of the large "hypermarkets" that have located out of the central areas. For example, the Brackenfel hypermarket in the Cape is located approximately 50Km from Cape Town and 15 Km from Bellville, the nearest large suburb.

4.8 GRAVITY MODELS

4.8.1 Early investigations of the market area concept were based on the notion that a definable relationship exists between the size of a city, and the distance from which shoppers are attracted. This gravity concept of interaction postulates that there is an attracting force between two populations that is proportional to their mass, and inverse to the friction against interaction that is exerted by the distance between the two populations. Interaction between two centres is therefore seen as a function of population concentration, and distance between the populations.

4.8.2 In 1929 Reilly[85] developed a law of retail gravitation to delimit retail market areas. Reilly described the attraction that two adjacent cities exerted on intervening small communities for the purchase of fashion goods. His law is expressed as follows

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(83) R.D. Luce, (1959).

(84) McCabe, (1974), P.13.

(85) Reilly, W.J., (1931).

$$\frac{T_a}{T_b} = \left(\frac{P_a}{P_b}\right)\left(\frac{D_b}{D_a}\right)^2 \qquad \text{(E 1)}$$

where:

T_a and T_b are the trade drawn to two cities a and b.

D_a and D_b are the distances from the intermediate place to a and b.

P_a and P_b are the populations of the cities a and b.

4.8.3 This model was later repostulated in terms of a break point between the trade areas of the two cities. This was the point at which the customers were indifferent to the two cities attractions. The new law was expressed as follows:

$$D_b = \frac{D_{ab}}{1 + \sqrt{\frac{P_a}{P_b}}} \qquad \text{(E 2)}$$

where:

D_{ab} is the distance between the cities a and b.

D_b is the distance of the break point from the city b.

4.8.4 Reilly's empirical work did not accurately substantiate his models. In addition, there are two major criticisms that have been levelled against them: firstly, that they were invalid hypotheses arrived at intuitively through an analogy with pure physics,[(86)] and secondly, that they delimited non-overlapping market areas.[(87)]

4.8.5 In recent years, an extension of the gravity hypothesis has been used to describe retail sales from a distribution of shopping centres. The main advancement was made by Huff[(88)] who developed the model to describe the interaction between a

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(86) McCabe, (1974), P.11; Nelson, (1958), Pp.150-151; Hayes, (1968), P.25.

(87) Wilson, (1974), P.206.

(88) Huff, (1962).

continuous population distribution and a larger number of shopping centres, with a consequent change in emphasis from the market area of the seller to the shopping area of the buyer. Huff suggested that as areas of competition continually overlap, customers appear to be allocated among shops in a probabilistic manner. His model is expressed as follows: the probability P that a customer will choose a centre j from a set of centres is

$$P_j = \frac{U_j}{\sum_j U_j} \qquad \text{(E3)}$$

where U_j is the utility associated with the j th centre.

4.8.6 If the utility U_j of a centre is a function of its "attractive power" (A_j), and of the distance from zone i to the centre (d_{ij}), then utility may be expressed as follows:

$$U_j = \frac{A_j^{\alpha}}{d_{ij}^{\beta}} \qquad \text{(E4)}$$

where α and β are unspecified powers.

Hence:

$$P_{ij} = \frac{\dfrac{A_j^{\alpha}}{d_{ij}^{\beta}}}{\sum_j \dfrac{A_j^{\alpha}}{d_{ij}^{\beta}}} \quad \text{subject to } \sum_j P_{ij} = 1.0 \qquad \text{(E5)}$$

4.8.7 This formula maintains that the probability that a customer from zone i will patronise a retail centre in zone j, is the ratio of the attractiveness of the centre to the distance from the zone centroid to the centre (raised to appropriate powers), divided by the sum of all similar ratios for all zones and centres.

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4.8.8 Total available retail expenditure from zone i can be expressed as E_i.

$$E_i = B_i . C_i \quad \text{where:} \tag{E6}$$

B_i is the average annual per capita retail expenditure in zone i. C_i is the number of customers in zone i. (See 3.8.2 for factors determining E_i).

4.8.9 The retail sales (S) attracted from zone i to centre j can therefore be expressed as

$$S_{ij} = E_i . P_{ij} \tag{E7}$$

Substituting,

$$S_{ij} = \frac{E_i . \dfrac{A_j^{\alpha}}{d_{ij}^{\beta}}}{\displaystyle\sum_{j=1}^{N} \dfrac{A_j^{\alpha}}{d_{ij}^{\beta}}} \tag{E8}$$

Subject to:

$$\sum_{i=1}^{m} \sum_{j=1}^{N} S_{ij} = \sum_{i=1}^{m} E_i \tag{E9}$$

where there are N zones for j and m zones for i.

4.8.10 The general form of this model can be expressed as follows: sales attracted from zones i to centres j are:

(a) Directly proportional to the retail expenditures available at zones i, E_i.

(b) Directly proportional to the attractive power of the shopping centres j, A_j.

(c) Inversely proportional to a function of deterrence between zones i and j, $f(d_{ij})$.

(d) Inversely proportional to the attractions of other centres j.

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4.8.11 If it is assumed that these hypotheses are multiplicitive, then

$$S_{ij} = K_i . E_i . A_j . f(d_{ij}) \qquad (E10)$$

again subject to:

$$\sum_{i=1}^{m} \sum_{j=1}^{N} S_{ij} = \sum_{i=1}^{m} E_i \qquad (E11)$$

4.8.12 In order to define K_i, we do the following:

$$\sum_{j=1}^{N} S_{ij} = S_{i*} = \sum_{j=1}^{N} K_i.E_i.A_j.f(d_{ij}) = K_i.E_i.\sum_{j=1}^{N} A_j.f(d_{ij}) \qquad (E12)$$

Because $S_{i*} = E_i$, as in (E11)

$$S_{i*} = E_i = K_i \; E_i \sum_{j=1}^{N} A_j.f(d_{ij}) \qquad (E13)$$

Therefore,

$$K_i = \frac{1}{\sum_{j=1}^{N} A_j \; f(d_{ij})} \qquad (E14)$$

By substituting (E14) into (E10) Huff's formula can be obtained again:

$$S_{ij} = \frac{E_i \; A_j \; f(d_{ij})}{\sum_{j=1}^{N} A_j \; f(d_{ij})} \qquad (E15)$$

4.8.13 Lakshmanan and Hansen[89] working independently, arrived at the above model. They defined the cost function in a negative exponential form to the base e. Wilson[90] maintains that the negative exponential function is convenient to manipulate analytically, and he uses it in many of his arguments. He adds that it would seem better to try to

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(89) Lakshmanan and Hansen, (1965).

(90) Wilson, (1974), P.70.

find empirically the shape of the cost function which gives the best fit between model predictions and observations, rather than simply to assume that one member of the family of power functions will fit best.

4.9 INTERVENING OPPORTUNITIES MODEL

4.9.1 This approach was originally developed by Stouffer[91] and it has been adapted by Schnieder[92] and Harris[93]. The model is based on the hypothesis that there is a constant probability that a customer will be satisfied at each opportunity that arises. Unlike the gravity model, interzonal distance does not appear explicitly; instead the possible destination zones are ranked in increasing order of impedance from the origin.

4.9.2 Wilson[94] derives an IO model as follows: Let $j(u,i)$ be the u ranked destination zone away from i. (Rank is determined by increasing travel cost). Then let $U_{ij(u,i)}$ be the probability that a single traveller from i will continue beyond $j(u,i)$. If L is the probability that he will be satisfied when offered an opportunity, then the probability that a traveller will not be satisfied by the first opportunity (ie. will continue beyond the first opportunity) is:

$$U_{ij(1,i)} = 1 - LD_{j(1,i)} \tag{E16}$$

where D is the number of opportunities in zone $j(u,i)$. By combining successive opportunities, we get:

$$U_{ij(u,i)} = U_{ij(u-1,i)} (1 - LD_{j(u,i)}) \tag{E17}$$

and by rearranging we obtain:

$$\frac{U_{ij(u,i)} - U_{ij(u-1,i)}}{U_{ij(u-1,i)}} = - LD_{j(u,i)} \tag{E18}$$

If $A_{j(u,i)}$ is defined as the cumulative number of opportunities from i up to and including $j(u,i)$, then we can obtain from (E18):

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(91) Stouffer, (1940).
(92) Schneider, (1959).
(93) Harris, (1964).
(94) Wilson, (1974). P.397.

$$\frac{U_{ij(u,i)} - U_{ij(u-1,i)}}{U_{ij(u-1,i)}} = -L(A_{j(u,i)} - A_{j(u-1,i)}) \tag{E19}$$

4.9.3 If continuous variation of opportunities is assumed,

$$\frac{dU}{U} = -L\,dA \tag{E20}$$

and this integrates to

$$\log U = -LA+C \tag{E21}$$

where C is a constant of integration.

In terms of the model's requirements, (E21) can be rewritten as:

$$U_{ij(u,i)} = Kie^{-LA_{j(u,i)}} \quad \text{where } K_i \text{ is a constant.} \tag{E22}$$

If there are 0_i travellers leaving i, then $T_{ij(u,i)}$, the number of trips from i to j(u,i) is:

$$T_{ij(u,i)} = 0_i(U_{ij(u-1,i)} - U_{ij(u,i)}) \tag{E23}$$

and by using (E22) we obtain:

$$T_{ij(u,i)} = 0_i K_i (e^{-LA_{j(u-1,i)}} - e^{-LA_{j(u,i)}}) \tag{E24}$$

4.9.4 Note that $\sum_{u=1}^{N} T_{ij(u,i)} = K_i 0_i (1-e^{-LA_{j(N,i)}})$ (E25)

if there are N zones. (E24) is subject to the constraint that

$$\sum_j T_{ij} = 0_i \tag{E26}$$

The $e^{-LA_{j(N,i)}}$ in (E25) is likely to be sufficiently small that it can be neglected, and therefore, because of constraint (E26), $Ki \simeq 1.0$. Equation (E24) can then be written as the intervening opportunities model:

$$T_{ij(u,i)} = 0_i(e^{-LA_{j(u-1,i)}} - e^{-LA_{j(u,i)}}) \tag{E27}$$

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4.9.5 Stouffer[95] saw one of the biggest problems of IO theory in defining opportunities. How does one define an opportunity to "shop", unless specific items can be isolated? However, RSS will not face this problem -- a filling opportunity is clearly definable.

4.10 MAXIMUM ENTROPY DERIVATIONS

4.10.1 As already noted, a principal criticism of the early gravity models is that they were based on an analogy with Newtonian physics. The maximum entropy approach of Wilson "overcomes any possible criticisms of the retail model as having weak empirical or conceptual bases".[96] It is essentially a method of making the best use of available information by expressing everything known about the system in terms of constraints. All unconstrained states are then assigned equal probability.

4.10.2 If the variables T_{ij} are used, it is possible to define a matrix of the T_{ij} known as a *distribution* $\{T_{ij}\}$. A *state* of the system is then defined as a particular assignment of individuals within $\{T_{ij}\}$. The assumption is now made that all microstates are equally probable (within the restriction of the overall macro-constraints). The terms micro and macro are used here to specify the individual elements of the matrix, as opposed to the constraints concerning the whole matrix.
The probability of a particular trip distribution occurring is proportional to the number of states that can give rise to the distribution. The greatest number of states that give rise to a matrix $\{T_{ij}\}$ is $W\{T_{ij}\}$.

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(95) Stouffer, (1940).

(96) McCabe, (1974), P.39.

4.10.3 Then:

$$W\{T_{ij}\} = \frac{T!}{\prod_{ij} T_{ij}!} \qquad \text{(E28)}$$

where T is the total number of trips.(97)

4.10.4 It can be seen that this is independent of the order of the individual trips. To find the most probable $\{T_{ij}\}$, $W\{T_{ij}\}$ is maximised, subject to the given (E30-32) constraints. The total number of possible states is w, where

$$w = \Sigma\, W\{T_{ij}\} \qquad \text{(E29)}$$

and the summation is over T_{ij}, satisfying equations (E30), (E31), (E32), below.

$$\sum_j T_{ij} = O_i \qquad \text{(E30)}$$

$$\sum_i T_{ij} = D_j \qquad \text{(E31)}$$

$$\sum_i \sum_j T_{ij} c_{ij} = C \quad \text{where c is a cost function.} \qquad \text{(E32)}$$

4.10.5 The set of T_{ij}'s which maximises (E28) subject to (E30), (E31), (E32) is calculated by Wilson(98) as follows:

Maximise the Lagrangian $\mathcal{L}$ where

$$\mathcal{L} = \ln W + \sum_i \lambda_i^{(1)} \left(O_i - \sum_j T_{ij}\right) + \sum_j \lambda_i^{(2)} \left(D_j - \sum_i T_{ij}\right) + \beta\left(C - \sum_i \sum_j T_{ij} c_{ij}\right) \qquad \text{(E33)}$$

where $\lambda_i^{(1)}$, $\lambda_i^{(2)}$, and β are Lagrangian multipliers.

(Note that if InW rather than W is used, Stirling's approximation

$$\ln N! = N\ln N - N \qquad \text{(E34)}$$

may be used to estimate the factorial terms).

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(97) Wilson, (1970), Pp.4-5.

(98) *Supra*, P.18.

4.10.6 The T_{ij}'s which maximise $\mathcal{L}$, and which therefore constitute the most probable distribution of trips, are the solutions of

$$\frac{\partial \mathcal{L}}{T_{ij}} = 0 \tag{E35}$$

and of the constraint equations (E30), (E31) and (E32). By rearranging Stirling's approximation we get:

$$\frac{\partial \ln N!}{\partial N} = \ln N \tag{E36}$$

and so

$$\frac{\partial \mathcal{L}}{\partial T_{ij}} = -\ln T_{ij} - \lambda_i^{(1)} - \lambda_i^{(2)} - \beta c_{ij} \tag{E37}$$

and this vanishes when

$$T_{ij} = \exp(-\lambda_i^{(1)} - \lambda_i^{(2)} - \beta c_{ij}) \tag{E38}$$

4.10.7 Substituting (E38) into equations (E30) and (E31) to obtain $\lambda_i^{(1)}$ and $\lambda_i^{(2)}$,

$$\exp(-\lambda_i^{(1)}) = O_i \left[\sum_j \exp(-\lambda_i^{(2)} - \beta c_{ij})\right]^{-1} \tag{E39}$$

$$\exp(-\lambda_i^{(2)}) = D_j \left[\sum_i \exp(-\lambda_i^{(1)} - \beta c_{ij})\right]^{-1} \tag{E40}$$

To obtain the result in the form of (E43), write:

$$A_i = \frac{\exp(-\lambda_i^{(1)})}{O_i} \tag{E41}$$

$$B_j = \frac{\exp(-\lambda_i^{(2)})}{D_j} \tag{E42}$$

and substitute into (E38), to get:

$$T_{ij} = A_i B_j O_i D_j \exp(-\beta c_{ij}) \tag{E43}$$

where, using (E39), (E40), (E41), (E42):

$$A_i = \left[\sum_j B_j D_j \exp(-\beta c_{ij})\right]^{-1} \tag{E44}$$

$$B_j = \left[\sum_i A_i O_i \exp(-\beta c_{ij})\right]^{-1} \tag{E45}$$

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Thus we wish to find the greatest number of states that give rise to the matrix $\{Z_{ij}(u,i)\}$. The maximand will therefore be:

$$\frac{Z}{\prod_{ij} Z_{ij}(u,i)!} \qquad \text{(E51)}$$

where Z is the total number of states for a given distribution

$$\{Z_{ij}(u,i)\}. \qquad \text{(E52)}$$

4.11.2 There will not be a constraint on trip attractions (similar to equation (E31)), but as there cannot be more trips continuing beyond j(u,i) than originally set out from i, the following applies:

$$Z_{ij}(u,i) \leqslant O_i \qquad \text{(E53)}$$

If (E53) is summed over all j_u,

$$\sum_{ju} Z_{ij}(u,i) = K_i^{\wedge} O_i \qquad \text{(E54)}$$

where $K_i^{\wedge}$ is a constant and $1 \leqslant K_i^{\wedge} \leqslant N$, where N is the total number of zones.

4.11.3 A constraint analogous to (E32) is also required. If intervening opportunities is used as a proxy for cost (See 4.12), the minimum cost for the trips beyond j(u,i) is $A_{j(u,i)} Z_{ij(u,i)}$, where $A_{j(u,i)}$ is the cumulative number of opportunities up to j(u,i). If this is summed over all i, and over all j(u,i), the second required restraint is obtained:

$$\sum_i \sum_{j(u,i)} A_{j(u,i)} Z_{ij(u,i)} = C \qquad \text{(E55)}$$

4.11.4 Maximising (E51) subject to (E54) and (E55), Wilson[100] has obtained the most probable distribution as:

$$-\ln Z_{ij(u,i)} - LA_{j(u,i)} - \lambda_i = 0 \qquad \text{(E56)}$$

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(100) Wilson, (1970), Pp.154-155.

therefore:

$$Z_{ij\,(u,i)} = \exp\left(-LA_{j\,(u,i)} - \lambda_i\right) \tag{E57}$$

4.11.5 To obtain λ_i, (E57) can be substituted into (E54) to get:

$$\exp(-\lambda_i) = \frac{K_i^{\wedge}\, O_i}{\sum_{ju} \exp\left(-LA_{j\,(u,i)}\right)} \tag{E58}$$

By writing:

$$K_i = \frac{K_i^{\wedge}}{\sum_{ju} \exp\left(-LA_{j\,(u,i)}\right)} \tag{E59}$$

and:

$$Z_{ij\,(u,i)} = K_i\, O_i \exp\left(-LA_{j\,(u,i)}\right) \tag{E60}$$

and substituting into (E50),

$$T_{ij\,(u,i)} = K_i\, O_i \left[\exp\left(-LA_{j\,(u-1,i)}\right) - \exp\left(-LA_{j\,(u,i)}\right)\right] \tag{E61}$$

is obtained, which is identical to (E24).

4.12 THE SIMILARITY OF THE IO AND HUFF TYPE MODELS

4.12.1 It can be shown that the primary difference between the IO and the Huff models is in their definition of cost. (Using maximum entropy techniques, and two different definitions of costs, each of these models was derived above).

4.12.2 The main assumption of the IO model is that the number of trips from i to j (u,i) is proportional to the number of opportunities at j and inversely proportional to the intervening number of opportunities. It can be seen that the IO's "number of opportunities at j" parallels the Huff model's "attraction of j". In addition, the IO model uses the number of intervening opportunities between i and j as a measure of cost, similar to the d_{ij} in (E15) or c_{ij} in (E48).

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4.12.3 If $Z_{ij\ (u,i)}$ trips are made beyond j(u,i), then these must incur costs greater than those which have been made to nearer zones. If the number of opportunities passed is used as a measure of cost, the minimum cost for all trips beyond j(u,i) is $A_{j(u,i)} \times Z_{ij(u,i)}$, where $A_{j(u,i)}$ is the cumulative number of opportunities from i up to and including j(u,i), i.e.:[101]

$$\Sigma A_{j\ (u,i)} = \sum_{n=1}^{u} D_{jn} \quad (102) \tag{E62}$$

From the definition of $Z_{ij\ (u,i)}$:

$$Z_{ij\ (u,i)} = \sum_{n=u+1}^{N} T_{ijn} \tag{E63}$$

where N is the total number of zones.

4.12.4 If (E62) and (E63) are summed over all i and all j(u,i), a cost function

$$\sum_{i} \sum_{j(u,i)} A_{j\ (u,i)} Z_{ij\ (u,i)} = C \tag{E64}$$

is derived.

By substituting $Z_{ij\ (u,i)}$ from (E63), it can be seen that the coefficient of $T_{ij\ (u,i)}$ in (E64) would be:

$$(u-1)\ D_{j1} + (u-2)\ D_{j2} + \ldots + D_{j\ (u-1)} \tag{E65}$$

4.12.5 This account of the cost of getting to a particular j(u,i) shows that the number of opportunities passed contribute to the cost associated with a particular element in a trip matrix, and that each of these zones of opportunities is weighted by its ranking -- the closer the j(u,i) to i, the greater the weighting.

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(101) See Wilson, (1970), Pp.154-155.

(102) $D_{j(u,i)} = A_{j(u,i)} - A_{j(u-1,i)}$. See 4.9.

4.12.6 Now, maximising:

$$\frac{Z}{\prod_{ij(u,i)} Z_{ij\,(u,i)}!} \tag{E66}$$

subject to constraint equations (E54) and (E64), Wilson(103) shows that by introducing Lagrangian multipliers λ_i and L for the constraints, the most probable distribution occurs when:

$$-\ln Z_{ij\,(u,i)} - LA_{j\,(u,i)} - \lambda_i = 0 \tag{E67}$$

so

$$Z_{ij\,(u,i)} = \exp\,(-LA_{j(u,i)} - \lambda_i) \tag{E68}$$

By substituting from (E68) into (E54), λ can be obtained:

$$\exp\,(-\lambda_i) = \frac{\hat{K}_i\, O_i}{\sum_{j(u,i)} \exp\,(-LA_{j\,(u,i)})} \tag{E69}$$

4.12.7 By writing (E59) and (E60) again, and using (E50), it is again possible to obtain equations (E24) or (E61), the statement of the IO model. Thus the IO model has been derived by entropy, assuming that cumulative opportunities passed is a measure of cost.

4.12.8 Wilson(104) has derived a "*gravity/opportunity model*" by assuming that intervening opportunities are used as a measure of cost but are not weighted in the form of (E65). He maintains that the assumption

$$c_{ij} = A_{j\,(u,i)} \tag{E70}$$

may provide a superior account of cost. If this substitution is made in (E32), the derivation of (E46) and (E47) may be made to give:

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(103) Wilson, (1970), Pp.154-155.

(104) *Ibid*, P.156.

$$T_{ij\ (u,i)} = a_i O_i \, D_{j\ (u,i)} \exp\left(-\beta A_{j\ (u,i)}\right) \tag{E71}$$

$$a_i = \left[\sum_{j(u,i)} D_{j\ (u,i)} \exp\left(-\beta A_{j\ (u,i)}\right) \right]^{-1} \tag{E72}$$

In this model the "attractiveness" function $D_{j\ (u,i)}$ is defined as the number of opportunities in zone j, which is the u ranked zone away from i.

4.13 DISTANCE TO THE NEXT OPPORTUNITY FACTOR COMBINED WITH IO MODEL

4.13.1 Hayes[105] discusses the insertion of a "distance to next opportunity" factor into the intervening opportunities model. He postulates the following equation:

$$\frac{\partial U}{\partial B} = - M U \tag{E73}$$

where:

B is the distance to the next opportunity.

U is the probability a customer will *not* be satisfied by an opportunity and will wish to continue.

M is a parameter describing the effect of distance to next opportunity.

(E20) is equivalent to: $\frac{\partial U}{\partial A} = - L U$ (E74)

where:

A is the cumulative number of opportunities between i and j.

L is the probability a customer will be satisfied when offered an opportunity.

Combining (E73) and (E74) gives:

$$U = \exp - (LA + MB) \tag{E75}$$

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[105] Hayes, (1968). P.49.

4.13.2 This will derive a modified IO model by using the steps for equations (E22) to (E27).

$$T_{ij\ (u,i)} = O_i \left[\exp -\left(LA_{j\ (u-1,i)} + MB_{j\ (u-1,i)}\right) - \exp -\left(LA_{j\ (u,i)} + MB_{j\ (u,i)}\right) \right] \qquad \text{(E76)}$$

where T_{ij} is the number of trips from i to j (u,i).

4.14 DERIVATION OF AN RSS MODEL

4.14.1 The broad requirements for an RSS model were outlined in 4.6. The major work in building a model will be in defining the deterrence and attraction components, bearing in mind that RSS and their customers have different characteristics to those in a general retail model.

4.12.2 Examining the deterrence portion first of all, it can be deduced that the following factors will reduce patronage of RSS $_j$ by customer i:

(a) The cost of travelling from i to j in terms of time and distance. The greater is this cost, the less the likelihood of patronisation of j.

(b) The number of opportunities passed between i and j. This factor is likely to be of more importance with RSS in RSA than with other shops generally, because there is a greater degree of homogeneity between the products of RSS than between the products of other "general" shops. These "general" shops are likely to offer a wider choice of types, prices and qualities of goods than the RSS do. Therefore the difference in attraction between different shopping centres is likely to be greater than between different RSS. The prices between RSS are virtually uniform (3.5), as is the

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product (3.4.5), and often customers go to an RSS to buy only one item -- petrol. It is more significant, therefore, when a customer passes intervening RSS opportunities than when he passes intervening "general shopping" opportunities.

4.14.3 Examining the "attractiveness" portion of the model on the other hand, will show the following to increase the patronage of RSS $_j$ by customer i:

(a) The distance to the next opportunity. This factor, which was discussed in 4.13, implies that a customer will frequent RSS $_{j(u,i)}$ if the distance to RSS $_{j(u+1,i)}$ is high.

(b) The remaining exogenous and endogenous attraction factors listed in 4.5.

4.14.4 It has been shown in 4.4 how hunger determines at what point in time a customer will visit an RSS. It also explains why one RSS is chosen rather than another: a customer will choose that RSS for which the ratio of satisfaction to costs is the highest, i.e. that RSS which has the maximum positive

sj/cij. (E77)

It was shown how satisfaction is derived by a customer from two areas: from the product itself, and from the variety of "attractions" of each RSS on the customer's frame.

4.14.5 The gravity models discussed in the above sections take account of both the costs and the attractions of the different RSS to different customers. They do not, however, take account of the dynamic element Hunger. Ideally, a dynamic model would make an estimate of the hunger of each individual in the system. The model developed in Chapter 6 however, will make an assumption which avoids the need to include a hunger variable: it will be assumed that each individual in the system is at his peak hunger value on one or more occasions during the period covered by the model. This will cause the maximum activity of each individual at the time the model is run.

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4.14.6 The concepts of search, and of customer frame (introduced in 4.2) must be accounted for by an RSS model. When the model is initially set up, an allocation of customers will occur, and it is reasonable to assume that this allocation is in line with the initial frames of each customer. If a new RSS is now introduced into the model, it will in practice initially be less attractive than the model suggests it should be. The reason is that the new RSS will not yet exist on the frames of many customers. Similarly, certain changes of the input data should require that customer frames be taken into account. For example, if a new road is built past an RSS, that RSS will not initially be as popular as the model predicts, because its improved location will not yet register on many customers' frames. In summary, when one RSS should theoretically draw customers from other RSS because of a changed parameter, it will not, in the short term, do this to the extent expected. (In the long term there will be no inhibition of customer allocation). It is therefore suggested that for short term analysis, a factor z be applied to all RSS that draw new customers from other RSS, such that $0<z<1$. z will tend toward 1 over time. It may be obtained by using the multiple regression approach described in 4.17 below.

4.14.7 The Huff and the IO models discussed so far in this chapter both consist of a cost (deterrence) and an attractiveness portion. The Huff approach ignores the importance of intervening opportunities, and also the distance to the next opportunity, whereas the IO approach ignores the actual cost of travelling from i to j, and the distance to next opportunity cost measure. It is obviously desirable to include all three measures in a single model.

4.14.8 A particular disadvantage of the IO model is that it will give equal rankings to consecutive RSS, no matter how far apart they are. In other words, the rankings of three RSS in the same street will be the same as the rankings of three RSS each 10km apart. The rank distance factor derived below attempts to solve this problem.

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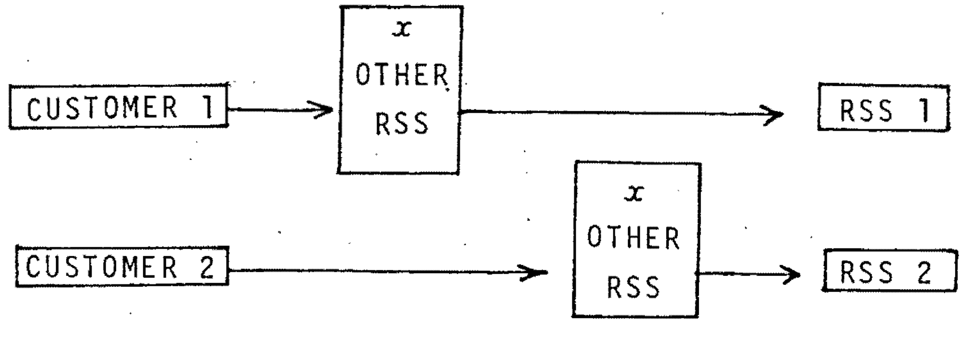
4.15 RANK-DISTANCE FACTOR

4.15.1 This variable will overcome the problem mentioned above, in which the IO model will give equal rankings to consecutive opportunities, no matter what the travel costs between those opportunities are. Both the rank and the travel costs are significant variables in the determination of an RSS visit by a customer, as has been seen so far in the chapter. However, there is no clear method by which they should be combined -- simply multiplying rank and travel cost is not adequate because:

(a) The distances of all other RSS must be taken into account. In Diagram 4F below, it can clearly be seen that a visit by customer 1 to RSS 1 is more significant than a visit by customer 2 to RSS 2, in spite of the ranks and travel costs of RSS 1 and 2 being identical.

DIAGRAM 4F. The Importance of "Other RSS" when defining deterrence.



(b) One can intuitively see that it is "more significant" when a customer visits his 30th ranked RSS, with a travel cost of 1 unit, than when a customer visits his nearest RSS which is 30 units away.

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4.15.2 The travel costs to all RSS ranked before RSS $_{j(u,i)}$ are taken account of as follows: a mean of all the RSS travel costs up to and including j(u,i) is obtained, and this is divided into the travel cost to RSS $_{j(u,i)}$:

$$\frac{D_{ij}(u,i)}{\dfrac{\sum_{u=1}^{u} D_{ij}(u,i)}{u}} \qquad \text{(E78)}$$

4.15.3 The result is the ratio of the travel costs to RSS $_{j(u,i)}$ to the travel costs of all RSS ranked before it (and including it). This ratio is then multiplied by the travel costs to RSS $_{j(u,i)}$ to obtain a rank-distance factor:

$$R_{ij}(u,i) = D_{ij}(u,i) \cdot \frac{D_{ij}(u,i)}{\dfrac{\sum_{u=1}^{u} D_{ij}(u,i)}{u}} = \frac{\left(D_{ij(u,i)}\right)^2 . u}{\sum_{u=1}^{u} D_{ij}(u,i)} \qquad \text{(E79)}$$

In the RSS model (Ch.6), a calibration variable λ is used to adjust this factor.

4.16 COMPOSITE ATTRACTION

4.16.1 The "attractiveness" section of the model will now be developed. Cordey Hayes, in (E73) and (E74) expressed the derivative of the probability that a customer will continue beyond j with respect to distance to the next opportunity and with respect to cumulative opportunities passed, as negative functions. Note that it is important that each zone j contains only one RSS, in order that the distance to next opportunity factor may be expressed using zones. His approach may be used to derive the following functions:

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$$\frac{\delta U}{\delta B_{ij}} = - MU \tag{E80}$$

$$\frac{\delta U}{\delta Y_j} = - QU \tag{E81}$$

4.16.2 These equations may be understood as indicating that U_{ij} the probability that a customer from i will continue beyond j will decrease as B_{ij}, the distance to the next opportunity increases, and as Y_j, a "general attractiveness" index of j increases.

Combining (E80) and (E81) gives:

$$U_j = \exp - (MB_{ij} + QY_j) \tag{E82}$$

Therefore, the probability that a customer will be satisfied, (and therefore attracted) by an opportunity is:

$$V_j = \exp (MB_{ij} + QY_j) \tag{E83}$$

4.16.3 The cost function (E79) and "attractiveness" function (E83) are now substituted into Wilson's suggested "gravity/ opportunity" model (E71) and (E72):

$$T_{ij} = a_i O_i V_j \exp (- \beta c_{ij}) \tag{E84}$$

$$a_i = \left[\sum_j V_j \exp (- \beta c_{ij}) \right]^{-1} \tag{E85}$$

(E84) and (E85) may now be expressed in the form of retail models such as those derived by Cullen[106] and Cordey-Hayes,[107] as in (E48):

$$T_{ij} = O_i \frac{\exp (MB_{ij} + QY_j - Z c_{ij})}{\sum_j \exp (MB_{ij} + QY_j - Z c_{ij})} \tag{E86}$$

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(106) Cullen, (1969).

(107) Cordey-Hayes, (1968).

4.16.4 The working model for Chapter 6 will be:

$$T_{ij} = O_i \frac{\exp(\alpha W_j + \beta B_{ij} - \lambda c_{ij})}{\sum_j \exp(\alpha W_j + \beta B_{ij} - \lambda c_{ij})} \qquad \text{(E87)}$$

where:

W_j is a composite attractiveness parameter.

B_{ij} is the distance to the next opportunity after j(u,i). (Note that there is only one RSS per j zone in the model, and therefore the necessity of expressing rank as j(u,i) falls away).

4.16.5 The formula will therefore account for the distances of all RSS ranked before u, and it will also account for the distance to u + 1. It might be argued that it should also account for the distances to u + 2, u + 3 ... etc. but, as will be shown in Chapter 6, the importance of RSS beyond u + 1 is very low. A cutoff valve was required, and it has been taken as u + 1.

4.16.6 There is a second practical reason for taking a cutoff at this point. The formulae discussed above are based upon exponentials of attraction and deterrence factors. Many computers cannot calculate values greater than e^{230} which will be a value greater than 10^{99}. For this reason, the rank-distance factor has been chosen as a ratio, rather than an absolute value, as has been the composite attractiveness variable developed below.

4.17 INDEXING

4.17.1 Most general shopping models are based upon two variables; one to encompass the "attractiveness" of the shopping centres, and another to encompass the various costs of movement

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from origins to shopping centres. The attractiveness variable has been postulated in a variety of ways, usually with one variable acting as a proxy for several related variables that could be used to describe attractiveness. McCabe[108] maintains that attractiveness is usually related to size, and the proxy variable for size could be:

(a) The annual sales volume of a store (usually the best measure of size, but not always available).
(b) The number of items carried by the store.
(c) Floor space.
(d) The number of types of store in a centre.
(e) The number of employees.

4.17.2 Lakshamanan and Hansen[109] have used floorspace data and Black[110] has used retail sales. These researchers have assumed that as the size of a centre increases, amenity will increase because of the appearance of "major name" stores, greater variety, and possibly greater competition. McCabe[111] maintains that the number of items carried by a store can safely be used as a proxy for all other non-locational variables. He maintains that "... the degree of uncertainty in shopping decisions appears to diminish as the size of the shopping centre increases, reflecting the assumed increase in the number of items available".[112]

4.17.3 It is clear that the attractiveness variable W_j in the RSS model cannot be similar to the attractiveness variable of the general shopping models. There is no powerful intuitive reason to assume that a "large" RSS will be more attractive to customers, as there is with a general shopping centre. Rather, there are likely to be a number of attractions which can be combined as a general "attractiveness" index.

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(108) McCabe, (1974), Pp.29-32.
(109) Lakshamanan and Hansen, (1965).
(110) Black, (1966).
(111) McCabe, (1974).
(112) *Ibid*, P.29.

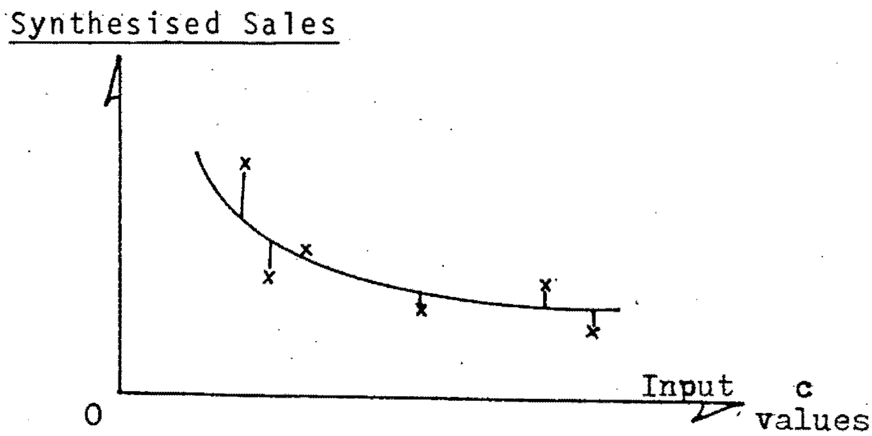
4.17.3 Diagram 4C showed how a number of RSS can be located on such a diagram for one particular customer at a given location and at a point in time. The locations of the RSS in this diagram depend upon the costs to the customer of getting to the RSS, and their attractions in their ability to satisfy his hunger.

4.17.4 On the cost side, Diagram 4C used cost of product C, plus AVD cost (represented as the distance above C). It has been shown above how there are costs other than AVD involved in selecting a particular RSS. A rank-distance factor was developed above as an improved deterrence measure.

4.17.5 On the attraction side, it may be said that the horizontal distance of an RSS from the vertical axis represents first, all factors other than the deterrence factor which will attract a customer to it; i.e. the "attractions" of an RSS discussed in 4.5, and second, the number of opportunities in zone j.(113) A method is required of isolating these "all other attractions" factors. The approach used in Chapter 6 is summarised below.

4.17.6 Firstly, the model is set up with all the necessary live data, except for the composite attraction values of each RSS. A value of one is inserted in the composite attraction variable required for each RSS, and the model is then calibrated (see below). After calibration, the model is run in simulation mode.

DIAGRAM 4G. Synthesised Versus Actual Sales



(113) To simplify any model, only one opportunity is included per zone.

4.17.7 The result of this simulation run will be an estimation of the sales of each RSS based on the deterrence portion of the model only. This has been graphed in Diagram 4G, where the smooth line represents the output of the model (ie. the synthesised sales), and the crosses represent the actual outputs of the RSS. The variations between the smooth line and the actual sales values may be referred to as E_j, and

$$E_j = W_j + e_j \qquad \text{(E88)}$$

where:

W_j is the difference accounted for by the "attraction" portion of the model, and

e_j is a variable accounting for random fluctuations, and for deficiencies in the deterrence portion of the model. This variable will be equivalent to the "residual" values of a multiple regression analysis.

4.17.8 RSS that are placed above the synthesised sales line in Diagram 4G (ie. which have positive values for E_j) may be considered more "attractive" than those which are placed below the synthesised sales line.

4.17.9 The E_j value for each RSS may now be subjected to multiple regression using the various attraction factors for each RSS; the E_j will be the dependent variables, and the variety of attraction factors the independent variables. The equation obtained from the multiple regression may be used for several purposes. The importance of each attraction variable in the regression upon synthesised sales may be assessed; to do this the model is run using attraction factors predicted by the regression equation, but with the required changes made to the particular independent variable under consideration.

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4.17.10 It is possible that there still may be a divergence between actual and synthesised sales of certain of the RSS under study. This implies that there are factors which affect RSS sales which have been excluded from the model (or rather, as independent variables in the multiple regression).

4.18 CALIBRATION

4.18.1 The initial run of the model will inevitably produce output with a large discrepancy between the actual and the synthesised sales of each RSS. These discrepancies will be caused by the varying weights of the attraction and deterrence variables for different study areas, and also because these two variables are calculated using different measures and methods.

4.18.2 The objective of calibration is to minimise the differences between observed results and those predicted by the model for the same time period. The alpha, beta and lambda parameters should be chosen to optimise one or more goodness of fit statistics; two are discussed below:

4.18.3 If $X_{ij}^{(OBS)}$ are a set of observations, and X_{ij} are the equivalent predictions from the model, the simplest objective would be to minimise the sum of squares, S.

$$S = \sum_{ij} (X_{ij} - X_{ij}^{(OBS)})^2 \quad \text{(E89)}$$

4.18.4 An indication of goodness of fit can be given if X_i and $X_i^{(OBS)}$ are plotted against each other, and a straight line fitted between them, such that:

$$X_i = a_0 + a_1 X_i^{(OBS)} \quad \text{(E90)}$$

An exact fit would produce a 45^0 line, such that $a_0 = 0$ and $a_1 = 1,0$. An inspection of the curves may indicate that only particular values are misaligned. A linear regression above would also require the maximisation of the coefficient of correlation R^2.

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4.18.5 A second goodness of fit measure is chi - square, where:

$$x^2 = \sum_i \frac{(X_i^{(OBS)} - X_i)^2}{X_i} \qquad \text{(E91}$$

4.18.6 Writers such as Wilson[114] and Cordey-Hayes[115] have warned against the bogus optimal fit that is obtained when $\alpha = 1$ and $\beta = 0$ using the standard two parameter shopping model.

4.18.7 Wilson[116] recommends the use of a simple matrix of α and β values to assist calibrate the model. Goodness of fit statistics are calculated for each element of the matrix, and the values of α and β which give the best fit are chosen. The computation can be repeated for a finer grid around these values, if necessary. In Chapter 6, the model developed has three calibration parameters, and therefore this method of choosing the best value from a (three dimensional) matrix would be extremely wasteful of computer time. A more rapid procedure known as "golden-section search" has therefore been programmed into the model. This method is discussed in detail in Ch. 6.

4.19 EXTERNAL INTERACTION

4.19.1 (E11) ensures that the system under study is closed, ie. that the total of all RSS sales is equal to the total of all RSS expenditures by customers. It is likely however, that some customers in any area under study will visit RSS outside that area. Conversely, some of the RSS being examined

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(114) Wilson, (1974), P.323.
(115) Cordey-Hayes, (1968), P.32.
(116) Wilson, (1974), P.324.

will sell to customers who originate outside the study area. This problem is likely to be more severe with an RSS model than with a normal shopping model, because RSS customers are, by definition, mobile.

4.19.2 Two methods by which the effects of external interaction can be minimised are: first, to maximise the size of the area under study, both in terms of the number of RSS and the number of customers, and second, to include one or more "external" zones in the model, in which data for external RSS and external customers is inserted. External interaction in the RSS model is discussed in 6.2.4.

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5 REGULATION AND THE RSS

5.1 INTRODUCTION

5.1.1 Chapter 3 indicated that regulation has important effects upon the RSS, shaping both their characteristics and their profits. The objectives of this chapter are to provide an introduction to regulation and the emerging theory surrounding it, and then to develop a framework within which regulations governing the RSS may be investigated. The actual legislation will be examined in more detail in Part III.

5.1.2 There are three main methods by which government can directly influence the private sector: taxing, spending and regulating. Regulation may be defined as intervention in the free market by a body in a position of responsibility (usually a regulatory agency). A regulatory agency is a "...quasi judicial government commission established by legislative act to oversee a specified economic field".[117] Regulation is a means of achieving government objectives directly, rather than through the use of incentives or deterrents. Regulatory powers may be conferred upon the departments or ministries of a government, as well as upon an independent agency.

5.1.3 The objective of regulation is to "...protect and promote the public interest"[118] by preventing certain sectors of the economy from earning excessive (monopoly) profits, and from engaging in inequatable price discrimination among customers, commodities and places. Weidenbaum[119] considers regulation to be a response "...to failures in the normal market system".

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(117) Encyclopaedia Brittanica.

(118) Rodee, (1967), P.553.

(119) Weidenbaum, (1977), P.16.

5.2 DESCRIPTION OF THE REGULATORY ENVIRONMENT

5.2.1 The traditional or original regulatory agencies were established to "...regulate a specific industry, with the related concern of promoting the wellbeing of that industry".(120) Examples of such agencies in the USA are: the Interstate Commerce Commission, the Civil Aeronautics Board, the Federal Communications Commission, and the Federal Power Commission. These agencies originated in the realisation that "...legislatures are unable, without assistance, to apply *continuous* and *expert* knowledge to the complexities of a modern industrial economy".(121) Such regulation is most often applied to public utilities, with the objective of including the full (external) costs and benefits of their operations. It will desire to avoid any resource or product markets being subject to undue influence by private enterprise. In certain of these markets (eg. energy and primary commodities), the state will have the strategic objectives of maintaining security and stability (ie. protectionist measures).

5.2.2 The newer regulatory approach (typified by the regulatory efforts of the US Congress in recent years) follows a different pattern. The newer agencies are broader in the scope of their jurisdiction -- their focus is not limited to a single industry, but rather to those aspects of all industries that fall under their jurisdiction. Examples of such agencies in the USA are the Environmental Protection Agency, the Equal Opportunities Employment Commission, the Consumer Product Safety Council, the Federal Energy Administration, and the Occupational Safety and Health Administration. The objectives of such agencies will be designed to preserve public order, the security of goods and persons, orderly and equitable employment, public health and the environment.

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(120) Weidenbaum, (1977), P.12

(121) Encyclopaedia Brittanica.

"Voluntary actions to deal with such problems may place a firm under a competitive disadvantage. The specific company attempting to correct the situation would tend to bear the full costs, while the benefits of improvement would be widely dispersed in society".[122]

5.2.3 The impetus for the newer regulation may be provided by consumer groups, environmental organisations, civil rights advocates, labour unions, and other citizens' institutions. Such regulation may be reinforced by the belief that many of society's problems today have in some degree been caused by business, eg. pollution, discrimination in employment, unsafe products, unhealthy working environment and misleading financial reporting.

5.2.4 Weidenbaum[123] has demarked three types of regulation. First, he identifies those regulations that are constant and ongoing controls, such as continuous price and market share controls. Perennial government activities in the economy such as taxation may be classified under this heading. The second area of controls are those typified by stop-go, and guidepost objectives. For example, price regulations may vary under different inflationary conditions. The third area of regulations are those that are evolving, and consist of tentative controls. In the USA, many environmental and employment regulations fall under this heading.

5.2.5 Note that the government not only has legal power to set up regulations, but is also a large buyer of goods and services in the private sector. By means of its monopsonist power, it is able to impose a variety of constraints upon business. Typically, it may tend to bear more of the risks normally borne by a seller (eg. R.&D.) and may tend to bear increasing responsibility for the suppliers' internal operations (eg. wages paid, minorities employed, imports).

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(122) Weidenbaum, (1977), P.16.
(123) *Ibid.*, P.20.

5.2.6 Weidenbaum[124] also identifies three different patterns of reactions by businesses to government regulations. (These reactions are not necessarily related to the classes of regulation described above). They are first, passive reactions by businesses, when they comply with government controls. Secondly, businesses may anticipate regulations, and will orient themselves to be in the most advantageous position possible at the time the regulations are promulgated. Thirdly, businesses may play an active role in the development and enactment of regulation. This will be done by participation in the political processes evolving regulation.

5.2.7 Some of the difficulties involved in, and problems that have emerged from regulating will now be discussed. The essential problem is that the objectives of any regulation are not easy to evolve and define, and the results, which are often unpredictable, are difficult, if not impossible to measure, especially when externalities are included. Rodee[125] maintains that the "...legislation which gives policy direction to an agency is usually vague, and a commission enjoys a great deal of freedom in establishing its goals, and particularly in implementing specific objectives". Issues outside the agency's jurisdiction may tend to be ignored. "The basic mission of industry is to provide goods and services to the public".[126] Issues such as productivity, economic growth, employment, costs to the consumer, and inflationary aspects may not be given their deserved weighting in the determination of regulations.

5.2.8 Typical problems are:

(a) The general and loose objective of "protection and promotion of the public interest" is often (if not always) subject to pressures from groups with differing (special) interests. There is often a tendency, particularly among the traditional regulatory agencies, for the public or consumer interest to be relegated as the agency focuses on the needs and concerns of the industry that it is

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(124) *Ibid*, P.167.

(125) Rodee, (1967), P.555.

(126) Weidenbaum, (1977), P.15.

regulating. A manifestation of the problem is that personnel may switch between the agency and the industry.

The opposite problem occurs with the newer regulatory agencies. Rather than too much concern for any industry, their broader scope can result in apathy as to the effect of a particular policy on a single industry. Normally, a single industry does not tend to dominate such an agency; rather, the most potent influences come from groups with specific interests such as environmental pollution, racial discrimination and product hazards.

(b) The piecemeal evolution of many regulatory agencies and laws has resulted in inconsistencies in their policies and objectives. Examples of conflicting goals are motor car fuel economies versus exhaust emission controls; and air pollution versus oil conservation by conversion to coal on power plants.

(c) The achievements, or performance of an agency and its staff are difficult to appraise. The vague objectives that may be given to an agency, and the unquantified external effects of its actions may tend to compound this problem.

(d) Weidenbaum[127] identifies an "announcement effect" in which fears or rumours of new controls in the future may dampen companies' investment or production plans.

(e) Difficulties may exist in the interpretation of regulations. Not only may there be conflicts in regulatory objectives (mentioned above), but the regulations themselves may be equivocal, or written in the esoteric jargon of specialists. Weidenbaum[128] provides some humorous examples, and also mentions how the small businesses particularly may have difficulty affording the time and expertise to comply with certain regulations. There is generally an increasing percentage of personnel employed by business who must have a detailed knowledge of regulation in their field.

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(127) *Ibid*, P.71
(128) *Ibid*., P.62-65.

(f) Regulatory directives will tend to move very slowly, especially in those cases where litigation is involved, or where large resultant losses may be incurred by one particular group. There is a "...disincentive to change once a regulatory pattern has been established".[129]

(g) Regulation may have unintended allocatory effects:

> "...forced attention to the influence which the regulatory powers of the state could have on the distribution of wealth as well as on allocative efficiencies".[130]

> "...unintended and indirect consequences (of regulation) may have more economic significance than the desired direct ones".[131]

J.Q. Wilson uses the example of ICC rates.[132]

(h) Cramton[133] argues that there will be a tendency for regulatory agencies to implement the passive functions of protectionism more effectively than the affirmative functions of planning, development and coordination. He maintains that an independent agency will tend to be isolated from the sources of political power, and because it has to evolve working arrangements with those it regulates, in addition to the various groups with which it functions (government, from whom it obtains its finance, industry pressure groups and consumers, for example) it will respond only to urgent pressures, and will steer clear of "change".

(i) Cramton also mentions that competition from exempt areas may limit the effectiveness of regulation. He feels that certain regulations may have "...little or no economic significance", and suggests that along with "market failure" there may also be "government failure".

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(129) G. Wilson, (1964), P.170.

(130) Peltzman, (1976), P.211.

(131) Caves, (1964).

(132) J.Q. Wilson, (1971), P.45.

(133) Cramton, (1964), P.189.

(j) Certain outsiders may gain new controls over the industry as a result of regulation.[134]

(k) Smaller firms are likely to become more influential once an industry is regulated.[135]

5.3 THE COSTS OF REGULATION

5.3.1 In theory, the final cost of regulation is the net present value of the summated costs and benefits of all changes that result from that regulation, both upon the regulated institution, and throughout the rest of the economy. It is also essential to consider the opportunity costs of regulation, ie. would the money spent on implementing one type of regulatory policy have had an improved cost-benefit ratio if channelled into other policies?

5.3.2 The costs of regulation are felt in three areas:

(a) The government (and thus the taxpayer). The costs of running the regulatory agencies are perhaps the clearest and most objective of the three. (Most agencies have a budget, and a clearly defined staff).

(b) Costs to the regulated businesses in complying with regulations.

(i) Their administrative costs in interpreting regulations and in supplying information to the government. Weidenbaum[136] cites cases of substantial increases in staff required by businesses to cope with this function. Increased training will be required, and decreased time will be available from the staff for production.

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(134) Stigler, (1971), P.7

(135) *Ibid.*

(136) Weidenbaum, (1977), Ch.14.

(ii) The businesses will often have to make certain changes to their operations in compliance with regulations. Areas such as work procedures and processes, capital employed, personnel employed, marketing methods and markets served may be involved, for example. Substantial direct costs can result from these changes. Weidenbaum[137] notes that an increasing share of investment is being devoted to complying with regulations rather than increasing output.

Note that sometimes these regulatory changes will be of benefit to the business itself. For example, government control upon certain operations in an industry may mean reduced competition, or greater stability in prices or factors of production.

(iii) A business may suffer from decreased sales indirectly caused by regulation. If a regulatory agency examines some aspect of an industry's operations, there may be a consumer 'wariness' or 'scare'. This will apply particularly when a product affecting consumer well-being comes under scrutiny (eg. food, drugs).

(c) Regulation will impose costs upon the consumer in terms of:

(i) Increased prices.

(ii) The non-availability of products as and when they demand (as indicated in the free market).

5.3.3 Posner[138] has examined the social costs of regulation (and of monopoly). Obtaining a monopoly is a competitive activity, so should a regulator set a price which will ensure monopoly profits (rents), these rents will be bid away in the form of nonprice competition between the regulated firms.

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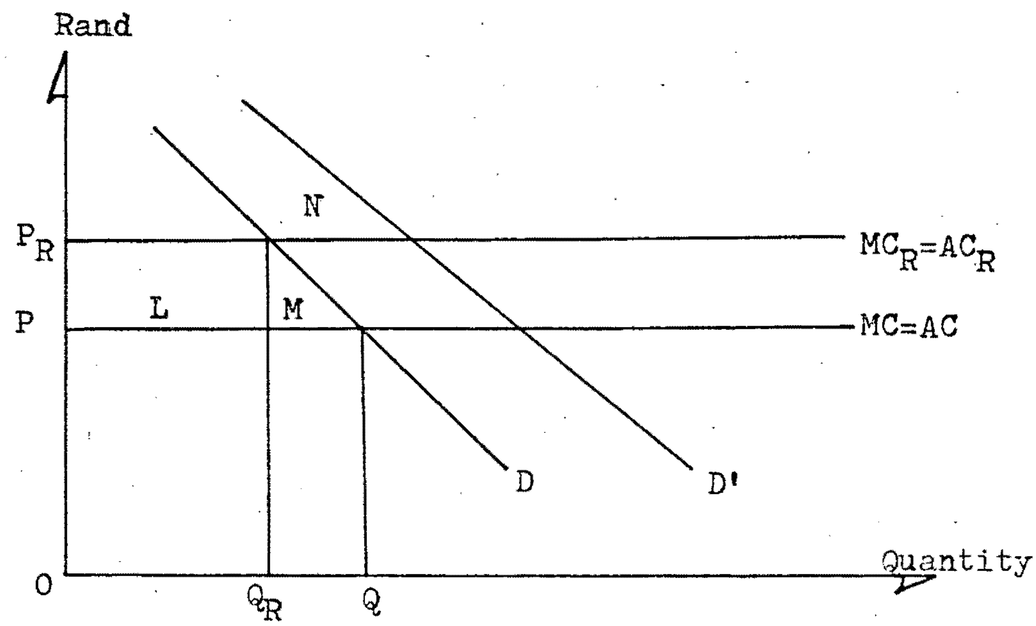
(137) Weidenbaum, (1977), P.193.

(138) Posner, (1975).

Barriers would have to be set against new entrants to the industry, who would also wish to compete away the rents. In terms of Diagram 5A, the equilibrium price for a competitive industry is shown as P, and the regulated price as P_R.

DIAGRAM 5A. Price Regulation



5.3.4 When the market price rises to P_R, consumers who continue to purchase the product will suffer a loss L. L is the rent the producers initially gain from the higher price. Those consumers who no longer buy the product suffer a loss M, regarded by Posner as a "deadweight loss" or a social cost. This loss M, however, underestimates the social cost of monopoly, because the existence of the rent L will attract resources into efforts to obtain it -- these resources seeking L are an additional social cost. The result will be a transformation of the rent into higher costs for the industry as each firm's costs shift from AC to AC_R.

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5.3.5 If nonprice competition was somehow inhibited at zero cost, the rent L would still transform into a social cost in the long term, because the rent would attract resources into a position of being able to obtain it in the first place. (Note that only some of these resources would be successful). Usually of course, the prohibition of nonprice competition will also involve social costs. Posner explains that these costs may be "low" if heavy monetary penalties (ie. transfer payments) are combined with "...modest resources devoted to apprehending and convicting offenders".

5.3.6 Kreuger[(139)] also discusses the social costs of rent seeking. She explains that the costs firms originally incur in seeking to obtain a monopoly rent will be of two kinds: direct (trips to the capital city, location in government approved areas etc.), and bribery (outright bribery, hiring of officials or their relatives, etc.). Both these costs are social costs. Bribery has been treated as a transfer payment, but it must be remembered that bribery will draw resources into the activity of being an official who might receive bribes.

5.3.7 Posner explains that the social costs in Diagram 5A might be reduced if, as a result of the expenditures on rent seeking, some socially valuable by-product were obtained (eg.: safety, customer service). In this case, the demand for the product would increase from D to D', and social welfare equal to N is generated.

5.3.8 In summary, the imposition of an above equilibrium price will result in the following costs:

(a) To consumers, the increased cost of product L plus a deadweight loss M. Another cost of regulation which is important in the case of RSS is the cost of the extra distances that must be travelled by certain customers because there are fewer RSS than in an unregulated market. (See Ch. 8).

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(139) Kreuger, (1974).

(b) To producers, a transfer gain L in the short run, which in the long run would be offset by competition to gain a larger share of L (or by new entrants to the industry, if there are no barriers).

(c) To the public a social loss equal to L will result from resources seeking L, by existing and potential firms. However, it is maintained that the social loss will not necessarily be equal to L. The situation is in effect a gamble, and there is no reason to expect the seeking resources to be equal to the prize. In addition, the situation described is a competitive one, and there is unlikely to be collusion.

The deadweight loss M is a social loss, whereas (the possible) N is a social gain. Regulatory costs incurred by the government (G) will be a social cost, as will Kreuger's bribery seeking costs B. (B and G are not shown in the diagram). Social costs are thus:

$$L + M + G + B - N$$

A BRIEF EXAMINATION OF THE EMERGING THEORIES OF REGULATION

"The central tasks of the theory(s) of economic regulation are to explain who will receive the benefits or burdens of regulation, what form regulation will take, and the effects of regulation upon the allocation of resources".[140]

5.4 MARGINAL APPROACH

5.4.1 Remarkably little work had been done on regulation up to the early 1960's, possibly because it had not been recognised as an area with potent economic and political consequences. Most work that had been done concentrated upon defining the "general" or "public" interest, and the allocation of government expenditure to serve such interest.[141]

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(140) Stigler, (1971), P.3.

(141) Pen, (1962), Pp.190-193.

5.4.2 An elementary marginal approach had been attempted, but with little success.[142] The rule that the last dollar spent by the state must provide the same marginal benefits as it would have provided had it been spent by the private sector is impossibly difficult to tie to reality. Such a rule implies that the last dollar spent in each government department provides an identical amount of "social good", and that this dollar is equal to the social benefits of the last dollar spent by each private entity. The rule may also be expressed as follows: the last dollar a private citizen is taxed should, directly and indirectly, provide the same benefit as it would if he spent it himself. The major problem with this rule is that the knowledge required to implement it does not exist.

5.5 REGULATION IN THE PUBLIC INTEREST: EXTERNALITIES

5.5.1 Pigou[143] has been credited with the original work in this area. He suggested that:

> "In any industry where there is reason to believe that the free play of self interest will cause an amount of resources to be invested different from the amount that is required in the best interest of the national dividend, there is a *prima facie* case for public intervention".[144]

5.5.2 He defined marginal private net product (MPNP) and marginal social net product (MSNP) as the private and social changes to production from the employment of the marginal resource, and explained how MPNPs between industries will equalise, but MSNP may diverge. He suggested that[145] when MPNP and MSNP diverge "when competition rules", or when a monopoly exists, it is theoretically possible to correct the situation through the use of a tax or subsidy, or by the regulation of price or output. He was advanced in his thinking in suggesting that:

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(142) E. Sax, discussed by PEN, *ibid*, P.194.

(143) Pigou, (1932).

(144) *Ibid*, P.331.

(145) *Ibid*, P.381.

> "...we cannot expect that any public authority will attain, or even wholeheartedly seek, that ideal. Such authorities are liable to ignorance, to sectional pressure, and to personal corruption by private interest".(146)

5.5.3 Coase(147) argues that Pigou's approach to the correction of social costs through direct taxation or regulation devices will not necessarily provide the optimal result. He explains how total social product is likely to be maximised through a process of bargaining between the affecting and affected parties. This bargaining process will result in an optimal allocation of resources, whether a liability for damages exists or not. However, Coase's argument assumes perfect knowledge, costless adjustments and no income effects. His theorem is also discredited by the problem of "free riders" in a bargaining process (it may be profitable for a minority to hold out, in the face of agreement by the majority), and also by the problem of strategic behaviour among bargainers (there is no guarantee of an agreement, especially if the number of bargainers is small; because individuals may feel they can "do better").

5.5.4 He says it is important to focus upon the total social products yielded by different arrangements, and that Pigou's "...comparison of private and social products is neither here or there".(148)

5.5.5 In summary, he suggests that:

> "The aim of such regulations should not be to eliminate (smoke pollution) but rather to secure the optimum amount of (smoke pollution), this being the amount which will optimise the value of production".(149)

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(146) *Ibid*, P.332.
(147) Coase, (1960).
(148) *Ibid*.
(149) *Ibid*.

5.5.6 Note that Coase suggested that the "value of production" should be maximised. Regulations which take only money measured effects into account may produce the results desired by Coase in his article, but they will ignore social costs and effects; an omission which will considerably change the desirable degree of regulation in certain circumstances.

5.5.7 In reality therefore, the greatest uncorrected social costs will be found where the affected persons are not each individually incurring substantial social costs; where the costs are of a social rather than monetary nature; and where these individuals are not cohesively represented. This is because the affected individuals will have little incentive or ability to pursue the socially required "corrections". (This provides the background to the approach used by Stigler in 5.8).

5.5.8 Much of the work of the traditional regulatory agencies (see 5.2) is assumed to involve "correction" of the regulated industry's operations to allow for external costs and benefits. The "public interest" theory maintains that this is why, and how regulation operates. Bonbright maintains that "public utility services are designed to be sold at cost, or at cost plus a fair profit".(150) His theory is based upon two assumptions: first, that free market operations tend to operate inefficiently (or inequitably) and may be abused by those groups with market power; and second, that the cost of government regulation is low. These assumptions allow the proponents of this theory(151) to argue that it is logical for the government to interfere wherever the free market is operating imperfectly. Stigler(152) explains how the proponents of this view would explain regulations which injure the public (eg. American oil import quotas) as costs of some social goal (here national defence).

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(150) Bonbright, (1961), P.23.

(151) Bonbright, (1961); Davis, (1958); Friendly, (1962).

(152) Stigler, (1971), P.3.

5.5.9 Posner[153] refutes these two assumptions: "...regulation is not positively correlated with the presence of external economies or diseconomies or with monopolistic market structure". He also maintains[154] that the costs of regulation are "high".

5.5.10 Demsetz[155] suggests that "the proper issue for antitrust then, is not the degree to which a market descriptively diverges from perfect competition, but the degree to which it diverges in either direction from that intensity of competition which takes account of the real social costs of competing. No one has yet successfully tackled this problem..." (Since Demsetz made this statement, M.K. Perry[156] has developed a model to examine this problem under somewhat limiting assumptions).

Demsetz makes two contributions in suggesting first, that concentration in a product market need not be taken as evidence of collusion, and second, that "...monopolisation through government protection is likely to be as difficult to defend intellectually as it is to attack politically".

5.5.11 Posner[157] explains how the existence of an internal subsidy (see 5.9) is an embarrassment to the proponents of the public interest theory. "The internal subsidy brings about results unthinkable in a competitive market".

5.5.12 A modified view of the public interest theory[158] is that regulation has failed, not for any of the above reasons, but because of mismanagement. However, Posner[159] maintains that many socially undesirable results of regulation are often desired by certain groups. He also asserts that there is little evidence of regulatory mismanagement, nor reasons why there should be any such inefficiency.

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(153) Posner, (1974), P.336.
(154) *Supra*, P.339.
(155) Demsetz, (1976).
(156) Perry, (1978).
(157) Posner, (1971), P.27.
(158) Herring, (1936).
(159) Posner, (1974), P.337.

5.5.13 The last serious problem with the public interest theory identified by Posner[160] is the lack of a "linkage or mechanism by which a perception of the public interest is translated into legislative action". He suggests two ways around this problem. First, one can "emphasise the moral differences between private and political action", and second one can "observe the potentiality for collusion among politicians." Powerful politicians may be able to use their power to obtain pecuniary income, or to "impose their conception of the public interest (which might differ from the conception held by the electorate)."

5.6 FAIR RATE OF RETURN

5.6.1 Averch and Johnson[161] discuss the situation in which regulation is designed to give a firm a "fair rate of return", based on the value of its capital employed. Under these circumstances, the cost of capital to the regulated firm can no longer be equal to the market cost of capital. "For each additional unit of capital input, the firm is permitted to earn a profit (equal to the difference between the market cost of capital and the rate of return allowed by the regulatory agency) that it would otherwise have to forgo". In other words, the firm will maximise its profits by using a greater amount of capital in its resource mix. "The effect of regulation is to force the firm to expand output (from its unregulated output)... but output does not expand to ... (the socially desirable level) ... because a portion of what would otherwise be profit is absorbed by ... (increased social) costs".[162]

5.6.2 If the regulator bases the "fair rate of return" on the capital employed in all markets together, rather than each separately, the firm may have the incentive to enter new markets

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(160) *Ibid*, P.340.

(161) Averch and Johnson, (1962).

(162) *Supra*, P.1057.

in which the cost of doing so exceeds potential revenues. It will do this in order to inflate its rate base, and so allow it to increase total profits. Because the firm can operate at a long run loss in such markets, it may drive out competitors and establish new monopolies.

5.6.3 This view is developed by Westfield[163] who examined the market for capital goods, and found that in certain circumstances it may be in the interests of a regulated industry to pay higher prices for plant and equipment than in the absence of regulation, and that these higher prices need not harm that industry.

5.7 EMPTY MOTIONS

5.7.1 Writers such as C. Lindblom[164] and J.W. Wilson[165] believe that there is little rationality in much government action. Lindblom believes that the effects of budget items on a country's welfare are too complex for objective assessment, demanding "intellectual capacities and knowledge beyond our reach". The politicians simply go through their motions, and "common ideology, common prejudice or even common ignorance" are decisive.

5.7.2 J.Q. Wilson, whose work was more specifically applied to regulation, may be considered as initiating the random behaviour school of thought. He proposed that whereas an "invisible hand" guides the market, a "dead hand" is involved with regulation. He maintains that most regulatory agencies do not have clear and previously agreed to standards against which the regulators and the regulated may operate, and that there is therefore a ..."fear of capricious government action".

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(163) Westfield, (1965).

(164) Lindblom, (1961), (1955).

(165) Wilson, (1971).

He maintains that the regulatory tasks ..."probably could not be performed well even in theory, and amid the practical realities of confused ends and ambiguous standards they are, through the fault of no one in particular, performed abominably". He maintains that agencies will "...go to some pains to avoid developing ... rules". This lack of rules in fact provides the agencies with arbitrary power for more specific cases.

5.8 THE INTEREST GROUP, CAPTURE, OR DEMAND AND SUPPLY THEORIES

5.8.1 There are several versions of the interest group or capture theories of regulation, which are defined by Posner(166) as when "...regulation is supplied in response to the demands of interest groups struggling amongst themselves to maximise the incomes of their members". Two lesser known theories will be briefly discussed, and then G.J. Stigler's important 'Theory of Economic Regulation'.(167) Note that the demand by certain sectors of society for governmental favours is not a new activity.(168)

5.8.2 The first of these capture theories is attributable, according to Posner(169) to "Marxists and Ralph Nader type muckrakers". It is suggested that J.K. Galbraith(170) would be similarly classified by Posner. The theory maintains that because "big business" and the "capitalists" control the institutions of our society, they also control regulation. However, the existence of much regulation designed to serve the interests of small groups (eg. in the USA: union labour, truckers and barbers) immediately discredits this theory.

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(166) Posner, (1974), P.336.
(167) Stigler, (1971).
(168) PEN, (1962), P.196.
(169) Posner, (1974), P.335.
(170) Galbraith, (1967).

5.8.3 A second version of the capture theory, attributable to political scientists such as A.F. Bentley[171] and D.B. Truman[172] emphasises the importance of interest groups in public policy formulation. A school of thought[173] maintains that over time, the regulatory agencies may tend to be dominated by the industries regulated. Unfortunately, the theory does not go as far as explaining how or why only certain agencies will be dominated by only certain groups. Empirical evidence may be found to both prove and disprove the theory.[174]

5.8.4 Stigler[175] proposed a more formal theory in which regulation is sought, rather than imposed (and therefore that regulation is designed for the benefit of the seeking group). Various groups will seek the following from the state:

(a) a direct subsidy of money;
(b) limits on new entrants to the industry;
(c) suppression of substitutes and encouragement of complements to the industry;
(d) price controls.

The allocation of these benefits will be governed by laws of supply and demand.

5.8.5 The absolute size of the costs and benefits of some proposed regulation, according to Stigler, is not the prime factor determining whether it will be implemented or not (although it would be in a market process). Instead, the characteristics of the political process are important in initiating regulation. The voters will employ political representatives who are given wide discretion to make decisions that would otherwise require the simultaneous and universal approval of all voters. Individual voters will not have access to these representatives in proportion to their interest on every issue the representatives handle. There will be information

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(171) Bentley, (1908).
(172) Truman, (1951).
(173) See Posner, (1974), P.341 for discussion.
(174) Posner, (1974), P.342.
(175) Stigler, (1971).

costs in familiarising with specific policy proposals, and voters will involve themselves in accordance with potential costs and benefits to them. A group which seeks access to power held by political representatives must therefore be prepared to:

(a) Incur information costs.
(b) Provide votes and resources desired by the politicians.

5.8.6 Stigler has indirectly used the theory of cartels to build a theory of the demand and supply of regulation. (See 6.1.3). The demand for regulation will be greater in industries in which private cartelisation is infeasible, usually when a large number of participants would mean that the costs of organising and policing a cartel would be very high. "...it may be cheaper for large number industries to obtain public regulation than to cartelise privately".(176)

5.8.7 Such large number industries will also have a greater voting power, and therefore a greater expression of demand to the politicians. There will be a point however, where additions to the size of the group will again decrease the demand for regulation, because the large numbers will cause less coherence in the group, and will mean that the benefits of regulation have to be dissipated among a large number of members (although of course, the costs per member will be lower).

5.8.8 Other factors tending to increase the demand for regulation by a group will be a low elasticity of demand for the industry's product, and high costs of entry into the industry. (See Migue, 5.10).

5.8.9 The higher the costs of obtaining information concerning regulatory effects, the higher the costs of organising a cohesive group, the higher the costs of votes and resources required by the politicians, and the higher the opposition from adversely affected groups, the lower will be the demand for regulation.

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(176) Posner, (1974), P.346.

5.8.10 Migue[177] summarises the theory as follows: "...given the time and money costs inherent in all political action, small groups of individuals with (large) concentrated benefits will invest more in political activities than large groups with diffused interests".

5.8.11 Peltzman[178] has developed a formal model based on Stigler's work. He maintains that "...direct political support -- ' votes' -- is the object sought directly by the regulator". An important principle he develops is that "...the costs of using the political process limit not only the size of the dominant group but also their gains". The rational regulator will develop a structure of costs and benefits that maximises his political returns.

5.8.12 Hirshlafer[179] argues that wealth maximisation, and not simply vote maximisation will be the goal of the regulators. This is because the regulators themselves are an interest group, and vote maximisation will be only part of their ultimate aim. An additional reason is that the regulator, and the vote-seeking politician are not necessarily one and the same body.

5.9 TAXATION BY REGULATION

5.9.1 Posner[180] acknowledges the value of the two prime theories of regulation (the "capture", and "public interest" theories) in his article, but maintains that neither view explains "...the deliberate and continued provision of many services at lower rates and in larger quantities than would be offered in an unregulated competitive market". He maintains that this phenomenon can only be explained if it is admitted that "...one of the functions of regulation is to perform distributive and allocative chores usually associated with the

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(177) Migue, (1977).
(178) Peltzman, (1976).
(179) Hirschlafer, (1976).
(180) Posner, (1971), P.22.

taxing or financial branch of government". The regulator will force certain firms to supply a service that a free and unregulated market would not supply, or would supply in reduced quantities. It will do this either to transfer wealth from one group to another, or because a politically dominant element of the state wishes to provide that particular product or service. The basic mechanism used is the internal subsidy, in which a firm provides a service below its real cost, the deficit being made up by certain customers of the firm who pay higher prices than they would otherwise. Were it not for the power of the state, acting through the regulatory agency to control entry, the system would not be viable, because otherwise new firms would enter into those areas where price was held artificially high, and the pure profits generated there would be competed away (and thus the original firms would not be able to subsidise the required markets).

5.9.2 Posner notes that many regulated industries provide services rather than commodities. This is because subsidised goods (rather than services) being transferrable, will tend to be sold on the free market.

5.9.3 He also notes that many regulated industries are important to the economic "infrastructure". A programme of internal subsidies need not bring about a larger total output than otherwise.

> "...it would appear that the primary effect of such a programme is not to increase the amount of transportation, communication or power produced but rather to extend the service to classes of customers and geographical areas that might not be served in a free market". "...internal subsidies are frequently designed to redistribute wealth rather than to correct imperfections in the market".(181)

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(181) Posner, (1971), P.40, P.41.

5.9.4 There are certain advantages that the internal subsidy may have as a method of public finance. It may save the administrative expense involved in cash transfers, and it may enable the adoption of simpler rate structures. In addition, by shifting taxing power from the central government to a regulatory body, there may be substantial savings of government/legislative resources. This is especially so where the regulated industry requires expert knowledge, and frequent review. Yet another advantage is that whereas taxes tend to disturb future expectations of the business and consumer sectors, the imposition of internal subsidies may be less unsettling. Lastly, there are questions of "justice" involved, in that customers in the same industry will bear the cost of a subsidy, rather than distributing the cost of a subsidy onto the tax-paying public at large.

5.9.5 Objections have been raised to the use of regulation as a public finance device. Internal subsidies tend to be arbitrary and inequitable, and also they distort the efficient allocation of resources. (It does this not only by forcing higher prices in some markets, and lower in others, but also through raising barriers to entry). However, "... there are no *a priori* grounds for assuming that... internal subsidy programmes imposed by regulatory agencies produce worse misallocations than income or other taxes".(182) Determination of the incidence of internal subsidies is complex, and therefore "If one is to oppose internal subsidies on equity grounds, it must be as part of a broader objection to the redistributive policies of the state".(183)

5.9.6 Certain problems arise in using internal subsidies as a public finance device. They may be difficult to enforce, because a firm providing an unremunerative service may reduce the quality of that service to decrease its costs, and to deceptively indicate that a decrease in demand has occurred.

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(182) Posner, (1971), P.42.

(183) *Supra*, P.43.

5.9.7 The size and effects of internal subsidies are not highly visible, and the cost of getting this information is high. This means that certain effective political groups may be able to use internal subsidies without the public knowing about it.

5.9.8 Another problem with internal subsidies is that there are no clear cut, previously set standards to use to decide on the allocation of costs and benefits.

5.9.9 Lastly, internal subsidies require a sufficiently large demand to enable regulated firms to withstand the burden of the subsidy. Where there is a strong private demand regulation may be used; but not in areas like defence and education.

5.10 ELASTICITIES OF FACTORS

5.10.1 As a result of his dissatisfaction with Buchanan and Tullock's article,(184) in which they maintain that firms requiring externality control will prefer direct (quota) controls to penalty taxes or charges, Migue(185) has introduced two new explicit determinants of regulation into the capture theories. These are the elasticities of the factors used by an industry(186) and the cohesive political power of the consumers of that industry. He maintains that regulation can be designed for the benefits of producers, consumers, or both.

5.10.2 If the supply of any resource input to an industry is price inelastic, the resource owners will be able to obtain a large portion of any government subsidy granted to its output.

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(184) Buchanan and Tullock, (1975).

(185) Migue, (1977).

(186) Note that Stigler mentioned elasticities in his 1971 article.

However, if resources are in price elastic supply, any subsidy will be dissipated among new resources entering the industry. Resources in elastic supply will, therefore, prefer barriers to entry and controls on output of the industry, rather than subsidies.

5.10.3 Citizens are individually both consumers of a broad range of goods and services produced by the economy, and at the same time suppliers of specific factors of production to specific industries. Therefore the benefits of regulation upon an industry are more likely to affect the owners of the factors in that industry, than consumers generally. "As a result, the benefits of government intervention should generally appear to voter-producers as more concentrated than the costs to voter-consumers".[187]

5.10.4 Consumers generally will prefer subsidies to barriers in any industry, because if they are powerful enough, they will be able to direct some of the subsidy to themselves. It can thus be seen how consumers, under certain conditions, will demand regulation for an industry. (Barriers to entry in an industry are therefore only likely to be raised where consumers are not powerful enough as a group, and where the factors used by an industry are in elastic supply).

5.10.5 Migue also concludes that for a regulated industry, the more price elastic are its input factors, the more protected, and therefore underdeveloped it will be; the more price inelastic are its input factors, the more subsidised and overdeveloped it will be.

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(187) Migue, (1977), P.215.

5.11 CAPITAL STOCK THEORY

5.11.1 Landes and Posner[188] explain that the US courts generally operate by producing extremely narrow and implicit resolutions to disputes. Broad rules require a string of judicial decisions for their creation. A series of these related precedents may crystallise a rule having almost the same force as a statutory rule. They treat the body of legal precedents as "a capital stock that yields a flow of information services which depreciates over time as new conditions arise that were not foreseen by the framers of the existing precedents".[189] A theory of capital stock, investment and depreciation rates is developed.

5.11.2 This method has not yet specifically been applied to regulation, and it still needs considerable development.[190]

5.12 DIRECT INFORMATION THEORY

5.12.1 P. Nelson[191] develops a theory of a "political market" containing politicians, voters and political goods, and he discusses the role of direct information in advertising by politicians. He maintains that the "track record" of political candidates gives an indication of their credibility in the eyes of voters, and candidates who make promises inconsistent with their records run the risk of losing votes. It therefore follows that most messages to the public are likely to be true. The opponents of candidates who are inconsistent or who lie will have an incentive to enlighten the public.[192] Nelson explains how advertisements will be most heavily distributed among voters who are most likely to vote for the candidates if they knew his position.

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(188) Landes and Posner, (1976).
(189) *Supra*, P.250.
(190) *Supra*, P.292.
(191) Nelson, (1976).
(192) Tullock originally developed this idea in his 1967 book, Pp.141-143.

5.12.2 Voters take a passive role in the acquisition of information. A critical variable determining voter behaviour is the character of the group from which he receives his political information. Groups will be easier to reach, and will be more homogeneous as population density increases. The greater the population density, for example, the more likely are minorities to be informed about their minority interests.

5.12.3 Nelson also explains why a minority will try to hide its gains from a majority, by making it hard for the majority to get information concerning those gains. His article implies the following, as far as regulatory behaviour is concerned:

(a) that politicians who are able to effectively direct information to a concentrated group of voters are more likely to be elected by those voters;
(b) the more cohesive, and the larger (up to a limit) the group of voters, the more likely their demands will be attended to;
(c) should such a group impose costs (regulations) upon the majority, they will have an incentive to hide those costs from the majority.

5.13 MAXIMISING WELL-BEING

5.13.1 Chant and Acheson[193] have proposed that the regulators will maximise their own well-being. There are several problems (5.2) that often crop up with regulation (such as vagueness of objectives, difficulties in interpretation of regulations, difficulties in obtaining adequate information with which to work, and the problems in measuring the effects of regulations) that will give the regulatory agency considerable freedom of operation. In spite of this "leeway", the

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(193) Chant and Acheson, (1972).

regulator has, there is no reason to expect it to operate inefficiently.[194] Therefore, the reasonably efficient skills of the regulator, according to Chant and Acheson, will be applied towards maximising their well-being. Decisions made by the agency will be designed to be as popular as possible with those groups with whom the agency works (both those who established, and who finance the agency, and those groups affected by its operations). Conflicting pressures on the agency will sometimes be evaded by its giving out confusing signals.

5.14 A COURNOT MODEL AND THE OPTIMAL NUMBER OF FIRMS

5.14.1 M.K. Perry.[195] examines the situation in which the imperfectly competitive behaviour of firms in an industry results in unexploited economies of scale by those firms. Economies of scale could be exploited with fewer firms, or competition could be fostered at the expense of economies of scale. The traditional policy alternatives in such cases are *laissez faire* (when workable competition exists "by some set of criteria") or monopoly regulation (when a "workably competitive" market doesn't exist). He maintains, however, that monopoly regulation may be "...ineffective in restraining the monopolists' pricing or may introduce inefficiencies in production".[196]

5.14.2 Another policy is required, and Perry suggests that a Cournot model may be used to reduce losses from unexploited scale economies by quantifying the nature of the tradeoff. He first calculates the equilibrium number of Cournot firms that would exist in a free entry market -- the hypothetical *laissez faire* situation. This is done for a variety of values of the two variables in his model; economies of scale, and demand elasticity. He then calculates the number

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(194) Posner, (1974), P.338.

(195) Perry, (1978).

(196) *Supra*, P.1.

of Cournot firms that would maximise consumer plus producer surplus, while using the same economy of scale and demand elasticity values. "Thus, the alternative to *laissez faire*, short of monopoly regulation, would be a set of policies designed to achieve the optimal unregulated industry structure".(197)

5.14.3 Perry's model concentrates only upon economies of scale and competition as measures of regulatory success. He assumes that the optimal number of firms depends only upon economies of scale, and elasticity of demand. He explains how these two factors are the most important determinants, but nevertheless ignores other less important determinants, such as the behavioural characteristics of firms.

5.14.4 The model also assumes that an optimal (possibly Pareto?) distribution of gains can be achieved. He suggests that consumers could be compensated for their losses from revenue obtained from proportional taxes on the profits of gaining firms, or by selling permits to firms to operate in the industry.

5.14.5 Apart from the "consumers" and "producers" dichotomy, Perry also ignores the question of gaining and losing groups in the economy. His theory assumes that regulation is initiated as a "corrective" measure by the government, and is not a result of pressures upon the government. (See 5.8; 5.15).

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(197) Perry, (1978), P.2.

5.15 DECISION GROUP GOAL THEORY

5.15.1 None of the regulatory theories discussed so far may be considered as "comprehensive", in the sense of being able to explain the provision of all regulation. Each theory tends to examine only one reason for a regulation's determination, and consequently each of the theories is unable to consistently explain all regulation to which it is applied.(198)

5.15.2 The "traditional" theories of regulation have postulated that the function of every government was to maximise some form of social welfare or utility (irrespective of whether the government was democratic, totalitarian, aristocratic or monarchist in form) and the economists concentrated their energies upon the form that this social welfare function might take.

5.15.3 These theories have been discussed by Downs, and the objectives proposed included:(199)

> "...maximise the total satisfaction in a society... (by dividing)...income on an equalitarian basis".
>
> "...taxation...should be employed...bringing about a different distribution of wealth..."
>
> "...maintenance of full employment".
>
> "...production of public goods should be carried on to the point...where the marginal satisfaction is the same from both public and private goods".

5.15.4 In his path-breaking book, Downs suggested a different approach to the analysis of governmental motives. He introduces the concept of the self interest of politicians, by

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(198) Posner, when referring to the most widely accepted of the regulatory theories (Stigler, 1971) maintains that "..the body of empirical evidence supporting the economic theory of regulation has, however, several shortcomings" (Posner, 1974).

(199) Downs, (1957), Pp.280-282.

assuming that they will have more concern for their own welfare than for that of others. He assumes that "...they act solely in order to attain the income, prestige and power which come from being in office".[200]

5.15.5 It would seem that policies designed to provide politicians with income, prestige and power will not perform the traditional functions of government discussed above. However, Downs goes on to explain that in seeking their own self interest, the politicians will provide the policies desired by the electorate. His reasoning is as follows: the politicians will not benefit from the trappings of governmental offices unless they are actually elected. They will therefore formulate their policies with the objective of winning elections, rather than any other reason. In other words, he maintains that their policies will be designed to maximise votes.

5.15.6 Downs' model is based upon six assumptions:

(a) All decisions are made by a "central unit of government" which can look at all margins of possible action.
(b) At each margin, there are only two alternatives of action.
(c) All government choices and their outcomes are independent of each other.
(d) There are only two parties competing for control of the government, one of which is now in office.
(e) Each party is aware of each individual voter's utility function, and therefore marginal policy preferences.
(f) The voters vote rationally, and they have costless information concerning the proposed government policies and their consequences.

5.15.7 Under these conditions, the government will subject each proposed policy to a hypothetical poll and choose the most popular voter preference. Unless it does this, it will be defeated by the opposition.

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(200) *Supra*, P.28.

5.15.8 There are likely to be divergences between the policies which are optimal from the point of view of the "government officials", and those which are optimal from the point of view of the community as a whole. This is not a weakness of Downs' model, because in real life such *externalities* occur. McKean[201] describes how the government officials may neglect costs inflicted or gains bestowed upon particular groups because:

(a) the inclusion of such costs and benefits may not be directly linked to the assessment of performance of the official;

(b) the affected groups may have little influence upon the officials;

(c) the officials may lack knowledge of the costs or gains, or they may have to rely upon biassed advice from various groups or institutions in the economy.

5.15.9 McKean's book postulates a process similar to that of Downs' model. He maintains that each individual will wish to maximise his "utility in life";[202] ie. not only, or even primarily selfish goals, but also moral, ethical and altruistic goals. Any decision will be subjected to a "T account" of resultant costs and benefits. An "unseen hand in government"[203] thus allocates governmental action in a manner with certain parallels to Adam Smith's "invisible hand".

5.15.10 Various other writers have elaborated Downs' model. G. Tullock has developed the roles of political ignorance, and of information and voting costs in Downs' framework,[204] and Buchanan and Tullock have elaborated variations of the model in their book,[205] including a consideration of log-rolling (which means either the trading of votes between

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(201) McKean, (1968), Pp.25-29.

(202) *Ibid*, P.13

(203) *Op Cit*, P.21.

(204) G. Tullock, (1967).

(205) J.M. Buchanan and G. Tullock, (1962).

small groups of voters, or the trading of policies by politicians with their potential voters. Its object is to provide a voter with issues he strongly desires in exchange for his support with issues he (less strongly) opposes).

5.15.11 There are several criticisms of Downs' model, based upon his six assumptions, and upon other criteria:

(a) Not all decisions are made by a "central unit of government", but rather by a limited number of people in those particular (normally senior political) positions in the government that have policy making and implementing authority delegated to them.(206) This means (depending upon the political system) that the ruling party will have a strong (if not monopoly) influence upon policy changes. Let us refer to these persons with policy changing authority as the "*decision group*". (DG).

(b) There are likely to be an infinite number of policy choices open to any government.

(c) Most of these policy choices will be interdependent, and will have interdependent outcomes (ie. trade offs will be involved).

(d) There are often more than two parties in a country.

(e) The parties are unlikely to have knowledge of individual voter utility functions.

(f) Voters may be irrational and uninformed.

Other criticisms of Downs' model are:

(g) He assumes that all parties will wish to maximise their votes. This is likely to be true of parties that are *not* in power but not necessarily so for a ruling party. Such a party will no doubt wish to maintain its position, but it may have some "surplus votes" available (ie. additional voters beyond those needed to hold it in power),

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(206) A.R. Ball, (1971), P.34.

which it can afford to lose should it wish to enforce policies unpopular with voters.(207) The party will then trade off a loss of support against other objectives. "Surplus votes" are likely to be greater when election time is a long way off, or when there is no effective opposition. For example, it is conceivable that certain DGs would deviate from vote maximising policies when bribed, or should they have a strong ideological goal.

(h) Downs' model assumes the existence of a democratic system, in that the parties' powers depend upon some form of electorate. In addition to this constraint, his model ignores the existence of non-voting groups in the economy who could have some influence upon the DG. All "*relevant groups*" (*RGs*), both voting and non-voting, must be taken into consideration by the DG in the formation of DG policies. An RG therefore has some wealth, control of the economy, political power (voting power or elected representatives) or some tool (the means to threaten or oppose) by which it can hinder or further the goals achievements of the DG. They will include competitive political parties.

RG access to the DG will be through a variety of channels -- eg.: the normal course of business, court actions, testimonies in legislative hearings, services to officials (such as research on particular issues), personal contacts, and through representatives heading opposition groups, etc. It must be remembered that the DG has less than perfect knowledge, and it is only through information obtained from its own research, and provided by the RGs that it is able to form its objectives. Special interest groups may be organised to lobby for a particular cause, others may be organised to counter the purpose of the first group -- they are all RGs.

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(207) "...there has been no need for the National Party to seek English-speaking support to ensure that the party remains in power". W. Kleynhans, in P.110 of De Crespigny and Schrire, (1978).

5.15.12 A new theory of governmental decision making will now be proposed which is likely to be particularly useful in the analysis of economic regulation.

5.15.13 The capture theories of regulation assume that various interest groups, "...struggling among themselves to maximise the incomes of their members",[208] will present their demands to the government, and that the government will supply regulations in response to these pressure groups. Downs and Stigler maintain that the government will allocate regulations in order to maximise the votes provided to it by the electorate. Others[209] have argued that the government will allocate regulations among interest groups such that it will maximise its wealth.

5.15.14 This chapter suggests, however, that the government does not just have one objective such as wealth or vote maximisation when developing regulations. The essential argument of this chapter is that the government will be guided by a series of goals that have been developed by the DG (who have been acting in their own interests) when it initiates regulations. The suggested new approach for regulatory analysis is set out below:

5.15.15 It is necessary to delimit the activities or areas to be analysed. The analysis of "regulation", for example, will prove a massive problem to handle. But the analysis of regulations circumscribing RSS may be a manageable task.

5.15.16 Next, the DG in the area of study must be identified. These people may be involved in a variety of activities. For example, there will be those who do the actual negotiating with the relevant groups (see below) in the economy, and there will be those who design the actual regulatory proposals resulting from these negotiations. The DG is also likely to include the people who have the power to ratify or veto any regulatory proposals. Hirshleifer[210] makes the point that policy making, and policy implementing must be distinguished. A mass of

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(208) R.A. Posner, (1974), P.336

(209) J. Hirshlafer, (1976).

(210) J. Hirshleifer, (1976).

5.15.19 The goals of each of the RGs must be identified. Note, however, that this must be done from the DG's point of view. Their ideals are typically likely to be: (See 7.11)

(i) To allow each of its individual members to maximise their monetary and social benefits (and consequently the political power of the group) within the existing social/economic structure. The group's political power will then in turn, bolster each member.

(ii) To propagate any ideological beliefs which the majority of its members have.

5.15.20 In 5.15.18 above, a list of DG objectives to achieve their ideals should have been identified. The importance of each of these objectives in the DG's eyes must now be assessed -- ie. each DG objective must be weighted.

This is likely to be a difficult task because the DG will seldom identify and publish its goals in the manner advocated above. In addition, few DGs will give their goals more objectivity than an ordinal ranking.

The technique used to weight the DG objectives in Chapter 7 was to judgementally apply a weight to each DG ideal; based primarily upon the (subjective) research involved in isolating each ideal. Once the ideals were weighted, the "fine tuning" was done by weighting each of the objectives under each ideal in the same manner.

The proposal to weight DG goals according to DG expenditure upon them was considered, but this approach was rejected because although the DG may have been *prepared* to spend \$x on any goal, there is no way of finding what the divergence between actual expenditure and \$x was.

5.15.21 Each objective of each RG must also be weighted. It is important to note that the weight attached to each RG goal is *not* the weight as perceived by the RG, but rather the weight as perceived by the DG.

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The same approach as above has been used for this difficult task... It will be seen in 7.11 that similar objectives and weightings emerge for most RGs. A computer model has been designed to evaluate the sensitivity of the final outcome to the variation of the different weights suggested in this chapter. This means that should the weights assigned to any goals be disputed, the relevance of such contention upon the final regulatory decision of the DG can rapidly be assessed.

5.15.22 Weights must be assigned to each RG, reflecting how the DG perceives each RG as affecting its (the DG's) goals. The more important the DG believes an RG to be upon the attaining, or not attaining of any of its goals, the greater the "relevance" of the RG.

The most important (but not the only) factor determining an RG's weight will be its size. In Chapter 7, weights are assigned to each RG according to their populations. The population-based weighting for a group may be too high if it is excluded from the democratic process (eg. the black group in SA). In such a case, the group's weight must be decreased relative to that of the other RGs until it reflects that RG's specific contribution towards or blocking of DG goals.

A population-based weighting should be adjusted if a group has relatively good, or poor access to the DG. (See 7.11).

The population-based weightings should also be adjusted if the RG's population is likely to change relative to other RGs in the future. A relatively rapidly expanding RG should be given an additional weighting by using the discounted cash flow technique used in finance, but with future populations substituted for future cash flows.[213] The resulting discounted future populations may then be used, instead of the original population-based weights. The discount rate to be used will be subjectively determined by the DG and will reflect the importance the DG places upon the achievement of its goals in the future, as opposed to the present.

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(213) See for example, G.D. Newbould, (1970), Pp.15-16.

In addition, an RGs weighting must be increased by a similar "discounted" factor if it is likely that its power in the democratic process will increase at some future date.

5.15.23 The data gathered so far is now set up as in Diagram 5B. This diagram is a representation of the way the DG "thinks" when deciding whether to implement a proposed regulation or not. Essentially, the DG will evaluate (see below) the effects of the proposed regulation upon each of its own objectives, to obtain a value A. The DG will then estimate the effects of the proposed regulation upon each RG for each of its objectives, to obtain a value of B.

If:

$$A + B > 0$$

then the proposed regulation will be implemented.

Diagram 5B. Information used in the DG Goal Theory

DG's	objectives	1	2	3	4	5	·	D
	weights							
	evaluation							

Group 1	RG 1's	objectives	1	2	3	4	5	·	R
Weight		weights							
W_1		evaluation							

Group 2	RG 2's	objectives	1	2	3	4	5	·	R
Weight		weights							
W_2		evaluation							

etc. for N RGs.

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5.15.24 Several feasible evaluation methods were examined,[214] and an approach to the evaluation of goals based upon Hill's goals achievement matrix[215] was developed. Hill suggested that various plans or policies may be evaluated through the use of a matrix set up to cover the activities of decision makers in a particular area. The columns in this matrix will consist of the goals (or more specifically, objectives) of the decision makers, the rows will be the areas (or rather RGs) affected. Both the goals and the areas (RGs) are given weightings. Hill assumes that the "costs" and "benefits" of a particular plan can be computed for each goal, for each group. Hill[216] defines "*costs*" as "retrogression from desired objectives", and "benefits" as "...progress toward desired objectives". Thus measurements are not necessarily in money units.

5.15.25 This evaluation technique may be applied to the approach to regulation suggested above. It will be discussed first under the assumption that all measurements are in the same unit (eg. money).

For DG goals	$d = 1,2,3 \ldots D$
For RG goals	$r = 1,2,3 \ldots R$
For RG's	$n = 1,2,3 \ldots N$

Implement a proposed regulation if:

$$\alpha A + B > 0 \quad \text{(The Decision Value)}$$

where:

$$A = \left[\sum_{d=1}^{D} \beta d \ (Bd - Cd) \right]$$

$$B = \left[\sum_{n=1}^{N} \sum_{r=1}^{R} \sigma n \ \epsilon r \ (Bnr - Cnr) \right]$$

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(214) Lichfield, (1970).

(215) Hill, (1966).

(216) Supra, P23.

α is an assessment by the DG of their political power (see below)

βd are the DG goal weights.

B is a benefit measure.

σn are the RG weights.

ϵr are the RG goal weights.

5.15.26 α is a value which represents the degree to which A may, or may not take precedence over B. Under a tyrannical and all powerful ruler, α will approach infinity, ie. the relevant groups will not be considered by the DG. At the opposite extreme, the value of α may be less than unity if the DG is in the middle of a democratic election campaign, and the votes of the RGs are critical to the DG's continued existence. The value of α will initially be determined in much the same way as the goal and RG weights suggested above. Once again, the computer model in Chapter 8 will be most valuable in examining a range of α values.

5.15.27 If the measurements for goals are not all in the same units, the most desirable policy may be selected using one of three methods suggested by Hill:

(a) The goals achievement account. The matrix as a whole is examined, and a subjective trade off is made between the extent of the achievement of each goal, and its weight.

(b) The weighted index of goals achievement. The incidence of each plan is summed and weighted, and the plan producing the highest sum of weighted indices is the preferred one. Each plan may be treated as an ordinal scale for the summation (although this will obviously waste precision if the data used was measured on an interval or ratio scale), using +1, -1 or 0 depending on whether the goals achievement is enhanced, decreased or unaffected. An alternative approach when interval or ratio scales are used, is to weight and sum

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each measure of achievement of the goals. The units of measurement must be subjectively manipulated to ensure that they "...are approximately of the same order".(217)

(c) Goals achievement transformation functions. Outcomes measured on one scale are transformed into units in which outcomes on another scale are measured. With quantitative data, difficulties arise if both series of data are not linear. It is a method which seems more amenable to quantitative data, but has had little practical application so far.

5.15.28 Proposed policies are individually evaluated using one of the three evaluation techniques suggested by Hill. Note that this approach can evaluate different degrees of the same policy (eg.: how much should certain government employees' salaries be raised?), and should therefore theoretically be able to find an optimal level for each policy.

5.15.29 The reader may argue that the formula suggested above has a serious flaw -- the objectives of the DG, and of the RG, will not be independent, nor unrelated. Rather, several of them will involve trade-offs with others (for example, the DG desires to contain inflation conflicts with their desire to increase defence expenditure under many policy proposals).

5.15.30 This argument is not valid, however, because the formula allows for such trade-offs. Note first of all that it is not an agency that is regulating the SA RSS, but rather it is the government itself which is directly intervening. Several writers(218) have suggested that agencies lack clear objectives, or have conflicting objectives. It is shown in Chapter 7, however, that the DG (and also the RGs) has clear

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(217) Hill, (1966), P.26.

(218) See 5.7, 5.13. See also Rees, (1979), Pp.160-168 for example.

and logical objectives, all of which steer towards, in broad terms, benefitting the DG (or RGs). Where these clear objectives do involve trade-offs with each other however, they will automatically be accommodated by the model.

5.15.31 Consider again the example of inflation versus defence, mentioned above. Assume the proposal to "build up strategic oil stocks" is being evaluated on the model. The proposal will probably positively affect the "defence" goal, and negatively affect the "inflation" goal -- the contribution towards the decision value depending upon the method of goal evaluation, and upon the goal weights. However, it can be seen that the conflict is allowed for, because the positive and the negative effects are both accounted for in separate goals.

5.15.32 It is even possible to go one step further. Assume that a proposed regulation has both positive and negative effects upon the *same* DG or RG goal. These are simply the "costs" and "benefits" mentioned in 5.15.24, and must, by definition, both be assessed and combined when setting up the model to evaluate the proposal. In summary, as long as the person setting up the model is aware of the conflicts, there is no problem.

5.15.33 The advantages of the DG-goal approach to regulation (over the other regulatory theories) is that it takes account of the plethora of (sometimes conflicting) factors which come into the determination of any regulation. Each of the other theories discussed in this chapter has concentrated on only one particular aspect of the determination of regulation. For example, the marginal approach concentrated on a balance of private and fixed marginal products; the public interest theory on the external effects in the economy requiring correction; and the rate of return theory on a "fair rate of return" for competitively powerful industries. Each of these theories,

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for example, could be included as a DG goal. It can be seen that the DG-goal theory is able to give an indication of the circumstances in which Posner's taxation by regulation theory comes into play. It also supports the incentive for secrecy that benefitting groups will have, as described in several of the theories in this chapter.

5.15.34 Of particular interest is the relationship of the DG-goal theory to Stigler's interest group theory. Stigler proposed that various groups will seek advantages from the "state", and that benefits would be allocated according to the pressures exerted on the political representatives. The new approach will separately account for the various RGs, and an improved definition of "political pressures" will be handled by the weightings allocated to them.

5.15.35 Stigler was able to specify some of the important *general* conditions that are likely to determine the demand for regulation by certain groups. However, his theory has been both supported and "disproved" in certain circumstances.[219] If, for example, regulation is promulgated with the prime purpose of providing an internal subsidy, or to serve an ideological goal of the DG, his theory will prove inadequate. In addition, Stigler's theory does not include a full account of the pressures forming a cartel or determining a regulation, in that a cartel that goes against the (major weight of) objectives of the DG will draw its opposition.[220]

5.15.36 Note that most of the policy development activities of the DG may be analysed in this same framework. Fiscal and monetary policies for example, will be developed for the benefit of the group with the power to propose and implement them. (Of course, the primary goal of such a group will normally be to ensure the "healthiest" possible state of the economy).

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(219) Posner, (1974), Pp.347-356.

(220) The prime factor determining the effectiveness of a lobbying group in the South African context is its "...legitimacy...with the government", and "...compatibility of interest group goals with government policy". (W.Kleynhans, in De Crespigny and Schrire, (1978), P.113).

5.15.37 Note also that this new theory has multiple goals, as opposed to Stigler's and Downs' single vote maximisation goal. Other criticisms of Downs' theory mentioned at the beginning of this section are also allowed for. The new theory can be used to handle any number of policy choices, even if they are interdependent. It can allow for any number of political parties and other groups. It is able, in theory, to take account of lack of perfect knowledge, both by voters and political parties. It can also be adapted to any type of political system (by adjusting α in the formula).

5.15.38 In summary, the DG has various groups and differing pressures before it. There may, for example, be a group which has formed a cartel which is lobbying for the maintenance of that cartel, and one or more negatively affected groups lobbying for its dissolution. The DG will then decide which of a variety of possible policies will be to its own maximum benefit. There is obviously an element of gaming in this process. Assume that the DG starts with a series of proposed policies, and assume that these policies become common knowledge. Each (positively or negatively) affected RG will then develop an ante-policy for each proposed DG policy. If the DG is able to gain knowledge of these ante-policies, it will obviously affect its own matrix, and the ratings for each of its proposed policies. This process can continue in a circular chain. This gaming approach has not been used in Part III of the thesis, because the required data is not available. Instead, a single evaluation is run for each regulatory proposal.

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5.16 RSS IN THE CONTEXT OF THE EMERGING THEORIES

5.16.1 Posner[221] maintains that regulation theory has not been "...refined to the point where it can generate hypotheses sufficiently precise to be verified empirically".

5.16.2 In this section, the applicability to the RSS of each of the theories discussed in 5.4 to 5.14 will be briefly examined. This will suggest an approach to the analysis of RSS regulation, and with this background, the proposed new theory in 5.15 will be used in Part III.

5.16.3 Marginal Approach. It is almost certain that the SA government has not adopted the marginal approach in the formulation of its RSS regulation. The reasons are: first, that the government must lack the knowledge required for the implementation of this rule; second, that there is no reason to assume that the government is using RSS regulation primarily as a taxation device (this will become apparent in Part III of the thesis); and third, it seems as a matter of policy that the government wishes to minimise regulation of the private sector by only interfering in cases where there are specific government objectives.[222] It is likely however, that government decision-makers do think in marginal terms when deciding on absolute regulatory levels.

5.16.4 Regulation in the public interest. Many of the individual RSS in South Africa are probably earning super-profits in view of their advantageous locations (See Chs. 4,6). However, these profits will not cause any RSS to fall under the eye of the Regulation of Monopolistic Conditions Act.[223] On the contrary, Part III will indicate that regulation of RSS in RSA has been at the direct expense of all the RSS consumers, and to the indirect benefit of only some of them.

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(221) Posner, (1974), P.356.

(222) Lombard, (1974), P.99; and 'SA in the 60's', Pp.44-45.

(223) No. 24 of 1955.

5.16.5 The proponents of the regulation in the public interest theory would argue that the costs of RSS regulation in SA are the costs of a social goal -- here the necessary security and stability of an essential commodity. A better explanation is provided by the DG-Goal Theory -- RSS regulation is to achieve specific governmental objectives (as opposed to an altruism of the government toward the public).

5.16.6 The modified version of the public interest theory, which maintains that regulation fails due to mismanagement, is also likely to be inapplicable to SA. It will be shown in Ch. 8, once the government objectives have been listed, that there is no evidence of inefficiency in their achievement. In addition, it should be noted that this "mismanagement" theory should be more applicable in those cases where the regulatory agency is a separate body from the government.

5.16.7 In his article(224) Posner raises the question of "...collusion among politicians" and suggests that powerful political groups may be able to use their power to obtain pecuniary income or impose their conception of the public interest. It is likely that the National Party has the power and cohesion to accord with Posner's theory. However, it is again suggested that the DG-Goal Theory provides an improved explanation in that through it a more closely defined reasoning can be applied to any government action.

5.16.8 Fair rate of Return. Averch and Johnson develop a theory of a monopolistic firm wishing to maximise profit, but subject to a rate of return constraint (based on the value of capital employed).(225) This theory is inapplicable to RSS for two reasons. First, the SA government does not ostensibly wish to *limit* the RSS or OC profits to a "fair rate".(226)

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(224) Posner, (1974), P.340.
(225) Averch and Johnson, (1962).
(226) See 7.5.11 for a discussion on the changing attitude of the government towards the OC, however.

Rather, it wishes to enhance and stabilise their profits to ensure that the OC continue to operate in SA. Secondly, RSS and OC regulation is not based upon capital employed, but rather upon a government-controlled OC gross margin. (See 3.5).

5.16.9 Empty Motions. Lindblom believes that many of the welfare effects of regulation are too complex for objective assessment (5.7). Indeed, it is possible that the SA government is not fully aware of the costs that RSS regulation imposes upon the consumer. However, in spite of the fact that the SA government may not have full knowledge, it has clear enough objectives to ensure that the actions it takes are not "empty motions". It is likely that this theory was directed at regulatory agencies in USA that are separate and independent of the government itself.

5.16.10 The Capture Theories. The first two capture theories discussed above have been shadowed by the improvements of Stigler's theory. They do not provide an acceptable link between the groups interested in regulation, and the emergence of that regulation. In Part III of the thesis, it will become clear that the SA government is not dominated by "oil interests" in the provision of its regulation.

5.16.11 According to Stigler's theory, the interest groups lobbying for oil regulation would be first, the OC; secondly, the RSS represented through the OC, and thirdly the RSS represented through bodies such as the Motor Industries Federation. He would maintain that the following factors would work in favour of the government providing regulation to the RSS: the large number of RSS in SA, the fact that they are already organised through their OC and the MIF, the inelastic demand for RSS fuels, the information likely available to the RSS on how regulation would affect them, and the low opposition from adversely affected groups (ie. their consumers, who have little knowledge of the effects of regulation, and who have no equally effective body to represent them to oppose regulation). It might be argued that the OC, the prime interest group, would prefer cartelisation to regulation, but Stigler would reply that in the South African situation the government would not allow private manipulation (cartelisation) of a strategic industry -- it would prefer such manipulation to be in its own hands.

5.16.12 Because the RSS and OC groups are "small", relative to the whole economy, and because the benefits of regulation to them could be substantial, Stigler would argue that the costs to these groups of obtaining beneficial regulation from the government (ie. the costs of organisation, information, assessment, and the votes and resources desired by their political representatives) would be economically justified.

5.16.13 An objection to the use of Stigler's theory in explaining RSS regulation in SA is that the obtaining of this regulation (by pressure groups) is not done in a framework which will directly, through a democratic process, affect the careers of any politicians. The pressure group will not "employ" politicians by means of votes and resources. Rather, there will be direct negotiation with the government.

5.16.14 Taxation by Regulation. Posner makes a valuable contribution to regulatory theory in that he raises the issue of regulation being used as a taxation tool via the mechanism of internal subsidies. In SA the internal transfer aspects of RSS/OC regulations were likely to have been given some weight in their formation -- it will be seen in Ch. 7 that the government gave greater weighting to others of its objectives, though.

5.16.15 It is likely that price regulation ensures a greater equality of prices throughout SA than would otherwise occur. To this extent, it is an internal subsidy mechanism. It will prohibit the OC from raising prices in one market type (probably the higher cost/lower volume rural markets) and lowering prices in another (the competitive urban markets). The state's objectives in ensuring these stable prices included, for example, the desire to transfer wealth to DG supporters and to ensure stability in the provision of an essential infrastructural service throughout the country. (See Ch. 7).

5.16.16 Another instance of RSS/OC regulation being used as a transfer device in SA may be seen in the application of UROTA requirements. UROTA requires certain RSS to supply several services that would only be supplied in lower quantities in a free market. However, UROTA requirements are relaxed in certain areas of RSA and under certain conditions -- effectively transferring wealth to them.

5.16.17 An important but indirect taxation effect of RSS/OC regulation in SA, and one of the central arguments of this thesis, is that the net effect achieved is a transfer of wealth from the general public to the government, (and to a limited extent, to the OC, the RSS, and other sectors of the economy).

5.16.18 Posner notes that the perpetrators of certain agreements will have a strong incentive to keep them secret from those on whom they impose costs -- this is also later confirmed in the SA context. (Ch. 7).

5.16.19 Elasticities of Factors. The application of Migue's theory to the SA context would lead one to conclude that resources used by the RSS are "elastic" in the long run, and that RSS consumers are not a powerful, cohesive or well-informed group. Because resources are in elastic supply, Migue would maintain that any regulatory subsidy would be dissipated among new entrants to the industry. The industry would, therefore, prefer barriers to entry, and controls on output, to a subsidy. The existence of a variety of government and OC-imposed barriers to RSS entry suggests that Migue's arguments in the SA context are valid.

5.16.20 In analysing the interest groups involved in "oil" regulation, the OCs are clearly the most coherent group -- they are few (eight) in number, have a high interest in, and benefits to gain from regulation, they have substantial monetary and information resources, and have direct access to the government. Consumers will generally prefer regulatory subsidies to barriers, because if they are able to enter the regulatory negotiations they will attempt to direct some of the subsidies to themselves. The regulatory framework for oil in SA therefore suggests that the consumer is very weak. Indeed it seems likely that there is no body to specifically represent their interests in the OC-government negotiations (except possibly the Automobile Association).

5.16.21 Capital Stock Theory. This theory is aimed at explaining the mass of legislation surrounding the (American) courts. In view of its embryonic stage of development, and also because the SA government has relatively clear regulatory objectives, (as opposed to having to rely upon objectives developed through precedents) it is not considered applicable for SA's RSS regulation.

5.16.22 Direct Information Theory. Nelson emphasised the importance of the image of the politicians in the public's eyes, and of their selling themselves as a "product" to voters, who are essentially passive.[227] His theory would maintain that certain politicians would associate themselves with RSS regulation, and that this would become an elective issue. It seems that his theory is more applicable to the US political market because RSS regulation has remained submerged as a political issue in RSA.

5.16.23 He again raises the valid point that a benefitting minority will have the incentive to hide its gains from a "losing" majority.

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(227) See also Telser's discussion (1976).

5.16.24 Maximising Well Being. As with the "empty motions" theory, it is suggested that this theory is directed towards certain regulatory agencies that are separate from, and independent of the government itself. The SA government has a clear set of objectives in providing the RSS/OC regulation, which would not allow the concessionary and compromising atmosphere that emerges under this theory. Note also, that because the regulators and the government are synonymous in SA, the application of this theory suggests the maximisation of *regulators'* well-being -- the hypothesis of the DG-goal theory.

5.16.25 The Cournot Model. Perry's model is inadequate for the analysis of RSS regulation, primarily because it is a model for the determination of the optimal number of firms in a restrictive situation -- namely, when the imperfectly competitive behaviour of firms in an industry is resulting in unexploited economies of scale. The model cannot examine the important RSS characteristic of price regulation, neither can it account for the plethora of regulations governing RSS, such as opening hours restrictions. It is suggested that Perry's model would be a useful method of examining the RSS industry, should the number of firms (RSS) in the industry be the only aspect of regulation of interest.

5.16.26 The DG-Goal theory is used as the approach to RSS regulation in Part III of the thesis.

6. PETROL SALES VOLUMES, RSS "ATTRACTIONS", AND LOCATION -- A COMPUTER MODEL.

6.0.1 *"SALES AREA"* is defined as the contour around an RSS that contains that x% of an RSS's customers which have the lowest ranked deterrence to it. Various sales areas can thus be drawn around the RSS, depending upon the value of x specified.

6.1 INTRODUCTION

6.1.1 Much of the work in this thesis so far has involved the description, and the theoretical analysis of RSS. There are certain important assumptions that have been made: for example, that total market demand is made up of independent, "small" and sometimes overlapping areas, and that only within these areas does "oligopolistic" competition exist. A quantitative and empirical evaluation of such assumptions is required.

6.1.2 The SA oil markets may be analysed at two levels: that of the RSS, and that of the OC. It is interesting to find that the individual firms at both these levels have certain characteristics which bear a close resemblance to the "ideal" cartel.

6.1.3 J.V. Koch[228] has listed the characteristics likely to lead to a successful and long enduring cartel as follows:

- (a) The number of firms in the cartel must be small.
- (b) The number of points in the market at which buying and selling takes place must be small.
- (c) The transactions of the cartel must be widely publicised in the cartel.
- (d) The transactions of the cartel must not be widely publicised outside the cartel.

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(228) Koch, (1976), P.287.

(e) Barriers to entry exist in the industry.

(f) The cost and demand structures of the cartel members are similar.

(g) The cartel faces consumers without monopsony power.

(h) If the government polices a cartel, through the regulation of some of its conditions, the incentive for members to break it is greatly reduced, making it considerably more effective than otherwise.

(i) If the market shares of the firms in an industry are unstable or falling, the incentive to collude is increased.

6.1.4 The market most likely to have these conditions favouring the formation of a cartel is an oligopoly.(229) The essence of oligopoly is the interdependence of firms in the oligopolistic market.(230) Other typical (and varying) characteristics of oligopolies are: the low number of sellers, the potential for (or existence of) price and product competition, uncertainty as to what the actions of rivals will be, the incentive to maintain barriers to entry, to divide markets, and agreement to fix prices. Their ultimate objective is to put the oligopolistic cartel in the position of a monopolist. One of the objectives of the remaining chapters of this thesis is to examine the extent to which the oil industry has achieved a "cartel" position. It will be shown in Part III that although certain regulations benefit the RSS and OC, they are primarily dominated by the government.

6.1.5 The objective of this chapter is to test the following major hypotheses:

(a) That location is the most important factor affecting the sales of an RSS.

(b) That the sales area of an RSS extends over only a "limited" area because competitive RSS are dominant sellers outside this "limited" area.

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(229) Leftwich, (1970), P.239.

(230) Koch, *Op cit*, P.280.

(c) That should more than one RSS exist within one of these "limited" areas, then those RSS will be in "oligopolistic" competition with each other.

(d) As a corollary to (c), that each RSS (and their host OC) will have strong incentives to limit competition because its effects are felt heavily by a "few" RSS, rather than being widespread.

In addition to the above tests, the various attraction factors (4.5) of RSS will be examined.

6.2 ASSUMPTIONS

6.2.1 A model should be a representation of the most important aspects of the problem under consideration. Inevitably, certain features of the real life situation will not be adequately represented. This and the following section list the assumptions and limits of the RSS computer model that has been developed.

6.2.2 The model is static, rather than dynamic in its handling of time. It is necessary to assume that the maximum hunger value for each individual customer will occur at least once during the time period covered by the model. The model in this chapter was set up using data covering the whole of 1978, and therefore this assumption will have no effect on the results. However, should the model be used for analysis over periods of say, less than a month, then certain customers who visit RSS less than once a month must all be assumed to visit RSS that month. For example, it is possible that somebody may fill his car only once every two months. The output of the model will be affected in that, although synthesised sales volumes will be correct, the synthesised numbers of customers allocated to each RSS will be too high.

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6.2.3 Another implicit assumption of the model is that all customers will have the time, during the period covered by the model, to visit the RSS of their choice. It is unlikely that the model will ever be run to cover so short a period that this assumption has any effect.

6.2.4 The problem of external interaction was introduced in 4.19. It is likely to have the greatest effect upon the model when the study area is "small", or when the RSS concerned are located on major freeways or roads in which a large portion of the traffic is likely to be "long-distance". The choice of study area for this thesis was guided by these considerations. (6.6) Neither of the two methods of minimising the effects of external interaction suggested was used, however. Cost considerations precluded the additional surveys required to increase the size of the study area, and to obtain reliable data to insert into external zones. A relatively small proportion of external customers exists in the RSS study area chosen, (8%), yet even here a sample size of 1215 customers would be required to set up one external zone with an AVD confidence interval of $\mp$ 1 km at a 95% level of significance.

6.2.5 These figures were calculated from the RSS survey as follows: Of the 300 customers in the survey, 24 (8%) were external. These customers had an AVD sample standard deviation of 5,003 km. The desired confidence interval is $\pm$ 1 km, and the desired confidence level is 95%. Emory[231] shows that the standard error of the mean is therefore 1/1,96=0,5102 and that $0{,}5102 = \frac{5{,}003}{\sqrt{n-1}}$. Therefore n = 97,155.
Because only 8% of customers are external, total sample size required is 1 215.

6.2.6 It is assumed that cij (see rank distance factor, 4.15) is an adequate deterrence function. The concept of AVD was developed in 4.3.5, but cannot be used in the model as the

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(231) Emory, (1976), Pp.149-151.

deterrence function because of the difficulty in obtaining an "average" AVD for any single customer to each of the RSS under study. The problem would be compounded when, as in this model, customers are aggregated by zone. For this reason, i to j road distance has been used as the primary measure of deterrence in this model. It is closely correlated with customer AVDs, because as the road distance from i to j decreases, so will most AVDs. Table 6A shows average customer deterrence used in the model alongside the average AVDs for each j obtained in a survey (see below). A coefficient of correlation of 0,8035 was obtained.

TABLE 6A. THE CORRELATION BETWEEN AVD AND DISTANCE DETERRENCE MEASURES

RSS	1	2	3	4	5
AVERAGE AVD	3,694	4,121	5,849	3,492	3,466
AVERAGE DETERRENCE (FROM MODEL)	14,656	14,769	15,438	13,562	13,081

Average AVD = -7,8582 + 0,83787 (Average Deterrence)
Coefficient of correlation = 0,8035

6.2.7 When a model is set up for a particular area, it is assumed that none of the characteristics of the area under study change over the period analysed. A particularly important variable in the RSS environment is trading hours. A change in trading hours will affect the relative convenience of many RSS (eg. later hours may mean an RSS a long distance from work, but on the customer's desired route, can now be reached). To assess the effect of a change in trading hours, the change in the numbers of customers residing in each i zone during selling hours must be examined.

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6.2.8 Other variables assumed constant are the season, the state of the economy, political factors, government regulation and the characteristics of the customers.

6.3 LIMITS OF THE MODEL

6.3.1 The RSS model is specifically for the determination of petrol sales, and NOT spares, vehicle or workshop sales. A recalibration of the RSS model may enable it to predict such sales, but the application of one of the gravity shopping models is likely to be more applicable, for the reasons discussed in 4.14.

6.3.2 The user must be well aware of the different types of RSS (See 3.2) when setting up the model. Both the deterrence and attraction factors will have different weightings for these different RSS. For example, customer toilet facilities will be a far bigger "attraction" for a national route RSS than a suburban RSS. For this reason, it is important that when a study area contains more than one type of RSS, a dummy variable for each type of RSS be used in the multiple regression to obtain the composite attraction variable.

6.3.3 If the model is set up in one area, the parameters obtained may not be used in another study area, because so many known and unknown variables change between different areas. (eg. cultures, habits, work types). Ideally, the model should be set up and run immediately, and not as an ongoing model unless input is continually updated. It is a static, rather than dynamic model.

6.3.4 If the model is to be used to analyse short term changes in sales, a z factor described in 4.14.6 must be used for each gaining RSS.

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6.4 TECHNICAL DESCRIPTION OF THE MODEL

6.4.1 A listing of the programme, which is written in FORTRAN IV, is provided in Appendix 1. Appendix 2 provides a description of the input required and options available; Appendix 3 provides a flow diagram. Certain aspects of the programme require further discussion.

6.4.2 Golden-section search is a method described by Wilson[232] to optimise some goodness of fit statistic. The RSS model has the option of using a coefficient of correlation, or a difference of squares as this statistic. The procedure works as follows: initially, for each of the model's parameters, a minimum and a maximum calibration parameter value is input into the model. Let these values for one of the parameters be β_1^k and β_2^k respectively, where the iterations of the procedure are represented by k. β_3^1 and β_4^1 are obtained as follows:

$$\beta_3^1 = 0{,}382 \, (\beta_2^1 - \beta_1^1) + \beta_1^1$$

$$\beta_4^1 = 0{,}618 \, (\beta_2^1 - \beta_1^1) + \beta_1^1$$

The values 0,382 and 0,618 are approximations for

$$\frac{F_{n-1-k}}{F_{n+1-k}} \quad \text{and} \quad \frac{F_{n-k}}{F_{n+1-k}}$$

where the Fs are Fibbonaci numbers defined by

$$F_o = F_1 = 1$$

$$F_n = F_{n-1} + F_{n-2}, \quad n \geqslant 2.$$

6.4.3 If R is being used as the goodness of fit indicator, Wilson shows that if

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(232) Wilson, (1974), Pp.320-322.

$R(\beta_3^k) > R(\beta_4^k)$

Then β lies in the interval

β_1^k to β_4^k,

and if

$R(\beta_3^k) < R(\beta_4^k)$ Then β lies in the interval

β_3^k to β_2^k;

6.4.4 This will provide the two new estimates for the next iteration, and the procedure is repeated. The RSS model requires the following input for the calibration procedure:

(a) An initial upper and lower estimate for each parameter.
(b) The number of golden-section iterations required for each parameter.
(c) The number of overall iterations for all parameters. This is required because the optimal value for one parameter is unlikely to remain constant as the values for the other parameters in the model are adjusted. The model optimises α, then β, and then γ individually, but the resulting values are unlikely to be optimal when taken simultaneously. Therefore, once the lower and upper limits for each parameter have been narrowed by the golden-section search the required number of iterations, those lower and upper limits are again widened, and the overall procedure is repeated. The average of the lower and upper limits of each parameter will tend toward joint optimality on a series of overall iterations.
(d) The amount by which the lower and upper limits of each parameter are widened on each parameter can be selected by the user. A value of 1.5 is suitable for an initial calibration run, and of 1.1 for "fine tuning".

6.4.5 The model allows for the insertion of a "distance to next opportunity" factor for each i to j combination (See 4.13, 4.14). Because these values may be of less importance than the deterrence function c, the user may wish to ignore this section of the model by inserting values of 0 for ATRA(I,J) and β.

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6.4.6 Use of the calibration "goodness of fit" indicators. The model has two statistical indicators for the comparison of actual versus synthesised sales at each RSS. The sum of squares D is a measure that closely parallels the least squares method used in regression analysis. Its formula is as follows:

$$D = \sum_j \left(\left| A_j - S_j \right| \right)^2$$

6.4.7 If synthesised sales are calculated while maintaining the objective of minimising D, both positive and negative deviations between actual and synthesised sales will be accounted for, and larger deviations will be given a greater weighting. If it can be assumed that p $(S_j | A_j)$ has the same variance σ^2 for all A_j, and that the means $E(S_j)$ lie on a straight line, and that S_j are statistically independent, then the Gauss-Markov theorem can be used to justify the use of this formula.(233) If the further assumption that p $(S_j | A_j)$ is normal is made, then maximum likelihood estimates(234) also justify the use of this method. Minimising the sum of squares will ensure that the two lines are as close as possible to each other.

6.4.8 The coefficient of correlation, on the other hand, is a measure of linear relation between A_j and S_j. The formula used is:(235)

$$\frac{\frac{\Sigma A.S}{N} - \left(\frac{\Sigma A}{N}\right)\left(\frac{\Sigma S}{N}\right)}{\sqrt{\left(\frac{\Sigma (A^2)}{N} - \left(\frac{\Sigma A}{N}\right)^2\right)\left(\frac{\Sigma (S^2)}{N} - \left(\frac{\Sigma S}{N}\right)^2\right)}}$$

6.4.9 The maximisation of r during the model's calibration will not ensure the minimisation of the deviations between A_j and S_j, but it will ensure that they parallel each other as closely as possible. This is because r at no stage specifically minimises

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(233) Wonnacott and Wonnacott, (1970), Pp.21-22.

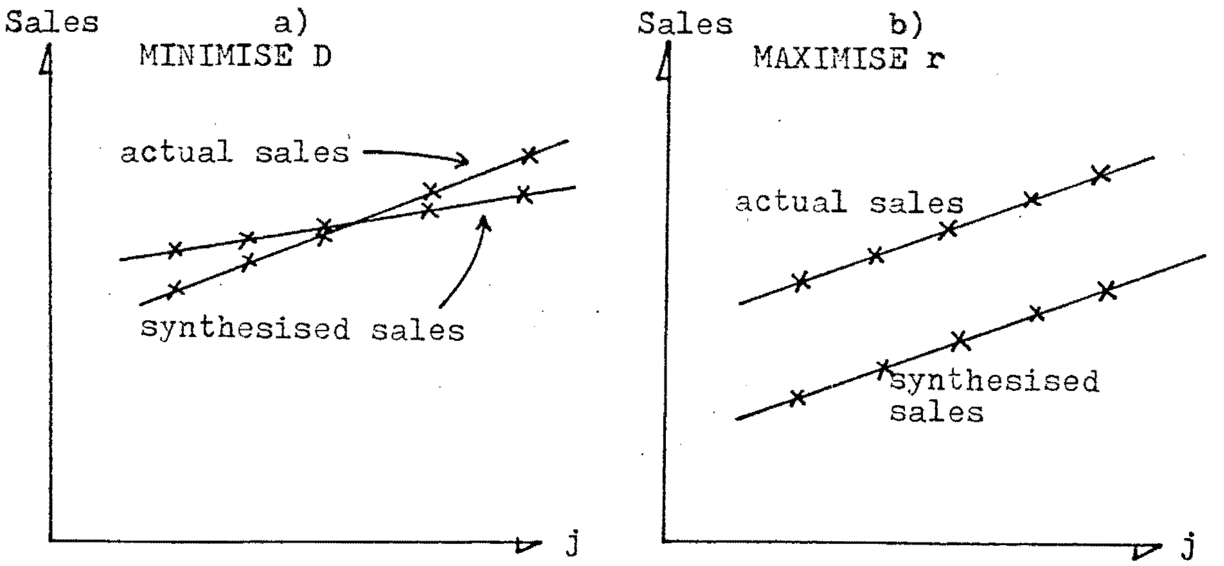
(234) *Supra*, Pp.34-38.

(235) P. Hickman and J.G. Hilton, (1971), P.298.

differences between Aj and Si. Rather it will maximise the "degree to which the variables are related".[236] Wonnacott[237] explains that the formula will (i) calculate the deviation of the A_j and the S_j from their respective means, (ii) sum each pair to indicate which cartesian quadrant they are in, (iii) ensure a common unit of measurement of these sums (standard deviations), and (iv) adjust each vector for sample size.

The difference between these two goodness of fit indicators is indicated in Diagram 6A. Their use is described in 6.5.

Diagram 6A. Comparison of Calibration Indicators



6.5 SETTING UP THE MODEL

6.5.1 The following data is required by the model, and is input according to the format in appendix 2.

6.5.2 Having selected the study area (see 6.6), it was decided that the most convenient i zones would be the enumerated sub-districts specified by the City Engineer's Department, Cape Town. These are sub-divisions of magisterial districts, used for planning purposes. The j in the model are individually located RSS, rather than zones.

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(236) Wonnacott and Wonnacott, (1970), P.103.

(237) *Supra*, Pp. 103-107.

6.5.3 The road distance from each i to each j was measured on a 1:12,500 map of the study area with an opsometer. Using this data, and the formula E79, a matrix of rank distance factors was calculated to be used as the deterrence function c_{ij}.

6.5.4 A point is required somewhere in each i, from which to measure distances. Rather than using the centre of each i, a point was judgementally determined in each i to approximate the "centre of gravity" of income. Because average incomes by i were used, this is equal to a "centre of gravity of customers". A personal knowledge of the study area was required to do this. In those residential areas that are evenly spaced with houses, the centre of the zone was used, but where houses are concentrated on one side of the zone, or where large blocks of flats exist, a subjective adjustment was made.

6.5.5 There are certain difficulties involved in defining the boundary of the study area, after the area itself has been chosen (See 6.6). Because the RSS model is a probabilistic model, no clear boundary exists. Note that the larger a study area is, the greater the number of RSS it will contain, and therefore the less serious will be this problem.

6.5.6 If the boundary is drawn too close to the RSS under study, customers that should be included will be excluded, and average sales per customer will be overestimated by the model. This will cause the consumption constant (RSS expenditure out of available income) to be too high. Conversely, if the study area is drawn too large, it will include customers who would actually patronise RSS outside the study area, causing average sales per customer to be underestimated by the model and too low a consumption constant. Ideally, the bounday should be drawn so that sales to customers residing inside the study area who patronise outside RSS are equal to sales to customers from outside the study area who patronise inside RSS. When this is achieved, the consumption constant calculated by the model should equal that obtained in an area customer survey.

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6.5.7 Because the obvious source of population and income data for the survey was the Technical and Management Services enumerated sub-districts (ESD), the study area boundary had to be based upon them. The RSS surrounding those RSS under study were linked by straight lines, to form a polygon. All ESD which had their major portion inside this polygon were included in the study area. When this was done, it became clear that certain i zones had been excluded (eg. UCT) and these were added in. The resulting consumption constant calculated by the model was 0,027.

6.5.8 The population of each customer zone is required. This was obtained from the City Engineer's Department publication.[238] Unfortunately, the most recent data available was for 1970. There has been an increase of approximately 90 dwelling units in the study area since then, (ie. approximately 340 persons), and virtually no reductions. This represents an error of $\mp$1% of the study area population.
The data was available for both white and coloured persons, and a weighted total was used.

6.5.9 Average per capita income for each customer zone is required. This was obtained for the coloured, and for the white population from the City Engineer's Department.[239] The most recent data available was for 1970, and this was updated by a factor 1,974 for whites and 2,255 for coloureds.[240]

6.5.10 Actual sales for each RSS are required. The annual sales in rand for each RSS were inserted into the model.[241]

6.5.11 A distance to next opportunity ratio was inserted for each i to j combination. The ratio was obtained as follows:

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(238) "Cape Urban Area Population by Suburb", 1970. TMS, City Engineer's Department, Cape Town.

(239) "Average Family Income in Greater Cape Town", TMS, City Engineer's Department, Cape Town.

(240) "Trends", P4.4. Vol.2, No.1, Sept.78, Bureau for Economic Research, U.Stellenbosch

(241) 26,8c/L -- a weighted average at the end of 1978.

for each c_{ij}, the c_{ij} to the next ranked j, ie. u+1, was obtained. The ratio used was:

$$\frac{c_{ij}\ (u+1,i)}{c_{ij}\ (u,i)}$$

6.5.12 An attraction value for each RSS was obtained as follows: firstly, all data was input into the model with the exception of the attraction values. Values of 1 were then inserted for the attraction values for each j, and for the upper and lower limits of the attraction parameter, alpha. The model was then calibrated using the coefficient of correlation as a goodness of fit indicator. The result was an allocation of customers to RSS based upon the deterrence function and upon the distance to next opportunity only. The essential output for this run is shown in Appendix 4.

6.5.13 Differences between actual and synthesised sales in this run are caused by: firstly, not accounting for the different attractions of each RSS, and secondly, errors and inadequacies in the deterrence function and distance to next opportunity ratio (see 4.17). Because there is no practicable means of isolating this second cause, the entire difference is assumed to be accounted for by a lack of attraction values. Hence the ratios actual sales/synthesised sales for each j are the "perfect" attraction factors.

6.5.14 If these values are now used as attraction factors, and the model is again calibrated,[242] synthesised sales for each j should exactly equal actual sales. The output from this run is shown in Appendix 5. Discrepancies between actual and synthesised sales of up to 0.2% are the result of imperfect calibration -- this particular run was allowed 11 golden-section iterations within each of six overall iterations -- requiring a little under a minute of CPU time.

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(242) Using the difference of squares as the goodness of fit indicator. On this run the minimum possible deviations between actual and synthesised sales are required (rather than the closest possible "parallel" relationship).

6.5.15 These "perfect" attraction values may now be used as dependent variables in a multiple regression, with the independent variables being the various attraction factors listed in 4.5. The predicted attraction values for each j are then inserted into the model -- the essential output for this run is shown in Appendix 6. The model is now ready to be used for the analysis of changes in the attraction independent variables, or other input data, or for predictions for hypothetical RSS sites.

6.6 THE STUDY AREA

6.6.1 The study area chosen was approximately 10 km^2 covering parts of the suburbs Mowbray, Rosebank, Rondebosch and Newlands in Cape Town, (See map in Appendix 7). It consists of five RSS and thirty-six enumerated sub-districts (ESDs) which were used as i zones. This particular area was chosen because:

(a) It is the only area in the Cape peninsula that consists of a "cluster" of RSS surrounded by an area containing no RSS. This made the definition of the study area boundary easier, and also reduced the problem of external interaction slightly (See 6.2.4).

(b) It contains five "suburban" RSS (See 3.2). This means that the study area need not be as large as would be required for the analysis of national route RSS, for example. In addition, because the RSS are all of the same type, this simplifies the multiple regression required to predict the attraction factors, because a dummy variable for each type of RSS is not required.

(c) The area is close to the university.

6.6.2 In addition to the data requirements mentioned in 6.5, a survey was made of the RSS in the study area to determine the average AVD for each RSS. This was used as an additional check

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on the validity of the model's results, which are discussed in 6.7 and 6.8.

The survey was conducted on the forecourts of the five RSS namely:

1. Hunt's, Rondebosch.
2. Robb Motors.
3. Cottage Motors.
4. Premier Motors.
5. Campground Service Station.

6.6.3 The survey dates chosen were the 9th, 10th and the 17th of October, 1978. These dates were chosen with the objective of obtaining a representative cross section of the population who visit these RSS. The 9th was a "normal" day during school holidays, the 10th was a public holiday on which a large cricket match was being played approximately 1,6 km away at Newlands on the border of the study area, and the 17th was a "normal" working day for all. The results were weighted as follows: the 9th -- 0,19, the 10th -- 0,13, the 17th -- 0,68. A total sample size of 300 was chosen, ie. approximately 60 customers for each RSS. This was ascertained after a pilot survey indicated the approximate sample size required. The final results gave the validities shown in Table 6B.

TABLE 6B[243] SURVEY AVD SUMMARY

RSS	HUNTS 1	ROBBS 2	COTTAGE 3	PREMIER 4	CAMPGROUND 5
Sample Size	62	66	53	61	58
AVD Confidence interval	$\pm$ 2km	$\pm$ 2km	$\pm$ 2km	$\pm$ 2km	$\pm$ 2km
Confidence level	99,8%	99,5%	98,6%	99,9%	99,9%
Average AVD	3,694	4,121	5,849	3,492	3,466
Sample Standard Deviation	5,0460	5,7846	5,7998	4,6606	4,3051

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(243) Confidence levels for each RSS were calculated as follows, given sample sizes, AVD confidence intervals, and sample standard deviations:

$$\alpha_{\bar{x}} \text{ (Estimate of standard error of the mean)} = \frac{\text{Sample standard deviation}}{\sqrt{N-1}}$$

$$\text{Confidence level (in standard deviations)} = \text{Confidence interval} / \alpha_{\bar{x}}$$

6.6.4 A simple questionnaire was designed to obtain each customer's AVD. It proceeded as follows: firstly, it was explained that a survey was being done by a student concerning the convenience of service stations to customers. Customers were then asked to answer three short questions: from where they had just come, (ie. the last place they turned off the car's engine); to where they were next going (similarly defined); and why they came to that particular service station.

6.6.5 The first two questions enable the calculation of AVD when plotted on a map. The third question was a brief check on the answers given to the first two, (eg. there is something wrong if the customer had an obviously high AVD, and yet maintained he came to that RSS because it was the most convenient), and it also gives a rough, but independent estimate of the importance of various attraction factors to customers. The emphasis in the questionnaire was on brevity and simplicity. The response rate was 99,3%. The results are summarised in Table 6C, and must be interpreted with caution because:

(a) A single question which solicits answers cannot be as reliable as a series of questions designed to gauge the importance of the reasons for visiting an RSS.

(b) The importance of each reason need not necessarily be proportional to the % occurrence in Table 6C, ie. for any single customer, one particular reason may exceed all others.

6.6.6 Table 6C nevertheless confirms the overwhelming importance of locational convenience, and it also highlights the importance of habit (which in many cases is also related to loyalty). (Habit was discussed in 4.2).

6.6.7 On the same days the survey was conducted, each RSS was assessed for its attractive factors. The results are presented in Appendix 8.

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TABLE 6C. CUSTOMER REASONS FOR VISITING RSS

REASON	NUMBER OF CUSTOMERS AND PERCENTAGE											
	RSS 1		2		3		4		5		TOTAL	
		%		%		%		%		%		%
Locational convenience	58	93,5	55	83,3	43	81,1	52	85,2	36	62,1	244	81,3
Habit	7	11,3	12	18,2	17	32,1	13	21,3	17	29,3	66	22,0
Credit	3	4,8	6	9,1	7	13,2	5	8,2	3	5,2	24	8,0
Hunger	6	9,7	3	4,5	5	9,4	1	1,6	3	5,2	18	6,0
Service	3	4,8	2	3,0	3	5,7	7	11,5	2	3,4	17	5,7
BRAND (Total)	4	6,5	2	3,0	2	3,8	15	24,6	6	10,3	29	9,7
Shell									6		6	2,0
Caltex							15				15	5,0
Mobil			2								2	0,7
B P	4				2						6	2,0
LOYALTY	1	1,6			4	7,5	1	1,6			6	2,0
OTHER			1		1	1,9	1	1,6			3	1,0

6.7 EVALUATION OF HYPOTHESES:

6.7.1 HYPOTHESIS: Convenience of location is the most important factor affecting the allocation of customers to RSS in the study area.

6.7.2 METHOD 1: The model is set up to represent "real life" using "perfect" attraction factors. (4.17, 6.5). The model is then rerun using the same parameter values as in the "real life" calibration run, except that all the RSS's attraction factors parameters are set to zero to eliminate their effect.

The result will be an allocation of customers based upon locational convenience only (through the deterrence and distance to next opportunity data). Identical parameters are used in this second run, because they define that particular set of RSS under study.

6.7.3 RESULT 1. The results are summarised in Table 6D, which indicate that for this particular study area, the ignoring of all the RSS's attraction factors simultaneously (ie. the concentration upon locational factors) resulted in variations of sales between 0,1% and 12,5%.

TABLE 6D. THE IMPORTANCE OF LOCATION

	RSS 1	RSS 2	RSS 3	RSS 4	RSS 5	TOTAL
Actual Sales	469 536	501 696	437 376	572 448	479 184	2 460 240
Sales based upon location only	473 179	502 444	382 793	574 557	527 267	2 460 240
Locational/actual %	100,8	100,1	87,5	100,4	110,0	100,0

6.7.4 It is likely that the above approach has underestimated the effect of RSS attraction factors, however. Note that total sales for each of the model's runs are identical. This means that during the "location" run, even though each RSS had zero attraction, the total number of customers attracted into the study area was still the same. In real life, some of these customers would have allocated themselves outside the study area -- ie. a problem of external interaction would arise. (4.19, 6.5). However, one of the objectives in choosing the study area was to minimise this problem. (External customers in the study area comprised 8% of customers). For future research, it is suggested that a larger study area be used to minimise the effect of external interaction.

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6.7.5 METHOD 2. The model is set up to represent "real life" using "perfect" attraction factors. It is then rerun using identical parameter values, but with the attraction factor for RSS 1 set to zero, other RSS retaining their "actual" attractions. The synthesised sales of RSS 1 are then compared with its actual sales to indicate what proportion is accounted for by locational factors. The procedure is repeated for each RSS.

6.7.6 RESULT 2. The results are summarised in Table 6E, which indicate that the power of locational factors to allocate customers over RSS can vary from 41% to 53% of individual RSS sales.

TABLE 6E. THE IMPORTANCE OF LOCATION

	RSS 1	RSS 2	RSS 3	RSS 4	RSS 5	TOTAL
Actual Sales	469 536	501 696	437 376	572 448	479 184	2 460 240
Sales based upon location only	249 478	240 183	180 856	266 001	224 698	-
Locational/actual %	53	48	41	46	47	-

6.7.7 The problem of external interaction is likely to be considerably reduced using method 2, because customers will most likely allocate themselves to other RSS *within* the study area, rather than outside the study area, when they are no longer "attracted" to any single RSS.

6.7.8 The difference between the two approaches is that method 1 gives an allocation of customers using locational factors only when all RSS have zero attraction at the same time, whereas method 2 allocates customers assuming only one RSS has zero attraction -- the others remain as in "real life". The answer to the question, "To what extent does location of an RSS account for the allocation of its customers?" therefore depends upon:

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(a) How many other RSS are competing for those customers;

(b) Whether the attractions of these competing RSS are eliminated, or included in the model.

The approach of method 2 is likely to be of the most value to users such as OCs.

NOTE 1: A further confirmation of the importance of location as a factor allocating customers over RSS can be seen in the survey results of Table 6C: 81,3% of customers volunteered (ie. without any prompting) locational convenience as a reason for visiting the particular RSS.

NOTE 2: The above results are also supported by those of the third hypothesis.

NOTE 3: A close relationship exists between increases in deterrence and decreases in sales of an RSS (*ceteris paribus*). When the deterrence function from each i zone to RSS 4 was iteratively increased in compounded steps of 2%, then RSS 4's sales fell, but not as rapidly as deterrence increased. The iterative series of runs on the model are summarised in Table 6F.[244]

TABLE 6F. DETERRENCE -- SALES ANALYSIS

ITERATION	1	2	3	4	5	6	7	8	9	10
% Deterrence Increase	2,0	4,0	6,1	8,2	10,4	12,6	14,9	17,2	19,5	21,9
% Sales Decrease	4,0	7,7	11,3	14,8	18,3	21,7	25,0	28,2	31,4	34,4

ITERATION	11	12	13	14	15	16	17	18	19
% Deterrence Increase	24,3	26,8	29,4	31,9	34,6	37,3	40,0	42,8	45,7
% Sales Decrease	37,4	40,2	43,0	45,7	48,3	50,8	53,3	55,6	57,9

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(244) If the logarithm of sales are regressed against the increase in deterrence, the relation: $\log_e$ (0,001.sales)=(8,23687- 1,89178(1+i)) where i is the % increase in deterrence is obtained. $R^2 = 0,9999$.

6.7.9 HYPOTHESIS: The size of an RSS's sales area is limited by competition.

6.7.10 METHOD: The numbers of customers allocated to RSS 4 will fall by more than 50% if the ratio of average deterrence from all customer zones to RSS 4 to average deterrence from all i to all other RSS increases by 50%. Most of the customers lost by RSS 4 will be located *outside* its 50% sales area contour.

6.7.11 RESULT: An increase in the average deterrence to RSS 4 by 50% (deterrence to other RSS remaining in "real life") resulted in a fall in RSS 4's sales of 61%. Table 6G analyses the customers lost by RSS 4. Row d shows the % of customers lost outside the three sales area contours examined; row e shows the % of the sales area from which these customers were lost. Row f summarises the analysis by clearly showing a greater % of "peripheral" customers to be lost to other RSS than "nearby" customers. This means that the severest competition exists on the peripheries of their market areas.

TABLE 6G. DETERRENCE -- CUSTOMER ANALYSIS

a	Sales area (x%) =	53%	78%	91%
b	Total no. of customers lost	3 871	3 871	3 871
c	No. of customers lost outside x% sales area	2 216	1 220	513
d	% of customers lost outside x% sales area	57%	32%	13%
e	% of sales area in which d were lost	47%	22%	9%
f	d/e %	122%	143%	147%

6.7.12 HYPOTHESIS: A change in the attraction value of an RSS will have its greatest effect upon other RSS located inside its original sales areas.

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6.7.13 METHOD: The original[245] 25,1%, 51,2%, and 80,6% sales areas of RSS 5 were examined when the attraction factor for RSS 5 was increased by 50%. (The attractions of other RSS remaining constant). It is shown that most of the additional customers gained by RSS 5 were already in its original sales areas.

6.7.14 RESULT: Table 6H summarises the results of this run. It clearly supports the view that RSS 5 is in competition with other RSS in the study area, and that its actions affect these RSS. (See 6.1).

TABLE 6H. ATTRACTION -- CUSTOMER ANALYSIS

a	Sales areas (x%) of RSS 5:	25,1%	51,2%	80,6%
b	Total no. of customers gained	1 973	1 973	1 973
c	No. of customers gained within x% s. area	407	858	1 461
d	c/b%. ie. % of total gain	20,6%	43,5%	74,0%
e	Nos. of RSS within RSS 5's x% sales areas	4,5	3,4,5	3,4,5
f	Index of sales area %s (base 25,1%)	100	204	321
g	Index of customer gain (base 20,6%)	100	211	359

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(245) A gain of customers by an RSS must, of course, increase its original sales area contours.

6.7.15 The sales area %s (row a) have been compated to the % customer gains (row d) by constructing an index for each. They are presented in rows f and g. It can be seen that the greatest customer gains by RSS 5 have been made in the outer sales areas. This is because most customers close (ie. with a low deterrence) to RSS 5 were already patronising it. Increased patronage was obtained from those customers to whom two or more RSS had approximately equal deterrence. To these customers, the increase in "attraction" of RSS 5 proved the turning point in their patronage.

6.7.16 Thus the major competition between RSS will be through the variation of their composite attraction factors, with the objective of gaining the customers closer to the peripheries of their sales areas (ie. on the outside of the 70-80% sales areas).

6.7.17 This result also provides further support for the first hypothesis above -- for the majority of customers, the deterrence function has proved more important than the attraction function in their RSS patronage decisions. The next hypothesis also supports the existence of this same competitive situation within sales areas. It shows how the closer RSS are to each other, the greater the competition for the SAME customers.

6.7.18 HYPOTHESIS: Should the sales area of an RSS contain other RSS (sharing RSS), those sharing RSS will have a strong incentive to eliminate the first RSS; the sharing RSS lying in the "closer" of the eliminated RSS's sales area contours will have the greater gains.

6.7.19 METHOD: The model was set up as for "real life", except that RSS 5 was eliminated. It was then recalibrated -- identical parameters could not be used because they define only the "real life" set of RSS. The allocation of customers resulting from this run was then compared with the "real life" customer allocation.

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6.7.20 RESULT: The customers previously patronising RSS 5 were allocated among RSS 1,2,3 and 4. RSS 4 is within the 25,1% sales area contour, and RSS 3 and 4 are within the 51,2% sales area contour (see Row e, Table 6H). This hypothesis maintains that RSS 3 and 4, in that order, will have the greatest % gains, (if other things are held equal).

TABLE 6I. ANALYSIS OF REMOVAL OF RSS 5.

	RSS NUMBER	1	2	3	4	5	TOTAL
a	"Real life" allocation of customers	7 074	7 140	5 643	5 996	5 064	30 917
b	Allocation of customers with RSS 5 eliminated	7 297	7 908	7 608	8 104	-	30 917
c	% gains	3%	11%	35%	35%	-	0%
d	$e^{\text{ATTRACTION}}$	2,695	2,714	3,142	2,707	2,482	

Table 6I presents the results of this analysis. As expected, RSS 3 and 4 have the highest gains. However, it was expected that RSS 4 would have a greater % gain than 3 -- in fact the gains have been identical, although RSS 4 did have a greater absolute gain. The reason that RSS 3's % gain has been as large as 4's is that RSS 3 has a higher attraction factor in the model. Row d presents e raised to the power of the attraction factor for each RSS. It is clear that the attractions of RSS are an important factor in the allocation of customers, PARTICULARLY when the RSS are close to each other. This supports the above hypothesis, because it again shows that when the importance of deterrence in the customer RSS patronage decision is low, (because the two RSS have approximately equal deterrence, or very low deterrence) the importance of the attraction factors becomes paramount.

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6.8 ADDITIONAL RESULTS

6.8.1 Certain of the attractive factors of an RSS making up the composite attractive variable in the model are controllable, ie. may be varied if the RSS concerned, or its host OC desires. It would be of considerable value to the RSS to know what the effect on its sales will be if it changes one of these "attractive elements". (See Appendix 8).

6.8.2 The method of obtaining the equation to predict the composite attraction variable has been described in 4.17 and 6.5. The "attractive elements" of an RSS will be the independent variables in this equation. The larger is the study area (and therefore the greater the number of RSS), the more observations there will be in the multiple regression equation. If there are N RSS in the study area (N observations) there may only be N-1 independent variables at the most.[246]

6.8.3 It is unfortunate from this point of view that the study area chosen contained only five RSS. The best equation obtained used only three independent variables: first, a rating based on the existence of an attractive amenity (shopping centre, school, etc.) close to the RSS; second a customer service rating; and third, the age of the RSS. The equation (t values in brackets) was:

$$\underset{}{ATR} = \underset{(-0{,}418)}{-0{,}65947} + \underset{(0{,}884)}{0{,}1388}\,ATRAM + \underset{(1{,}110)}{0{,}171888}\,SERVC + \underset{(1{,}128)}{0{,}015423}\,AGE.$$

$\bar{R}^2$ was -0,1.

6.8.4 In spite of the weakness of this predictor equation, some interesting results were obtained in Table 6J. The average of each of the attractive elements for the RSS under study was used to build a base case. The effects upon this base case of varying

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(246) Johnstone, (1963), chapters 4 and 5.

one attractive element at a time were then examined. Positive linear relationships were established between variations in the attractive elements, and base case sales. If, for example, the age of this average RSS were somehow increased by 10% from 29,4 to 32,34 years, and the ages of other RSS were held constant, Table 6J indicates that its sales would increase by 3,29%.

6.8.5 The size of the sales effect depends upon:

(a) The number of independent variables in the multiple regression equation, and their parameters.
(b) The number of RSS in the study area.
(c) The location of the RSS concerned in relation to its competitors.

TABLE 6J. THE EFFECT ON SALES OF CHANGES IN SELECTED ATTRACTIVE ELEMENTS

An independent increase of x% in one element only of ...		...will cause the RSS's composite attraction variable to change by:	...and this will cause its sales to change by:
element	x%		
1. ATTRACTIVE AMENITY	1%	0,4392%	0,32%
(For the study area, values ranged from 1 to 5)	10	4,39206	3,23
	100	43,92064	32,26
2. CUSTOMER SERVICE:	1%	0,76452	0,56
(For the study area, values ranged from 3 to 6)	10	7,64529	5,62
	100	76,45295	56,15
3. RSS AGE:	1%	0,44837	0,33
(For the study area, ages ranged from 17 to 40 years)	10	4,48379	3,29
	100	44,8379	32,93

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6.8.6 An attractive RSS has been defined in 4.17 as one which will draw more customers than its locational convenience alone justifies. The average customer AVD for an RSS will therefore be a good indicator of its attractiveness -- not a perfect one, however, because the "centre of gravity" of customers locations will affect this AVD figure. For example, should a highly attractive RSS be located in the centre of the heaviest mass of population in the study area, its average customer AVD will be lower than expected.

6.8.7 Table 6K presents these two series of attractions. The exponent of the attraction factors calculated by the model are used, because this is the form in which the model uses them. A correlation coefficient of 0,94 was obtained.

TABLE 6K. SIMILARITY OF AVD AND MODEL'S ATTRACTION

RSS	1	2	3	4	5
Average AVD	3,694	4,121	5,849	3,492	3,466
$e^{(\text{Attraction})}$	2,695	2,714	3,142	2,707	2,482

6.8.8 The model and the survey have (although not intentionally) given a crude indication of the validity of the frame, search and habit concepts (4.2).

6.8.9 The small β parameter obtained in the "real life" run indicates that the distance to the next RSS opportunity has little correlation with the decision to visit an RSS. This indicates the existence of customer habit, of limited customer search, and of customer frames of limited size.

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(a) 22% of the customers in the survey volunteered, without any prompting, habit as a reason for their RSS visit. It is expected that this figure would be far higher had a direct question been asked.

(b) This section has indicated the importance of age in determining the attractiveness of an RSS, in spite of the fact that the newest RSS in the survey was 17 years old! This indicates that *very* little is spent by customers on search to update their frames. The importance of habit was also confirmed during the survey when it was noted that a "large"portion of the customers visiting RSS 3 were "elderly". RSS 3 and RSS 1 are both 40 years old (see Appendix 8). However, RSS 1 has lost much of its original character and now has a different clientele.

6.8.10 RSS 3 and RSS 4 had the longest dealer service at 15 and 17 years respectively. The combinations of RSS age, dealer service, long service of the driveway staff, and unaltered character of the RSS apparently appeals to the older customers. It may possibly be argued that a high proportion of the elderly live in the area -- this point was not investigated.

6.9 DETERRENCE -- A DISCUSSION, AND SUGGESTED NEW LOW COST APPROACH FOR THE OC.

6.9.1 Chapter 4 developed the concept of AVD, and although this is the ideal theoretical RSS deterrence measure it was not used in the RSS model for practical reasons. (6.2) Instead, a road distance measure from customer zones to RSS was used. In spite of this apparent disadvantage, the model was adequately set up for the study area. One may conclude, therefore, that in this particular study area, working or residential proximity to RSS may be an important (possibly the most important) determinant of RSS sales.

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6.9.2 This does not discredit the AVD concept however, and particular care must be taken when using road distances in any other study because:

(a) The study area chosen was particularly suited to the use of road distances (See 6.6).

(b) A close relationship exists between AVDs and road distances (See 6.2).

6.9.3 It is likely to be an expensive, time-consuming task to set up the model for a study area containing say, ten RSS. The model in this chapter took approximately three normal working man weeks to set up, (remembering that one of the factors in the choice of study areas was ease of set-up).

6.9.4 Appendix 9 provides the details of an RSS model that is likely to be markedly quicker and cheaper to set up, especially over large areas. It will have some sacrifice in accuracy, but will be an improvement on the sales prediction methods being used by many OC at present.

6.10 HIGH CONCENTRATION AREAS

6.10.1 A phenomenon which has been observed is the existence of "pockets" of RSS in certain areas. For example, there is the inevitable "gasoline alley" in small towns on national routes; there are also "corridors" of RSS lying on the major routes into cities (eg. Voortrekker Road, Cape Town).

6.10.2 It is suggested that these high RSS concentrations emerge in single or merged high profit market areas. New RSS are attracted to these areas even if a substantial number are already there, because the existing competitors are in fixed locations, whereas the entering RSS have a choice of locations. This choice allows them to gain a "large" share of the market (until yet another RSS enters the area). The inhibition of much competition (See Ch.8) also ensures that some of the RSS, which would otherwise disappear do not.

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6.10.3 For example, assume a town on a national route has three RSS, all located in its main street, and that none of them is making outstanding profits. A new RSS may locate on the periphery of the town on the main road, and it may compete away a lucrative portion of the market. The outcome will be three RSS with "low" sales, and one RSS at the entrance to the town, with high sales (drawing the eyes of yet another potential competitor!)

6.10.4 The high concentration area concept is outside the limits of this thesis. (1.2) However, an approach to empirical evaluation could be the comparison of median and modal sales of RSS in a study area. The larger the divergence between the two within an area of limited size, the more likely the above situation exists.

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7. SETTING UP THE DG-GOAL REGULATORY THEORY

7.1 INTRODUCTION

"The interests of governments are of many kinds; oil is often the lifeblood of their economies and vital to their military security; it plays a role in external political alignments and responsibilities; it influences, sometimes powerfully, their balance of payments; it is a significant item for their tax receipts in domestic currency; and it is responsible for the creation of vested interests which often exercise considerable economic and political influence. Each government is faced with a different set of circumstances, and the relative importance of the individual ingredients varies, necessitating different weightings in the determination of the general policies to be adopted". [247]

7.1.1 The objective of this chapter is to set up the DG-goal regulatory theory of 5.15 to enable it to be used to test several hypotheses in the final chapter.[248] The DG and RGs are identified, as are their goals. Weightings are then applied to both the groups and goals. The contentious nature of this work has necessitated research in a range of areas, and a dependence upon the views of a variety of writers. If the reader is unhappy with any of the results provided in the evaluation matrices at the end of this chapter, he is asked to refer to Chapter 8, in which several major hypotheses affecting some of the evaluations are derived, using methods other than the DG goals theory. In addition, a computer model is developed in Chapter 8 to allow for the rapid evaluation of alternative values of contentious variables. This "sensitivity analysis" allows the effect of error in a variable's derivation to be seen in the final regulatory decision's outcome.

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(247) Penrose, (1968), P.23.

(248) In spite of Posner's assertation that regulatory theory has not been "...refined to the point where it can generate hypotheses sufficiently precise to be verified empirically". Posner, (1974), P.356.

7.2 LIST OF REGULATIONS AND CONSTRAINTS GOVERNING RSS/OC OPERATIONS

7.2.1 up to 1977, a variety of acts had been used to control various aspects of the oil industry -- these are summarised in 8.3. The Petroleum Products Act, No.120 of 1977, had the effect of placing most of the government's powers over the oil industry into a single Act. In addition to the specific regulations discussed below, this Act gives the government the power to manipulate the oil industry at will.

7.2.2 UROTA (Undue Restraint of Trade Act, No. 50 of 1949) To combat "...certain combines, associations and cartels which give rise to monopolies".[249]

"...the main article the minister has in mind in connection with this bill is the sale and distribution of petrol and oil".[250]

7.2.3 UROTA ensures that petrol supplies cannot be denied by the OC to a garage operator wishing to sell petrol, providing that the potential RSS reaches certain standards. UROTA was repealed by the Regulation of Monopolistic Conditions Act (No. 24 of 1955). However, it did not disappear as a regulatory force, but instead was then included in the unpublished Rationalisation Plan (an agreement between the OC and Department of Commerce -- see below).

7.2.4. UROTA applies only to RSS with pumps installed on or after 6/4/50. Major UROTA requirements are that the applicable RSS must have at least one qualified mechanic, sufficient floor space for repairs to be carried out on six vehicles simultaneously, and a range of tools. In effect, the Act ensures that applicable petrol sellers also become fully equipped repair garages. Once these UROTA standards have been met, any garage that wishes to become a petrol seller is entitled to supplies

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(249) Minister of Commerce, Hansard 23/6/49.

(250) Hansard 24/6/49.

from one of the OC. Should one of the OCs decide that the garage would be a profitable petrol reseller, and therefore desire to contract with it, the resultant RSS would then come off that particular OC's rationalisation plan quota. (See below). However, should none of the OCs want to tie that garage, it then has the right to be allocated by the Department of Commerce to one of the OCs for its fuel supplies. It then becomes known as a ROSTER RSS.

7.2.5 Note that there are two further institutions maintaining UROTA type requirements for RSS. Firstly, the MIF refuses to admit new RSS members which do not measure up to standards very similar to those of UROTA. Secondly, the various municipalities in RSA all have building restrictions and standards requiring various minimum specifications to be met.

7.2.6 The above ensure that it is highly likely that any new RSS built in RSA today is also a fully equipped repair garage, with one exception. Certain areas, notably the "country" areas, and "Bantu" areas, will have some of the UROTA requirements waived by the Secretary for Commerce upon application.

7.2.7 THE RATIONALISATION PLAN.[251] This is an informal agreement between the government, the OC and the MIF, which has been in force since 1960. It consists of a series of five year plans, in which each of the petrol wholesalers (OCs) have the number of new RSS which they may open limited by quota. The plan also allows the participants to open a limited number of new RSS, on condition that they close an equal number of nearby RSS already in existence -- such "swops" do not come off quota allocations.

Further points of note are:

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(251) See G. Kukard, Sunday Times Nov. 72. Also Financial Mail, 1st quarter 71, Survey on the SA oil industry.

(a) The plan makes provision for the Minister of Economic Affairs, at his discretion, to add further RSS to the quotas of each participant. These additional quotas tend to be used as a "reward" for companies that promote the participation of South African capital and enterprise in the oil industry. Local location and ownership of oil industry components is a specific DG objective. (See 7.5.11d).

(b) The smaller OC (Esso and Trek) are given additional quotas.

(c) The development of sites which, in the opinion of the Secretary for Commerce are in the national interest (eg. in "developing" areas) will not come off quotas.

(d) ROSTER sites do not come off quotas.

(e) In rural areas, some general dealers sell petrol -- the rationalisation plan prevents the OC from supplying equipment to a dealer if he is within a "certain" (unknown) distance from an RSS.

(f) The plan provides that there shall be no restrictive clauses in any OC/RSS contracts, other than those tying the RSS to a certain brand of fuel; ie. contracted supplies for tyres, batteries and various other accessories are prohibited.

7.2.8 <u>CONTROLS UPON THE SITING OF AN RSS</u>. The Minister of Economic Affairs, and the "local authorities" of various areas are empowered to control the location and erection of buildings, and to demolish or alter existing buildings.[252] An OC or other person wishing to build a new RSS must submit plans to the local authority for consideration. These plans are examined by all the departments likely to be concerned, eg. town planning, land survey, roads, building survey, water and electricity. Normally the local building surveyor makes the final decision as to whether the RSS may be built. However, in certain cases such as rezoning or relaxation of zones, the authority of the Administrator is required.

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(252) Sub-section (1) of Section 35 of Ordinance 33 of 1934; and National Building Regulations and Building Standards Act, No. 103 of 1977.

7.2.9 Building regulations vary depending upon the area, but typically, cover the following areas:

(a) A division of land into zones, certain of which prohibit RSS.
(b) Minimum building/land area ratios.
(c) Prescriptions of distances from main roads, and details of entrance and exit roads.
(d) Minimum parking areas.
(e) Limitations of work that may be done in certain zones.

7.2.10 It can be seen that the government therefore has a means of "channelling" new RSS development into areas that it desires. Although each case is theoretically considered on its merits, the right of veto remains as a powerful political tool should the government require. Note also that the setting of building standards constitutes a form of barrier to entry.

7.2.11 <u>PETROL PRICE AND MARGIN CONTROLS</u>. The Minister of Economic Affairs is empowered to control, *inter alia*, the prices and therefore margins of fuel products in South Africa.[253] In 3.5 there is a discussion on, and breakdown of the price structure.

7.2.12 Between April, 1971, and February, 1979, there were thirteen petrol price changes. In 1960, the OC fixed GM was approximately 1,7 c/L, and it remained unchanged until March, 1977, when it was *decreased* by 0,3 c/L.[254] The GM allowed by the Minister to the RSS has been changed in the order of once per year. However, this does not reflect the true RSS margins, as the OC normally allow the RSS some negotiated rebates. In 1977, the average RSS margin, including rebates, was more like 2,16 c/L than 1,86 c/L.[255]

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(253) Price Control Act No. 25 of 1964, Petroleum Products Act No. 120 of 1977.

(254) Financial Mail, 1st quarter 76, P.923; 1st quarter 77, P.643; 4th quarter 75, P.432. See Table 3C.

(255) Financial Mail, 3rd quarter 77, P.337.

7.2.13 Petrol price and margin changes are not promulgated by the Minister. The Department of Commerce and the OC agree upon a proposed price change, and notice is then given in writing to the OCs. A few days before the change, the OCs give notice to the RSS. The public is normally notified of the change through the various media, at the time of the change or possibly a little before.

7.2.14 CONTROLS UPON RSS TRADING HOURS, THE PRIVATE STORAGE AND TRANSPORTATION OF FUEL, AND UPON SPEED LIMITS. The National Supplies Procurement Act 1970, empowers the Minister of Economic Affairs to control the procurement, distribution and selling of a variety of goods and services. Certain loopholes in the Bill[256] were eliminated by the Petroleum Products Act, 1977. This Act gives the government unlimited powers to control the "strategic" oil industry, including complete control over the entry of new RSS.

7.2.15 Changes in RSS trading hours, prohibitions of the private transport and storage of petrol, speed limits and maximum fuel tank sizes for vehicles are normally gazetted by the minister. These regulations are aimed primarily at the private motorists, who consume 70-80% of the petrol in South Africa.[257]

7.2.16 REGULATIONS GOVERNING ADVERTISING AND SALES PROMOTION (ASP) BY THE OC.[258] The minutes of a meeting between the OC and the Department of Commerce form the basis of an agreement governing ASP. The essence of the agreement is that ASP be limited to emphasising economy, (as opposed to other factors such as power), and that chance, or game type promotions be prohibited. It is suspected that the agreement also includes limitations upon ASP budget sizes. Within this environment, each OC has the incentive to increase its advertising effectiveness, and also to police the others for transgressions of the agreement.

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(256) Certain RSS were able to sell after hours; a motorist prosecuted for speeding was acquittted because he had been going downhill at the time.

(257) Financial Mail, 2nd quarter 76, P.1135.

(258) Sales promotion refers to direct selling methods to customers, whereas advertising refers to increasing the awareness of customers, in OC parlance.

7.2.17 Note that the Petroleum Products Act now empowers the Minister of Economic Affairs to control ASP.

7.2.18 PATRIOTIC APPEALS. Although this does not fall under the definition of regulation, it should be noted that the government has made numerous "patriotic" appeals to industry and the public to conserve fuel. These appeals therefore constitute a tool in the arsenal that the government uses to control the OC/RSS. It is not known how effective these appeals are.

7.3 IDENTIFICATION OF THE DECISION GROUP (DG).

7.3.1 The objective of this section is to identify the DG controlling RSS/OC regulation, as required by the DG goal theory. (See 5.15). Particular care has been taken to attempt to identify real, rather than nominal authority hierarchies and communications lines.

7.3.2 The cabinet, (consisting only of full, as opposed to deputy ministers), is at the pinnacle of the South African governmental decision-making hierarchy.[259] Its position is illustrated in Diagram 7A, which shows the major groups in this hierarchy. The cabinet, whose members are both heads of the various state departments, and who are also members of parliament, is "...the real source of executive decisions".[260] This executive is

> "...the supreme power nucleus of the whole system of South African government and administration."[261]

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(259) B. Roux, in P.70 of D. Worrall, (1975).

(260) *Supra.*

(261) Roux, in P.64 of D. Worrall, (1975).

7.3.3 The four primary reasons for its power are:[262]

(a) The executive maintains a key role in the appointments of parliamentary and executive officials, and of judges.
(b) It initiates most legislation.
(c) It has the primary responsibility for the implementation of most legislation.
(d) The working procedures of parliament provide it with decision advantages.

7.3.4 The prime minister is initially appointed by the leaders of the majority party in parliament -- a decision which is "ratified" by the state president. The prime minister then selects his executive councillors (ministers). The majority party therefore not only has a parliamentary majority, but it has a complete control of the cabinet.

7.3.5 The prime minister is therefore "potentially the most important single political actor in the polity".[263] According to Schrire[264] South African prime ministers have traditionally been strong figures unchallenged by their colleagues. He has numerous opportunities to influence policy, and where there is no strong opposition his views will usually prevail. He also has "...several means whereby he can delay policies that he does not approve of but dare not openly oppose".[265] Of particular importance is his role as chairman during cabinet meetings. He is not all-powerful, however, and whenever he is in strong disagreement with his cabinet, he will be overruled.

7.3.6 Although the cabinet is in the supreme position on the decision hierarchy, it is obviously not the sole policy making body, particularly in matters requiring the evaluation and analysis of issues of great complexity. The expansion of modern government, and the number of complex decisions, has

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(262) *Supra.*
(263) Schrire, (1978), P.179.
(264) *Supra,* P.177.
(265) Schrire, (1978), P.177.

led to the greater use of cabinet committees in critical areas such as defence and economic affairs. (See "Public Agencies", 7.3.15). The cabinet has remained the pre-eminent policy-making body however, although the policy ratification, rather than initiation and formulation aspect should be emphasised.

7.3.7 Cabinet ministers are very important influences on policy formulation, particularly within their areas of "specialisation". Not only will they have a varying say in the policy activities of the cabinet[266] but also a decisive influence on policy matters falling within their departments.

7.3.8 The South African parliament is the "...sovereign legislative in and over the Republic".[267] It comprises a House of Assembly, and a Senate -- the House of Assembly being the more powerful of the two.[268] Membership is restricted to whites, who are elected by their constituencies.

> "...in the house itself, the majority party is the dominating force which is in turn dominated by the cabinet". [269]

7.3.9 The powers of the house are, in order of importance:[270]

(a) The passing of legislation.
(b) The control of the executive.
(c) Certain judicial decisions.
(d) The hearing of petitions.

7.3.10 The Senate consists of members elected by the House of Assembly, the provincial councillors, and by the state president. It has powers and procedures that are somewhat similar to, but restricted by, the House.[271] Roux maintains that:

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(266) *Supra*, P.181.
(267) Section 59 (1), Constitution Act, No. 32, 1961.
(268) Roux, in Pp. 48-58 of Worrall, (1975).
(269) Roux, P.51, *ibid*.
(270) *Ibid*.
(271) *Supra*, P.58.

"It has clearly been used as an instrument to further the policies of the ruling party in the House".[272]

7.3.11 The State President is

"...a nominal, ceremonial head of state";[273] and

"...an instrument of the executive council".[274]

He is elected by the House of Assembly and the Senate, and will invariably be from the majority party.[275]

7.3.12 The central administration consists of the state departments, and of other "public agencies". (See 7.3.15).

> "These institutions have been created to carry out governmental objectives but all of them also participate in various ways in the broad policy making process which eventually culminates in legislation".[276]

7.3.13 The ministers are the constitutional heads of departments. The prime controllers in the state departments are the administrators (secretaries and under-secretaries) who are often delegated considerable powers by their ministers.[277]

7.3.14 The influence of the secretary on policy varies from department to department, as will the influence of senior bureaucrats. Schrire[278] identifies three factors affecting this influence: first, the technical character of the department

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(272) *Supra*, P.62.

(273) *Supra*, P.46.

(274) *Supra*, P.47.

(275) *Supra*, P.44.

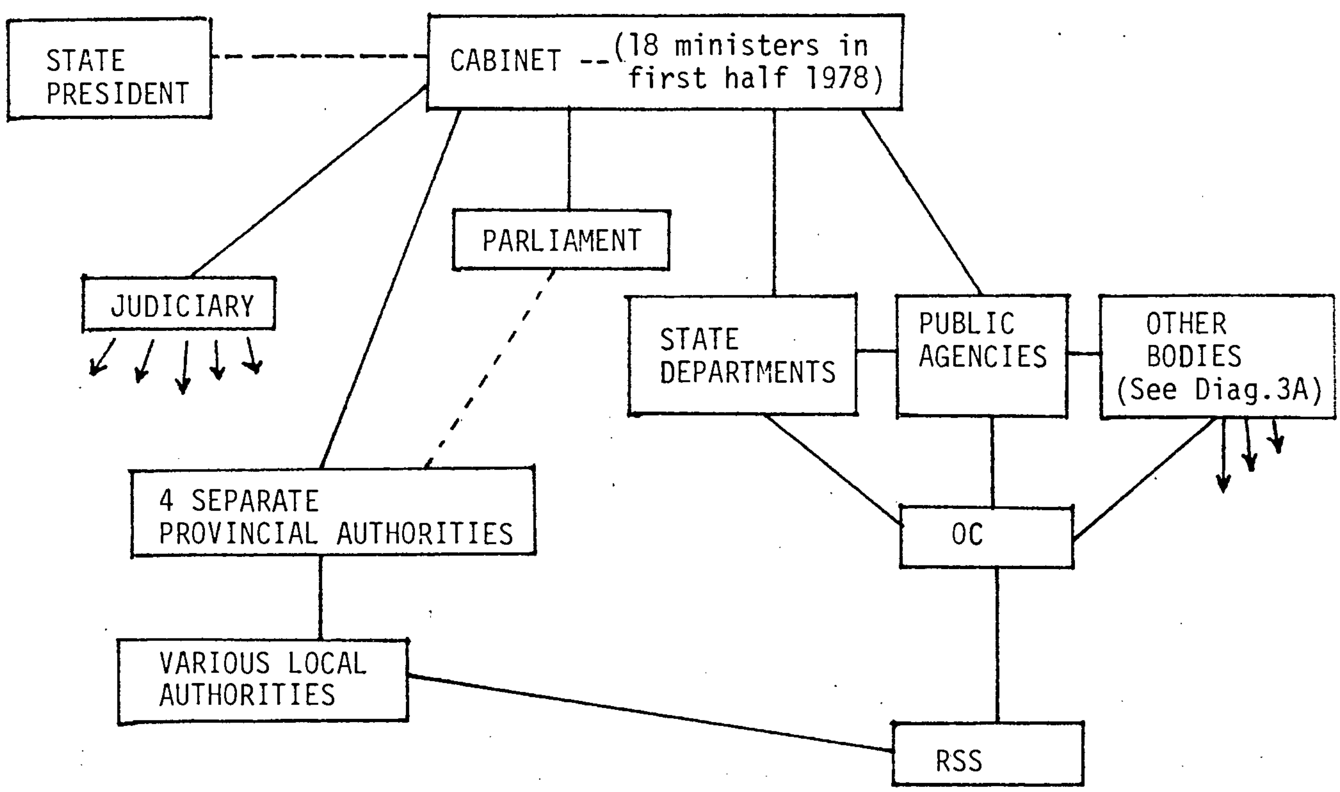
(276) *Supra*, P.80.

(277) *Supra*, P.87.

(278) Schrire, (1978), P.182.

the more technical and non-controversial the department, the more likely the secretary and his delegates will be the *de facto* policy makers. On this score, the Secretary for Commerce is likely to have considerable powers. Secondly, the larger the department, the more delegation required, lessening the influence of the minister and secretary through necessary delegation, and through the administrative workload. The Department of Commerce is a relatively small ministry, with its budgetary vote comprising 38% of the mean 1977-78 Department vote.(279) Thirdly, the character and involvement of the minister in his department are important.

DIAGRAM 7A. Outline of the DG and RG Hierarchies



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(279) Report of the Auditor General for the Financial Year 1977-78.

7.3.15 The "public agencies" in Diagram 7A consist of the following:[280]

(a) Department type state-owned and government-controlled commercial enterprises. (eg. the railways and post office).

(b) Public corporations. (eg. The Land and Agricultural Bank of SA., the Reserve Bank, the SA Iron and Steel Industrial Corporation).

(c) Agricultural produce control boards, in terms of the Marketing Act, 1937. Bearing in mind the "...rural bias of the ruling political party..."[281] it should be noted, for the discussion on the DG matrix below, that "...these boards were established to protect the interests of the producers first".[282]

(d) Special purpose control boards consisting of specially qualified persons appointed by a minister or the state president. (eg. the National Transport Commission, the Board of Censors).

(e) Advisory councils, generally created for the tendering of advice to senior political executives. There are a great variety of these boards, at both the national and the provincial level. (eg. Economic Advisory Council, Board of Commerce and Industry, Cabinet Committee on Energy Policy, Planning Advisory Committee).

(f) Councils for particular trades and professions. These boards are prescribed limited self government by a minister, and generally work in close liaison with the state department concerned. (eg. the SA Medical and Dental Council, the Apprentice Boards).

(g) Boards and Councils of a judicial nature. These boards are created when "...the ordinary courts are considered to be ineffective instruments for the realisation of certain ends..."[283] (eg. Unemployment Benefits Council, Industrial Councils).

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(280) Roux, P.99, P.109 in Worrall, (1975).

(281) *Supra,* P.104.

(282) *Supra,* P.103.

(283) B. Roux, P.105 of Worrall, (1975).

(h) National research institutions. These are special institutions which have been established outside the public service. (eg. the SA Bureau of Standards, the Council for Scientific and Industrial Research).

(i) *Ad hoc* committees and commissions. An increasing number of these committees and commissions are being used as policy advisory instruments, and for enquiries where illegal activities are suspected.

7.3.16 In 1975, there were 41 government departments, and over 100 statutory boards, councils, commissions and corporations directly under control of the cabinet. Roux[284] maintains that "...the cabinet is incapable of dealing effectively with the problem of executive co-ordination". He also maintains that there is often duplication of work. The device of special advisors at the prime minister level was used to attempt to solve the problem, but has actually aggravated it.[285]

7.3.17 The SA constitution provides that the judiciary may only challenge the right of parliament to pass legislation when such legislation affects entrenched clauses of the constitution.[286] However, the constitution provides it with the power of complete autonomy in its juridical function, protecting it from all outside interference. It has been suggested, however, that the cabinet has certain powers over the judiciary:

> "Curtailment of the judiciary's powers, decision-making by commission, complete pragmatism in inter-governmental relations, increasing participation by top officials in the policy making process..."[287]

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(284) B. Roux, P.71, P.82, *Op Cit.*

(285) *Supra*, P.72.

(286) Sections 59,108,118, Constitution Act, No. 32, 1961.

(287) B. Roux, P.29, *Op Cit.*

7.3.18 There are four separate provincial authorities in SA, each with a provincial administrator who is appointed by, and is the agent of the central authority.(288) He is responsible for ensuring that central government policies are applied in the provinces. "...South African provincial authorities have very little scope for decision-making independent of the central government".(289) The provincial administrator is chairman of an executive committee whose members are elected by the majority party. The executive committee is primarily a "cabinet" to assist the administrator. The provincial council performs a role not unlike that of the House of Assembly at the national level. The members of the provincial council are elected, and their power to pass legislation is limited to that which is "...of a merely local or private nature in the province".(290) Roux(291) has noted the increasing financial dependence of the provincial authorities on the national exchequer.

7.3.19 The local authorities consist of bodies of various sizes, powers and functions, but are no real independent authority.(292) The local authorities are empowered to pass by-laws, but subject to the approval of the provincial administrator. However, "...central government and provincial legislation has precedence over by-laws".(293)

7.3.20 Each of the regulations and constraints governing RSS listed in 7.2 was examined with the object of identifying the groups who:

(a) Did the actual negotiating with the relevant groups concerned with the proposed legislation.
(b) Designed the regulatory proposals.
(c) Ratified or vetoed these proposals.
(d) Controlled the implementation of the proposals.

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(288) B. Roux, P.110 in Worrall, (1975).
(289) *Supra*, P.111.
(290) Section B4(1) l,m, Constitution Act, 1961.
(291) B. Roux, *Op Cit*, P.33.
(292) B. Roux, *ibid*, P.116.
(293) *Ibid*, P.122.

7.3.21 The most important regulations governing the RSS and OC, the price controls and the rationalisation plan, were negotiated and designed primarily by the Department of Commerce. The Secretary for Commerce would have been directly involved at the "working" level, and he would have reported to the Minister of Economic Affairs, who presented the regulatory proposals to the cabinet. It is particularly important to note that these regulations were not promulgated as an act. Not only does this mean that the regulatory details are not available to the public, but also that parliament did not have the opportunity to use its normal powers to influence the regulations. Any special advisory bodies involved in the rationalisation proposals would have been directly under the control of the Department of Commerce.

7.3.22 UROTA was initially an act of parliament, but was repealed in 1955 (see 7.2). This suggests that various members of parliament were initially involved in the drawing up of UROTA, in addition to the persons suggested immediately above. However, the fact that it was included in the rationalisation plan after 1955 suggests that it was amended, without the inclusion of the parliamentary group (and the attendant publicity) in the new regulations.

7.3.23 Controls upon the siting of an RSS fall under the authority of the local authorities in all cases except when a policy decision has to be made. The guidelines which the local authorities may use for decision-making are received from the Department of Commerce. Thus conditions governing RSS siting, in addition to reflecting local authority objectives, will also adhere to national objectives which have been set. Initially, these national objectives would be set by the cabinet and by parliament through various acts, and thereafter would be enforced at a local authority level (with the provincial administration ensuring that the ruling party's objectives were being adhered to).

7.3.24 Price and margin controls fall under two acts. (See 7.2). The fact that petrol price and margin changes are not gazetted (unlike many other price controlled commodities: eg. bricks, steel) means that the minister retains such decisions for himself, his department, and ultimately of course, the cabinet. This is in contrast to regulations promulgated under the National Supplies Procurement Act which, although giving the minister wide powers to control the procurement, distribution and selling of a variety of goods and services, nevertheless requires him to allow parliament limited authority in the structuring of regulations which fall under it.

7.3.25 The last major area of RSS/OC governmental control discussed in 7.2 was that covering advertising and sales promotion. Once again, there is no legislation involved, and the control is an "informal" one between the Department of Commerce and the OC. The DG would therefore be the same as that constructing the rationalisation plan.

7.3.26 In summary, the major DG components involved in the construction of RSS/OC regulation are, in order of importance:

(a) The Department of Commerce, under the policy direction of the Minister of Economic Affairs. The Secretary for Commerce would appoint and guide groups for specific tasks, but such groups would have little independent decision-making authority from him.

(b) The cabinet, from which the minister receives broad policy direction, and to which he submits major policy decisions.

(c) Parliament, for those regulations in which it is involved. (Regulations which parliament has assisted in shaping will still reflect the objectives of the majority party, however).

(d) The provincial authorities, in the light of power delegated to them by the Department of Commerce.

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7.3.27 NOTE: There are allegations that the Afrikaanse Broederbond, a national society with membership restricted to certain elite Afrikaners, is a manifestation of the SA DG. "The SA government today is the Broederbond and the Broederbond is the government".(294) It is maintained that the majority of senior government posts, including the prime minister's, are held by Broederbond members(295) and also that there are close ties between the primary Afrikaans church (the NGK) and the Broederbond.(296)

The Broederbond was formed in 1918; "...one of its most important aims...the cutting of all constitutional ties with Britain and the establishment of a free, independent, republic ruled by Afrikaners".(297) Other objectives were the promotion of the Afrikaans language and culture(298) (although it is not a cultural organisation(299)), and the Afrikaans domination of SA,(300) primarily through economic control.(301)

7.3.28 It is argued that today the Broederbond might not be as influential as before 1948; for the Nationalists to "...hold the reigns of power is to hold all the power worth having".(302)

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(294) I. Wilkins and H. Strydom, (1978), P.1

(295) *Ibid,* P.2.

(296) *Ibid,* P.8.

(297) *Ibid,* P.135.

(298) *Ibid,* P.140.

(299) *Ibid,* P.145.

(300) *Ibid,* P.140.

(301) *Ibid,* P.143.

(302) Harris in Worrall, (1975), P.262.

7.4 THE DG OBJECTIVES

7.4.1 The four *ideals* listed in 5.15 were intended to be broad enough to cover the more definitive *objectives* of most DGs. An attempt is made below to isolate the major objectives of the SA (government) DG: this list will be focused upon the oil industry. Although the four ideals below are probably broad enough to cover *any* DG objectives, the list of DG objectives presented below will certainly not be comprehensive. For example, the objective of community health[303] does not have a direct enough connection with the oil industry to warrant its inclusion in the list below. Each ideal has been cited, and then a likely list of objectives for the achievement of the ideal by the SA DG .

7.4.2 In certain cases, the objectives are entirely logically derived from the ideal, but more often the objectives listed will be contentious. In such cases, an attempt has been made to obtain the consensus of various writers.

7.4.3 Note that these DG-matrix objectives suggested below will be somewhat more "selfish and personal" than the "traditional" governmental objectives mentioned (along with other theories) in Ch.5, such as:

(a) "Correcting" the divergence between social and commercial costs and benefits, or between public and private risk preferences and time preferences.
(b) "Correcting" the profits made from the exploitation of a particular resource or commodity.
(c) The redistribution of employment or wealth from one group to another.
(d) The manipulation of infant industries, industries facing structural changes, or industries which substantially affect imports or exports.

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(303) van der Merwe, P.J., P.188, in Lombard, (1972).

7.4.4 It is particularly important to bear in mind that many of the DG goals suggested below are mutually incompatible, and involve trade-offs with one another. These trade-offs will only be briefly mentioned below. However, they will be included in the evaluation matrices of 7.15 and 7.16. In 5.15.29-32 it was shown that trade-offs in goals are accommodated by the model.

7.5 DG IDEAL 1.

7.5.1 The DG will wish to secure the tenure of the positions that it already holds. "The *first* responsibility of a government is to provide a secure life for all citizens".[304] The priority of the state security goal is emphasised in this government publication. The independent development of population groups (apartheid) at times seems to be emphasised as a security, rather than ideological goal.[305]

7.5.2 Note: "State security" is a phrase on the lips of many white South Africans today. Essentially, it is a phrase which covers the security, indeed the survival, of the DG and their supporters. State security is not discussed as an ideal or objective because many of the objectives discussed below contain elements of it. It may therefore be defined as threats to DG goals.

OBJECTIVES TO ACHIEVE DG IDEAL 1.

7.5.3 The DG will wish to ensure that adequate defensive power exists to counter both its internal and external enemies.[306]

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(304) "South Africa 77", P.321. SA Department of Information.

(305) *Supra*, P.942.

(306) Barber in Leftwich, (1974), Pp.319-339.

> "The absolute essential minimal function that government must provide for any society is protection against external and internal enemies. The government *is* the group exercising dominant force; if the existing government group fails to provide protection in a trial of strength, the newcomers will then constitute the government". (307)

This view is backed, in the SA context, by de Crespigny.(308) he overthrow of the colonial governments in Angola and Mocambique, and their replacement by black (marxist) rulers, and the severe pressures that the Rhodesian DG faces in the war with black dissidents, provide a crude barometer of the pressures upon the SA DG.

7.5.4 An indication of the importance of the defence objective is provided in Table 7A.

TABLE 7A. S.A. DEFENCE EXPENDITURE (Rm).(309)

	1955	1960	1965	1970	1971/2	72/3	73/4	74/5	75/6	76/7	77/8
DEF.EXP.	39	38	192	272	317	335	472	692	948	1350	1654
% of GDP	1,0	0,8	2,6	2,1	2,2	2,1	2,4	2,8	3,5	4,4	4,8

Other defence related expenditures should also be examined, primarily:

	1976/7	1977/8
Public works on military bases:	32	46
Police and law buildings:	29	34
Police, Justice and prisons vote:	287	329

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(307) Hirshleifer, (1976), P.480.

(308) de Crespigny and Schrire, (1978), P.221.

(309) "Estimate of the Expenditure to be defrayed from the State Revenue Account". 31/3/78.

7.5.5 The imposition and maintenance of a legal framework will be an objective of the DG for two primary reasons. Firstly, it is an essential function of any government to provide a system of rights or property within which society may operate in a disciplined (and therefore more efficient) manner. Secondly, and more importantly, this legal framework is also the means by which the government will operate to achieve its goals. Several of these goals will even be achieved directly through the legal framework, for example, apartheid objectives (7.8) and controls upon the use of petroleum fuels (7.7).

7.5.6 The DG will wish to provide adequate police power to enforce the law. Certain writers believe that the distinction between the police and the military is at times blurred, with the police tending to play a military-type and intelligence role in dealing with certain groups hostile to the present DG.

> "An immense and all pervading security system has thus become an essential part and necessary buttress of the discriminatory policy of apartheid".(310)

This view has been confirmed by the government: "External security is maintained by the country's military establishment and, to a lesser extent, by its police force".(311)

Schlemmer implies that the police are an important tool of the DG in the achievement of their goals:

> "South Africa is an authoritarian society embodying considerable formal powers of coercion, sustained not only by powerful and far-reaching laws against subversion but also by administrative action by the security police outside the scope of the courts".(312)

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(310) Maud in Leftwich, (1974), P.302.

(311) "South Africa 1977", P.319. SA Department of Information.

(312) Schlemmer, in P.160, de Crespigny and Schrire, (1978).

7.5.7 The maintenance of peace, both within the productive sector[(313)] and between various groups,[(314)] will be a DG sub-objective within the maintenance of a legal framework. According to van der Merwe

> "The objective of industrial peace involves the prevention and settlement of disputes between employers and employees and the prevention of inter-racial competition in the labour sphere".[(315)]

7.5.8 Industrial peace is desired by the DG to allow the attainment of others of their goals. The scope of police and law power in SA, according to Schlemmer[(316)] reflects the "preventative" goal of the government. This is another phrase for "state security", mentioned at the beginning of this section.

7.5.9 <u>The DG will wish to ensure that supplies of "strategic" resources, particularly oil products, are secured.</u> "...an effective embargo on oil deliveries to the Republic would... cause economic hardship".[(317)] A shortage of oil could also endanger many of the DG objectives (for example, all those discussed so far, to some extent).

7.5.10 Up to the end of 1978, 90% of SA's crude was imported from Iran.[(318)] In the light of the (conflicting) DG goals of secure supply and balance of payments equilibrium (see 7.7), this was no doubt the most efficacious policy at the time. The cessation of Iranian supplies has necessitated alternative supplies of crude at higher prices[(319)] (thus negatively affecting the balance of payments -- a secure supply is therefore desirable even from the point of view of this goal).

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(313) P.J. van der Merwe in P.159, Lombard, (1972).

(314) Roux in Worrall, (1975), P.73.

(315) P.J. van der Merwe, *op cit.*

(316) Schlemmer, *op cit.*

(317) Petroleum Economist, (February 1978), P.56.

(318) The Economist, (20-26 January, 1979), P.54.

(319) "SA is paying almost R20 per barrel for its present crude oil supplied". -- The Economist, (10-16 March, 1979), P.82. This is almost 50% above "world prices". On 25 March, 1979, BBC radio maintained SA is paying R21 per barrel. It is not clear, however, whether these are average or marginal prices. The Financial Mail, 1st quarter, 1979, P.469, suggested that SA was paying R18 per barrel at that time. Additional confusion on pricing arises if SA drew on her stocks at the time of the "Iranian crisis".

7.5.11 Certain policies followed by the DG to ensure security of supply are discussed below:

(a) There is currently a large scale search for substitutes for imported crude oil.

(i) The Sasol 1 and II oil from coal plants have been built by the government with the ultimate objective of providing 25-30% of SA's hydrocarbon demand by 1980.(320) By 1982, it is estimated that SASOL will supply 30-35% of SA's demand, ie. over 4Mt pa.(321) In his 1979 budget speech, Senator Horwood maintained that the planned SASOL II extension will raise costs by R3 276m, to a total of R6b. Part of the finance will be provided by a petrol tax of 2 c/L since March 1976 (raised to 4 c/L in January 1977).(322)

(ii) It is logical to search for indigenous crude supplies -- a search which has been shrouded in secrecy.(323)

(iii) There is currently much research into petrol substitutes which could be produced in SA. For example, UCT is examining methanol-petrol mixtures (methanol could be produced from coal or wood). The possibility of using ethanol produced from sugar cane by-products, or of using methane derived from sewage is also being examined.

(b) There is considerable direct DG control over the oil industry. This is discussed in 7.6.

(c) The DG will wish to ensure the continued operation of the six international oil marketing companies in SA. Considerable value is placed upon their expertise, particularly in the international crude oil supply networks, and in their provision of high level technology (for example, refinery operation and product development).

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(320) Financial Mail, 1st quarter 1977, P.865. Also Petroleum Economist, *op cit.*

(321) Financial Mail, 1st quarter 1979, P.560.

(322) Financial Mail, 2nd quarter 1976, P.1135; and 1st quarter 1977, P.562.

(323) On 23 March, 1979, at 1315 hrs, Radio RSA announced: "...about R200m has already been spent on the search for oil in SA".

The main method of ensuring the continued operation of the OC in SA will be to ensure that they have a *stable* and *lucrative* level of profits being repatriated from SA as a result of their operations. Figures concerning profits and volume levels are not published. However, it is known that the rate of growth of petrol sales in SA up to 1973 was 10-12% pa. (see 3.5). Because of the fixed GM, it is therefore likely that OC petrol profits were increasing at a rate close to this estimate at that time. In the last three years, petrol volumes have not grown. In addition, the OC have been recovering 0,4 c/L less than they should have been since June 1975, according to their 1960 agreement with the Department of Commerce.(324) On top of this, the OC GM was cut by 17% in 1977, (Table 3C), and there has been rapid cost inflation in SA. (See also Table 8D).

There are two deductions that can be made, in the light of the fall in OC profits that must to a large extent have been allowed by the DG *Firstly*, it is possible that the DG believed that the profits being earned by the OC were "excessive" ie. higher than required to ensure their continued operation in SA. The fact that no OC have ceased operations in SA since 1973 in spite of the profit fall tends to confirm this. It should also be remembered that even if one or two of the OC did "pull out" of SA, the DG would still benefit from the operations of the four or five remaining. It is also interesting to note that during this decade increasing political pressure has been exerted upon the international companies operating in SA, (for example, the American Polaroid company ostensibly withdrew in 1978) and that no OC has yet bowed to this pressure. Rather, the OC have become very "community" and "change" conscious.(325)

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(324) Financial Mail, 4th quarter 1975, P.432.

(325) For example, see Shell's publication "Shell's Involvement in Social and Public Affairs in SA" Dec. 77.

imported. The second method of encouraging a South African located refinery is to prevent "excessive competition", and to raise the prices of refined petroleum products above world market prices. This is the normal route, he maintains. Adelman notes that some consuming country governments may have difficulty with such a policy because of the effects upon internal price levels, and therefore of international competitiveness; and also because consumers may be organised enough to resist such controls. Adelman's suggestion is hypothesised and tested in 8.3.27.

(e) Another method of insuring against oil supply cut-offs will be the building up of stocks of oil products. The SA DG has built up "large" stocks (of unpublished size) of state financed crude oil.[329] The vote for the strategic oil fund in 1976/7 was R139m, in 1977/8 was R257,4m, and in 1978/9 was R271,5m.[330] Consumers are currently paying 11 c/L into the strategic oil fund.[331]

Apparently[332] disused coalmines are used for storage, and the stocks are sufficient for two to three years consumption. The DG also requires the OC to hold and finance stocks of oil products.[332/333]

7.5.12 <u>The DG will desire to develop harmonious international economic relations</u>,[334] particularly from the point of view of obtaining a high credit rating, promoting exports, and obtaining imports of products she cannot produce herself.[335] . Their major objectives, according to Barber[336] are:

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(329) The Financial Mail, 1st quarter 1979, P.78, maintains that the strategic oil reserve consists of 45Mt.

(330) "RSA Estimate of the Expenditure to be defrayed from State Revenue Account", 1977/78 and 1978/79.

(331) Financial Mail, 1st quarter 1979, P.662.

(332) Petroleum Economist, (February 78), P.56.

(333) P.R. Odell, (1974), P.184.

(334) "South Africa 77", SA Department of Information, P.942.

(335) H.J.J. Reynders and J.C. van Zyl, P.72 of Lombard, (1974).

(336) J. Barber, Pp.319-320, in Leftwich, (1974).

> "...identification and cooperation with the western powers; a leading role in Africa; an extensive network of economic contracts; military security with special concern for Southern Africa and the surrounding oceans; and the right to determine internal policies without external interference, and in particular to preserve white rule".

International trade represents a major portion of SA's economic activity.(337) In particular, SA plays a major economic and military role among the surrounding less developed countries.

> "The SA Government believes that its activities in Southern and sub-Saharan Africa are directly related to...(undermining) the attacks of the Afro-Asian states and (restoring) friendship and mutual confidence with the western states".(338)

7.6 DG IDEAL 2.

7.6.1 To maximise DG political support and political power.
Before the objectives under Ideal 2 are listed, there will be a brief discussion of the views of various writers on the subject of white power and wealth in SA.

7.6.2 The DG will normally adopt policies designed to please its supporters. However, the success of such policies in terms of further DG support will depend NOT on the *actual* effects upon these people, but rather upon their *perception* of the DG's role in producing these effects.

7.6.3 The SA DG supporters are essentially the white, capitalist electorate -- primarily the Afrikaans-speaking. (See below). It is generally agreed(339) that these groups wish to ensure the continuance of an economically powerful and prosperous white supremacy, although several writers(340) believe that the emphasis is now on survival, rather than prosperity.

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(337) *Ibid.*

(338) *Ibid,* P.326,331,335,338.

(339) See Bromberger and Barber in P.65 and P.319, Leftwich, (1974). Also Worrall, (1975), P.348,and Moodie, (1975), Pp.x-xi.

(340) See Bromberger and Maud in Leftwich, *op cit,* P.69 and P.292.

7.6.4 There is also a controversy on the effect of growth and prosperity upon the economic and political position of the whites vis-a-vis the blacks. Writers such as Johnstone(341) believe that white supremacy and general prosperity go hand in hand, whereas a "reformist" school(342) maintains that they are alternatives, and not complements.

7.6.5 Johnstone's essential argument is that the whites have used their political supremacy to ensure high wages for white workers by keeping blacks unskilled by limiting their geographical and occupational mobility, and have ensured higher profits in the white-owned productive sectors by ensuring a cheap labour pool using methods such as pass laws, long contracts and a denial of trade union rights.

Wolpe(343) maintains that

> "The development of capitalism in SA was based upon an abundant supply of cheap black labour, the flow of which was ensured by the underdevelopment of the limited land available to Africans".

7.6.6 Legassick(344) argues that the white farmers and mine owners were instrumental in preventing the emergence of an African rural bourgeoisie. The maintenance/attainment of a prosperous farming community may be accepted as a DG objective.(345)

7.6.7 However, Bromberger(346) (a "reformist") believes that Johnstone's allegation of legal and effective black educational bars is wrong. He prefers to lay emphasis on the inherent social and economic educational bar resulting from the average

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(341) Johnstone, (1970). See also Maud, *supra*, Pp.289-310.

(342) For example, O'Dowd, Horwitz and Adam, discussed by Maud, *op cit*, Ch. 9.

(343) In P.93 of Leftwich, (1974).

(344) *Ibid.*

(345) van der Merwe C. in P.138, Lombard, (1972).

(346) In P.61, Leftwich, (1974).

black's circumstances and background. He also argues against the legal wealth and income bars proposed by Johnstone, again suggesting that the causes of the relative black poverty, and overall decreases in black incomes are of a social/economic rather than political nature.[347] Bromberger notes that the real private earnings of blacks in urban areas have actually increased between 1950-1970, when the incomes of the African population as a whole were declining.

7.6.8 There are other "reformist" writers in addition to Bromberger who argue that the dominant white group will eventually make political concessions to other groups. O'Dowd[348] believes that there will be a normal pattern of development "...from minority rule, through a liberal era, to a welfare state.."[349]

Horwitz suggests that "...economic rationality urges the polity forward beyond its iedology".[350]

This view is backed by Adam.[351]

7.6.9 The reformist arguments are based upon the tenet that ideological racial criteria will eventually be superceded by colour-blind pragmatism. Maud[352] strongly criticises this reformist view. He believes the "historical legacies" and social features of South Africa are not as flexible as suggested, and that the fight for white survival rather than prosperity also acts in favour of the status quo.

7.6.10 Writers such as Sadie[353] and Arkin[354] believe that the white trade unions have to a large extent been responsible

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(347) *Ibid*, P.80.

(348) *Ibid*, P.287.

(349) *Supra*.

(350) *Supra*.

(351) *Supra*.

(352) *Ibid*, Pp.289-309.

(353) *Ibid*, P.86.

(354) In P.162, Worrall, (1975).

for this black-white wage gap. The white trade unions operate within the framework provided by the Industrial Conciliation Act; they have not only been instrumental in maintaining high white wages but have also ensured considerably higher levels of white employment than otherwise.(355)

7.6.11 Bromberger has agreed that Johnstone's view is historically correct(356) but that this relationship need not have, and in future will not be correct. He sees today's economic growth as requiring more semi-skilled labour, which will therefore create a demand for blacks to be further trained. This argument applies primarily in an urban, rather than rural or mining context. He also argues that many whites will prefer security and stability rather than extra wealth, and will therefore trade off additional wealth against (a) a more settled and stable urban community and, (b) settled and stable rural black communities (independent homelands). (See 7.8).

OBJECTIVES TO ACHIEVE DG IDEAL 2.

7.6.12 <u>The DG will wish to maximise the net present value of the earnings, profits and wealth accruing to its supporters.</u> This will be done through the mechanisms outlined above. The redistribution of wealth and employment will also be done by more direct transfers: "...white farmers have benefitted from an elaborate apparatus of state subsidies and other supports".(357) In addition to using taxes and subsidies, the government may, for example, exert its influence on the locational decision for a large new plant, or it may control prices in an industry. (See discussion on Posner's internal subsidies in 5.9). Ultimately a government can directly intervene in the operations of an industry, controlling the sources, processing, storage,

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(355) *Supra.* Also Leftwich, (1974), P.86; and P.J. van der Merwe in Lombard, (1972), P.158.

(356) In P. 106, Leftwich, (1974).

(357) Welsh, in P.263 of Leftwich, (1974).

distribution and marketing aspects. The objectives of such a high degree of control will usually not only be wealth and employment redistribution, but also the control of a strategic or developing industry, the manipulation of the balance of payments, or the provision of an essential commodity or service for economic development.

7.6.13 It is suggested here that the RSS have been used by the DG as a transfer mechanism. It is a DG goal to ensure the widespread provision of petroleum products throughout SA. It has been seen in 7.2 how concessions have been made to the rationalisation plan requirements in certain rural areas -- effectively therefore, a transfer of wealth to those areas. More importantly, price controls also act as a transfer mechanism. The transfer of wealth to one group will, *ceteris paribus*, rouse the opposition of all other groups -- this objective therefore involves a trade-off.

7.6.14 <u>The DG will wish to minimise involuntary unemployment among its supporting groups.</u>

7.6.15 <u>The DG will attempt to maximise the value of its supporting groups' votes.</u> There is widespread belief in South Africa that the Nationalist Government has structured the boundaries of several electoral constituencies to maximise Nationalist support -- an allegation difficult to prove either way. Welsh maintains that:

> "The political strength of the farmers has been augmented by a feature of the electoral system which, in effect, makes a platteland vote worth more than an urban one".(358)

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(358) Welsh, in Leftwich, (1974), P.263.

7.6.16 <u>To gain the patronage of groups and individuals that oppose the DG.</u> The DG, as the group representing a white minority, could never hope to gain the support of the black majority. Their efforts to woo additional supporters will therefore be concentrated on the opposing whites.[359]

7.6.17 Kleynhans[360] maintains that

> "...there has lately been a growing stream of English-speaking voters who either apply for membership (of the Nationalist Party) or support the party at the polls".

He believes that much is being done to woo the English, including the appointment of English-speaking cabinet ministers and senators. Nevertheless, he maintains, only a minority of English-speaking voters support the Nationalist Party.

7.6.18 <u>To decrease the political power (and wealth and social status) of groups that continue to oppose the DGs.</u>

7.6.19 The primary opposing group is that of the blacks in South Africa. The effects of white policies on them have already been discussed. The coloured people of South Africa, concentrated mainly in the Cape, have also been subjected to exclusion from the political process.[361] They have not identified with the vast body of Africans in SA in their opposition to the Nationalist government, but rather have become a separate group.[362] Their language (Afrikaans) and culture have enabled them to establish themselves in a stronger economic position than most Africans, but they are still subject to a deprivation of political and social rights.[363]

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(359) Moodie, (1975), Pp.285-287.

(360) In P.110, De Crespigny and Schrire, (1978).

(361) Worrall, (1975), P.222.

(362) *Ibid*, Pp.222-223.

(363) Rex in Leftwich, (1974), P.57.

7.6.20 The Asians in South Africa initially entered the country to work as indentured labourers on the Natal sugar plantations. They built up "...their own recognised occupational specialisation and consequentially social rights..."[(364)] but were subjected to apartheid after the 1948 Nationalist government emerged. The Asian leadership initially saw "...little advantage in co-operation with other non-white organisations..,"[(365)] although in 1949 a formal alliance of objectives was made between the South African Indian Congress and the African National Congress.

7.6.21 De Crespigny[(366)] believes that the interests of the whites on the one hand and the coloureds (particularly) and the Asians on the other are not irreconcilable within a common polity. Coloureds, he maintains, will increasingly make common cause with the blacks and even identify themselves as blacks, but if they enjoyed the same legal rights as whites they would soon become rather less concerned with advancement of the interests of non-homeland blacks.

7.6.22 The fourth group opposing the current South African DG is a portion of the whites, notably from the English-speaking segment. Moodie[(367)] maintains that it is from the

> "...English-speaking South African elite who have equally vested interests in the status quo comes whatever meaningful liberal opposition to racism that continues to exist in white South Africa".

7.6.23 The English opposition to apartheid poses a policy dilemma to the Afrikaans Nationalists. At the one extreme, it is suggested that

> "...all those who protest against or violate the apartheid goals of Afrikaner nationalism are sooner or later seen as mortal enemies against whom any measures may be adopted to ensure their pacification". [(368)]

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(364) *Ibid*, P.58.

(365) Worrall, (1975), P.227.

(366) De Crespigny, (1978), Pp.210-211.

(367) Moodie, (1975), P.xi.

(368) Maud in Leftwich, (1974), P.294.

And at the other extreme: "...popular opinion since the Republic -- especially among younger Afrikaners -- has been in favour of co-operation with the English".[369]

7.6.24 The fifth major "group" opposing the DG may be considered as the various pressures outside South Africa which would like to see the SA DG deposed. The main components of this external group will be (a) the blacks, particularly those in black-ruled countries, and (b) Communist, and to a lesser extent socialist powers, particularly those who actively support the black opposition to SA's DG. This group has been discussed in 7.5.

7.6.25 The SA DG will have little ability to decrease the political power, wealth and social status of these external groups. At present, there is rather more of an emphasis on compromise with them. Limited trade even occurs with SA's hostile black-ruled neighbours.

7.6.26 To gain direct control of strategic areas of the country/economy, with the objective of increasing DG economic and military power. In the RSS/OC regulatory context, such strategic areas will include: major policy decisions regarding imports of oil products, and their refining, storage, distribution and transportation; the power to set price controls; and the power to commandeer petroleum products for military purposes. There will be an incentive to maintain secrecy concerning the extent of the controls, in order to minimise opposition to them. These controls are reviewed in 7.2. (See also the importance of local ownership to the DG, discussed in 7.5).

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(369) Moodie, (1975), P.287.

7.6.27 To increase the number and importance of policy decisions that the DG is able to make by reducing the number of policy decisions made by non-ruling-party members, and by minimising the delegation of policy decisions (and where delegation is made, by ensuring it is only to ruling-party compatriots).

7.6.28 It will also be logical for the DG to ensure that the implementation of its policies is under its control, or in the hands of DG supporters.

7.6.29 Several of the objectives designed to achieve other ideals will also work towards the achievement of Ideal 2. For example, any policies followed by the DG to impose and maintain the Afrikaans culture (Ideal 4) are likely to lead to further DG support from the Afrikaans portion of the electorate. Because however, Ideal 4 is a DG goal *per se*, it is examined separately.

7.7 DG IDEAL 3

7.7.1 The DG will wish to ensure the net long term growth of the monetary and social benefits that it obtains from its position.[370] This ideal is ranked after "state security" in "South Africa 77".[371]

OBJECTIVES TO ACHIEVE DG IDEAL 3:

7.7.2 Stable and long term growth and development of the economy (and therefore its *tax base*). Note, however, the discussion in 7.6, in which certain writers maintain that economic growth and white supremacy are alternatives and not complements. If the views of such writers are correct,

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(370) Self interest may not only comprise a desire for high income and sweeping powers, but it may take such forms as competition for the best service, or a striving for professional status by means of excellent work. (See McKean, (1968), P.13).

(371) "South Africa 77", SA Department of Information, P.942.

economic growth, if it is a goal, will be coupled with a stronger enforcement of the apartheid doctrines in order to maintain the dominant white position.

7.7.3 Economic development is likely to be a goal because:

(a) Such development is likely to increase the DG's own political support, particularly if the general population is able to identify its development with the ruling party concerned. (Conversely, if a group is able to identify its lack of development with a ruling political party, this will fire its opposition). The Nationalist party, since it came to power in 1948, has "...led South Africa through the greatest economic boom in its history...white South Africans...have reaped the main fruits of that boom".[372] Van der Vyver maintains that an electorate will be reluctant to initiate radical changes in times of prosperity -- reform rather comes from hardship. Although the boom has come to an end, the white electorate is still an extremely prosperous group. One method of maintaining such prosperity is to transfer wealth to them (7.6); a second is to promote general prosperity.

(b) Economic growth is normally synonymous with the growth of the tax base. A larger tax base is of direct social and financial benefit to the DG, in addition to providing increasing finance for the means by which the DG power and security is maintained. (See 7.5). The DG will wish to use those revenue raising or rent capturing devices which have the lowest negative effects in terms of DG goals. There will be an incentive to spread the tax burden widely, and also to ensure that the greatest tax incidence is on those groups which are least able and likely to oppose them.

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(372) Van der Vyver in de Crespigny and Schrire, (1978), P.245.

The low elasticity of demand for petroleum fuels, and their tax structure have been discussed in Ch.3. Taxes on petrols raised the substantial sum of approximately R600m in 1978.(373)

7.7.4 It is likely that the DG will wish to ensure that *economies of scale* and more "efficient" allocations of resources in various industries, should their potential exist, are realised.(374) The most likely industries for such state intervention will be those which comprise a relatively "large" portion of GNP, those with "few" firms, and those that are already under some degree of government control -- normally because of their "strategic" importance. The oil industry is a prime example.(375)

7.7.5 It must be remembered that to ensure economies of scale, the required reduction in the number of firms can only be obtained at the expense of a reduction in the competition in that industry. The trade off between competition and economies of scale that the DG faces have been examined by Perry, and are discussed in 5.14.

7.7.6 The DG believes in the maintenance of a free enterprise economy to ensure the continued creation of wealth and long term improvement of living standards. De Crespigny(376) believes that a restrained free enterprise economy (as opposed to a *laissez-faire* state) will achieve this. The Minister of Economic Affairs was reported as saying(377)

> "We believe strongly in the virtues of an economic system based on free enterprise and would like to leave as much scope as possible for the private sector..."

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(373) 5 500 ML (See 3.5.2) x 10,4 c/L (See Table 3C) = R572m. This excludes railage charges.

(374) The efficient use of local resources - See S.J.Kleu, in P.98, Lombard, (1972); and "South Africa 77", Chapter 21.

(375) The success of the DG in achieving this goal can be seen in a quote from The Financial Mail, 1st quarter, 1975: "...average (RSS) throughput in SA is already the highest in the world, four times more than in UK, for example".

(376) De Crespigny and Schrire, (1978), Pp.214-216.

(377) The Argus newspaper, 27/9/78.

7.7.7 There are various economists however, who believe that the "public interest" has a heavier weighting, and who remain sceptical of the government's avowed promotion of free enterprise.[(378)]

7.7.8 Lombard[(379)] believes there is some confusion in the private productive sector as to the extent the government wishes to intervene. Kleu[(380)] maintains that the government will interfere with those industries rendering "essential services", with "natural monopolies", and where "competition would be wasteful of resources".

7.7.9 The costs of regulation were discussed in 5.3. In ensuring an efficient allocation of resources in the economy, the DG will obviously wish to avoid high costs imposed through government interference.

7.7.10 The *balance of payments* is of great importance in the determination of oil industry policy.[(381)]

> "The growth opportunities of our economy are directly affected by the state of our balance of payments which, in turn, is to a large extent influenced by our foreign expenditure on crude oil".[(382)]

The balance of payments effects of oil imports are of concern to the DG; however, other aspects of foreign trade policy also help determine oil industry policy. According to Reynders and van Zyl,[(383)] SA's foreign trade policy embraces all measures involved in influencing and organising its economic relations with other countries. This will include areas such as resource allocation (often resource protection), the balance of payments, the changing of domestic consumption patterns and the exploitation of foreign markets.

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(378) Arkin in Worrall, (1975), P.158.

(379) Lombard, (1972), P.237.

(380) *Ibid*, P.98.

(381) "SA 77", *op cit*, P.951.

(382) Minister Heunis, "Motorist", February 1976.

(383) In Lombard, (1972), Pp.63-64.

> "The maintenance of external balance or, equivalently, the maintenance of balance of payments equilibrium is generally regarded as one of the most important macro-economic policy objectives of modern government".(384) "...it would appear that SA has been under almost continuous pressure to achieve short term balance in its external accounts throughout the post war period".(385)

7.7.11 Major factors affecting balance of payments equilibrium have been the "level of gold and other foreign exchange reserves", (which are to a large extent determined by imports and exports), gold production (which is related to the external gold price, and the rate of exchange), capital inflows, and the level of domestic spending. Policy has to a large extent been related to the level of foreign reserves, which the character of the "open" SA economy requires to be kept at "substantial" levels.(386)

7.7.12 Nearly 100% of SA's crude oil is imported; at an estimated cost of R1 575m in 1978 (see 3.5.1) this represented 16% of the total import bill; it is the largest single import item. Details of crude oil import growth rates for SA are not published, but the growth rates of crude oil prices (see Table 7B) provide an indication of the strains that have been placed on the balance of payments after 1973. The fact that in early 1978 the Ministry of Economic Affairs estimated that petrol conservation measures had resulted in a 22% savings,(387) indicates the priority of the DG's foreign exchange saving objective.

7.7.13 The maintenance of balance of payments equilibrium involves a complex interrelationship of DG goals and trade offs. Restrictions on petroleum imports will have direct repercussions on SA's economic growth and development, and on the level of business confidence.(388) Fuel restrictions will have a particularly adverse effect on the activities of many white South Africans, which the DG will wish to avoid. ./...

(384) *Ibid*, P.85.

(385) *Ibid*, P.89.

(386) *Ibid*, P.85.

(387) Financial Mail, 1st quarter 78, P.70.

(388) Fuel restrictions and control measures have so far fallen primarily on the private rather than productive and government sectors -- see 7.15.8.

TABLE 7B: CRUDE OIL PRICE ESTIMATES

	1945	1950	1957	1960	1965	1968	1969	1970	1971	1972
Market Price, Current $/barrel	1,05	1,65	2,08	1,50	1,17	1,83	1,27	2,00	1,65	1,85
Market Price, 1975 $/barrel	3,28	3,86	3,92	2,68	1,96	2,78	1,84	2,70	2,20	2,38

	1973	1974	1975	1976	1977	1978	1979
Current $/barrel	(June) 2,70	(May) 9,55	(Oct) 11,51	(June) 12,70	(June) 13,20	(June) 13,70	(March) 23,60
1975 $/barrel	3,26	10,62	(1975 ave) 11,30	(6) 12,07	(7) 11,66	(7) 10,12	(9) 16,67

NOTES:

(1) Prices up to 1975 are based on a Table on Page 46 of "Paying for Energy", Twentieth Century Fund, Dec.75.
(2) Based on the price of Arabian light 34º at Ras Tanura.
(3) Based on long term, rather than short term tanker rates, where applicable.
(4) The considerable price variations in this table are discussed in Pp.44-52 of "Paying for Energy", *ibid*.
(5) The figures up to 1975 exclude any premium which SA might have been paying.
(6) Financial Mail, 3rd quarter 1976, P.1136.
(7) See 3.5.1.
(8) See Table 3B for COL conversions from 1976 onwards.
(9) See 7.5.10.

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7.7.14 The balance of payments goal will also be related to the DG security of resources goal (see 7.5). The DG may be prepared to trade off a higher price for petroleum products against additional security of supply. "It is officially admitted that the price paid for Iranian crude is higher than that paid by other customers".[389] The building of the Sasol plants provides further evidence here -- at present they produce products at a premium over world prices, although it is expected that in the future they will be competitive with OPEC prices.[390]

7.7.15 Other DG goals that might be jeopardised by oil import restrictions are discussed in this section (an underutilisation of oil industry capacity, particularly of refineries, may occur), and in 7.5 (there may be pressures on the maintenance of an orderly trading environment).

7.7.16 The DG will attempt to *contain inflation.* It will be seen that this objective exists primarily because of the negative effect that inflation has on other DG goals. It could therefore, have been included as a sub-objective of several of those mentioned above, but for the sake of a more explicit handling, it will be discussed separately.

7.7.17 The primary objection to inflation by the SA DG is its debilitating effect on economic growth and development.[391] Monetary stability, far from being an alternative to economic growth, is a condition for it. Inflation has a distorting effect on the propensities to save and invest, and hence on resource allocation. A policy of accepting inflation is likely to lead to difficulties in controlling its rate.

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(389) Petroleum Economist, (Feb. 78), P.56.

(390) Financial Mail, 1st quarter 1979, P.662.

(391) Lombard, (1972), P.28.

Long term inflation will also affect certain groups in the economy more than others. Groups with "fixed" incomes (typically pensioners) will suffer, as will the incomes of those employees of large institutions who do not have the power (usually via trade unions) to maintain their economic positions. Inflation may also have a negative effect on the balance of payments objective. When inflation exceeds the rate experienced by trading partners, a deficit will be produced, or the currency will depreciate. This may lead to exchange controls, with a consequent misallocation of resources,[392] or to rising import costs, which will further feed the *overall* rate of inflation unless the export sector is able to achieve immediate compensating economies of scale (which is unlikely).

7.7.18 The inflation containment goal particularly will involve a trade off with other DG goals. The objectives under Ideals 1 and 2 will, for example, tend to be inflationary as they are pursued with more vigour -- (See Table 7A).

7.8 DG IDEAL 4.

7.8.1 To fulfil ideological or other principles which the DG itself has.

There is a "...duplication of the ethos of the Dutch Reformed Church amongst the undisputed rulers of SA".[393]

7.8.2 Afrikaans religious objectives. "The Calvinist theory of politics assumes in a very actual manner the subordination of all aspects of life to God's will..."[394]

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(392) *Ibid*, P.29.

(393) Harris in Worrall, (1975), P.262.

(394) Worrall, (1975), P.207.

> "Calvinist principles at the bottom of the Afrikaner's political conceptions, so setting Afrikaners...apart from the rest of society".[395]

7.8.3 The Afrikaners believed they were the

> "...Calvinists of Western European origin and a nation in their own right before the arrival of the English".[396]

7.8.4 Moodie outlines the pressure from England on the Afrikaners during the early 1800's.[397] "Bowed down under 20 years of British oppression, the Afrikaners at length rose up and went out of the Cape Colony..."[398] -- the Great Trek. He describes the fighting with the black indigenous on the trek, and thereafter the "pursuit" of the colonial office. The discovery of gold in the Transvaal, and the pouring of the "curmudgeons" of the empire into Johannesburg was another Boer setback. After the Jameson Raid of 1895, negotiation failed in the face of continued British provocation, and the Boer War (1899-1902) was declared. There was tremendous Afrikaner suffering during this war, and 26 370 women and children died in British concentration camps.[399] Upon victory, the British adopted a policy of strengthening the English population in SA.[400]

7.8.5 The Afrikaners believe that their suffering in the Great Trek and the Boer War was not a sign of God's rejection, but rather of his testing -- "...an honour to be accepted and glorified as the seal of God's election".[401]

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(395) *Ibid.*
(396) Moodie, (1975), P.3
(397) *Ibid*, Pp.3-4.
(398) *Ibid*, P.5.
(399) *Ibid*, P.18.
(400) *Ibid*, P.10.
(401) *Ibid*, P.13.

7.8.6 They also believe that as a group they will be rewarded in the future for their past suffering.

> "This hope transformed the suffering of the present by an exalted anticipation which sanctified them. Thus English speaking prejudice and discrimination proved God's election and at the same time ensured the separate existence of the Afrikaner consciousness. Maintenance of this separation became a sacred duty".(402)

> "Thus, in defence of its sacred mission, all those who protest against or violate the apartheid goals of Afrikaner nationalism are sooner or later seen as mortal enemies against whom any measures may be adopted to ensure their pacification...build up of repressive forces...eminently justified and rational".(403)

7.8.7 It can also be seen from the above, how imperialism became linked with capitalism in the Afrikaner's mind.

7.8.8 The question that arises is -- does the "bourgeoisie" Afrikaner today understand, and believe in his religious (and cultural) history? It is suggested here that many of the Afrikaner goals (see also 7.8.9 below) in addition to being ideological, are in fact more practical means of promoting Ideals 1-3. "In SA, the Dutch Reformed Church is undoubtedly more than a mere interest group".(404)

7.8.9 <u>Afrikaans nationalist objectives</u>. Worrall(405) believes that the Afrikaners have evolved as a cohesive nationalist group because of their common historial background, language, religion, experience of military defeat and historical frustration of economic inferiority. He believes the two outstanding motor forces of Afrikaans nationalism are their language, and economics.

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(402) Moodie, (1975), P.14.
(403) Maud in Leftwich, (1974), P.294.
(404) Harris, in P.256 of Worrall, (1975).
(405) Worrall, (1975), P.183.

7.8.10 The most important aspects of the development of the Afrikaner group will be briefly discussed below, in order to provide a framework for their present objectives.

7.8.11 Worrall describes the first organised pressure to reorganise the Afrikaners as a group during the late 19th century, primarily in the face of the anti-Afrikaans laws promulgated during that century.(406) The Anglo-Boer War (1899-1902) "...exacerbated rural dislocation and decline, forcing many (whites) to move to the towns".(407) By tradition, the Afrikaners have been the farmers of SA, and by the beginning of the 20th century they were the noticeably poorer sector of the white society in SA.(408) This situation for the Afrikaner worsened up to the time of the great depression, when many rural Afrikaners had been forced to move into urban areas. In 1910, 20% of Afrikaners were town dwellers; by 1936 the proportion was 40%.(409) The English, by contrast, had long been a highly urbanised group who dominated commerce and industry, and, until the 1940's, the upper echelons of the public service.(410)

7.8.12 A greater unification of the Afrikaans people occurred after the Anglo-Boer War,(411) but it was not until the 1930's that a true Afrikaner ideology emerged over the prime barrier of geographical differences in political and economic interests.

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(406) *Ibid.*

(407) Welsh, in Leftwich, (1974), P.250.

(408) Worrall, *op cit*, P.184.

(409) *Ibid.* In 1974 80% of white SA farmers were Afrikaners -- Welsh, in Leftwich, (1974), P.263.

(410) Welsh, *ibid*, P.251.

(411) Worrall, (1975), P.184.

7.8.13 When the nationalist party came to power in 1924 under Hertzog, they adopted the objectives of entrenching the colour bar in industry, and the realisation of a "two stream" concept of SA nationhood.(412) Several important acts were promulgated at this time to augment the position of the whites *vis-a-vis* the blacks. Examples are the Industrial Conciliation Act of 1924, the Wages Act of 1925, the Mines and Works Act of 1926, and the Land Act of 1936.(413) In 1938, Hertzog announced Die Stem as the national anthem, among various moves to bolster the Afrikaans language in the face of English opposition.(414) Worrall maintains that: "The progress of the National Party in successive general elections is essentially due to...the hardening of political allegiances on language lines".(415)

7.8.14 In 1939 the United Party came to power under Smuts, and it was not until 1948 that the Nationalists emerged as the ruling party. "...the principle of language equality for which General Hertzog had so dedicatedly campaigned was replaced by the advocacy of the supremacy of the Afrikaans.(416) Afrikaans educational, cultural and business institutions have actively promoted the Afrikaans language.(417) The great improvement in the Afrikaner's economic position has resulted in social and economic changes, and thus changes in the character of Afrikaans nationalism. Afrikaners have been reconciled to the free enterprise system, and their businessmen are less ethnically oriented -- although not

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(412) *Ibid,* P.198.

(413) The Land Act is regarded as a watershed in the apartheid process, designed to ensure the continuance of group cultures. See N.J. Rhoodie, (1969), Pp.49-50.

(414) Worrall, *op cit,* P.203.

(415) *Ibid,* P.185.

(416) *Ibid,* P.207.

(417) *Ibid.*

specifically attempting to reconcile with the English group either. Certain of the Afrikaner unity, and church influence has disappeared.(418) SA's becoming a republic in 1961 removed an important prop of the Afrikaner unity.(419)

7.8.15 It is likely that the Afrikaner objectives of white labour supremacy, the dominance of the Afrikaans language, ethnic and religious unity, and a prosperous farming community are still rigorously followed today. But the emphasis has changed from one of consolidation and marshalling of support to one of survival. The homeland policy attempts to ensure geographical segregation of ethnic groups, and de Crespigny(420) maintains it is a DG objective to ensure that they become independent and economically viable societies. Apartheid is essentially designed to ensure the continuance of the group's own cultures.(421)

7.8.16 In May 1961, the prime minister Dr H.F. Verwoerd was quoted as saying:

> "We do not only seek and fight for a solution which will mean our survival as a white race, but we also seek a solution which will ensure survival and full development -- political and economic -- to each of the other racial groups. We want each of our population groups to control and govern themselves... the transition stage...is our policy of separate development".(422)

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(418) Worrall, *op cit*. P.212.

(419) *Ibid*, P.216.

(420) De Crespigny and Schrire, (1978), P.220.

(421) Moodie, (1975), P.266.

(422) Kleynhans in Pp.109-110, de Crespigny and Schrire, (1978).

7.9 SUMMARY OF DG GOALS, AND THEIR WEIGHTINGS

7.9.1 A summary of the DG objectives identified above is provided in Table 7C. In order to obtain the weighting for each objective, a weight was first allocated to each ideal. These were obtained on a judgemental basis.[423]

DG Ideal 1 : Weight 45%. The DG will wish to secure the tenure of the positions that it already holds.

DG Ideal 2 : Weight 28%. The DG will wish to maximise its political support and power.

DG Ideal 3 : Weight 17%. The DG will wish to ensure long term growth of the monetary and social benefits that it obtains from its position.

DG Ideal 4 : Weight 10%. The fulfilment of DG ideological and other principles.

7.9.2 Note that Ideals 1 and 2, with 73% of the total emphasis of all DG goals, reflect its desire to entrench itself.

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(423) i.e. The "indirect" approach to weight determination, as suggested by Hill, (1966), P.27.

TABLE 7C: DG OBJECTIVES : SUMMARY AND WEIGHTINGS

REFERENCE	OBJECTIVE	WEIGHTING (as a %)
7.5.3	Adequate defence	20
7.5.5	Maintain legal framework	12
7.5.9	Security of strategic resource supply	9
7.5.12	Harmonious international economic relations	4
7.6.12	Maximise DG supporters' NPVs	3
7.6.14	Minimise DG supporters' involuntary unemployment	3
7.6.15	Maximise DG supporters' votes value	4
7.6.16	Gain additional support from DG opposition	1
7.6.18	Minimise value of votes (and also NPVs) of DG opposition	4
7.6.26	Control strategic areas of country/economy	7
7.6.27	Maximise number and importance of DG policy decisions	6
7.7.2	Stable, long term tax base growth	7
7.7.4	Efficient use of local resources	1
7.7.10	Maintain balance of payments equilibrium	5
7.7.16	Minimise inflation	4
7.8	Impose and maintain Afrikaans culture	10
		100%

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7.10 IDENTIFICATION OF THE RELEVANT GROUPS (RGs)

7.10.1 An RG was defined in 5.15 as a group which must be taken into consideration by the DG in the formulation of its policies. It is closely related to, but more broadly defined than the interest group concept used in political science,[424] which is defined as a number of people, or association(s), who are trying to influence public policy in their own direction, or affect the behaviour of society, while themselves not becoming involved in the governing of the country.[425] It can be seen that an RG is therefore broader than an interest group, in that it will include not only those who are *actively* attempting to affect government policy, but also those passive groups that the government must take into consideration in developing its policies.

7.10.2 Four major factors which are identified by Harris[426] as affecting SA interest groups are discussed below. (They will obviously also affect RGs.)

(a) Legal restrictions. In SA, some types of interest groups are restricted by law. The potentially powerful trade unions, for example, are restricted by job reservation and registration limitations.[427] Many other acts limit the political and social activities of various groups in a wide range of areas.[428]

(b) Race. In SA, many interest groups are based on race, although there is a surprising "...frequency with which certain interests transcend race".[429] Because of the government's racial objectives (7.8), it will tend to break down the broad RGs before it by racial classification.

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(424) Harris, in Worrall, (1975), Pp.253-260.

(425) *Ibid*, P.259.

(426) *Ibid*, Pp.260-264.

(427) *Ibid*, P.261.

(428) Horrel, (1978).

(429) Harris, *op cit*. P.260.

(c) The presence of certain unusual groups at the "highest levels of the land..." may result in "...pressures which are antipathetic to the norms and values of the ruling class in SA society (meeting) a reception more hostile than would normally be expected elsewhere". These unusual groups are primarily the Dutch Reformed Church, and the Afrikaner ethos expressed through organisations such as the Broederbond.[430]

(d) The government's attitude. "South African interest groups need not expect government to react in a whole-hearted way to their efforts, unless the efforts of the group are in accordance with the policies of the cabinet".[431] Harris explains how the government tends to act aggressively, rather than passively, towards groups before it.

7.10.3 The net effect of these four factors is that many interests that would, *ceteris paribus*, emerge as interest groups in the UK or USA, will remain submerged in SA.

7.10.4 A vital factor to be considered in assessing the power of any interest group or RG is the *access* of such groups to the government DG. It has already been explained (7.3) that in the SA RSS context, the DG consists of a limited number of people, and at the higher levels of the DG hierarchy, there are problems of co-ordination and communication. This concentration of decision power in the hands of a limited number of people has been one of the factors shaping the "aggressive" character of the government mentioned by Harris above.
It has also ensured that the DG has to rely on information provided by "outsiders" for many of the decisions that it takes. "Ministers find the help and advice of lobbies essential on matters in which interest groups possess particular expertise".[432]

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(430) Harris, *op cit.*, P.262.
(431) *Ibid*, P.263.
(432) *Ibid*, P.275.

However, these "outsiders" will not be the general "all and sundry" of interests before them, but will consist of a limited number of groups which the DG has had some part in influencing. For example, there are only three organisations in the private productive sector which have the privilege of special access to the parliamentary lobby in Cape Town. They are the Federated Chamber of Industries, the Chamber of Mines and the Afrikaanse-handelsinstituut. (See 3.3). Other groups with advantageous access are the SA Railways, which "...clearly have the ear of the government..."(433) and the "public agencies" discussed in 7.3.15.

7.10.5 Typical channels of access to the DG might be:

(a) Via MPs through parliamentary debates, petitions and discussions.
(b) Via services to government officials, or the DG itself. (In SA such services are usually provided by the public agencies).
(c) Via personal contacts with the DG.
(d) Via court actions and legislative hearings.

7.10.6 It can now be seen that in SA, the channels of access to the DG have to a large extent been commandeered by groups identifying with the majority party.

7.10.7 The RGs, as they may be used in the rows of a decision-matrix, are summarised in Table 7D. Groups from the black homelands, as well as the Republic, are included, because the homelands are supplied with petrol in essentially the same (DG controlled) structure as South Africa. This table includes columns for the estimated population of each RG, and also for a subjectively determined factor by which the population-based weightings may be modified to obtain a final group weighting.

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(433) Harris, *op cit.*, P.269.

7.10.8 The total population was divided using each of three methods: (a) racial/locational; (b) occupational; and (c) employer. One essential "group" referred to on occasions earlier in the thesis is the "RSS consumers". They have not been included explicitly because they are, in fact, included, to a greater or lesser extent, in each of the RGs mentioned.

7.10.9 The external group has not been broken down because such analysis would serve little purpose in the present context. Its components will vary, depending on the problem under consideration, and therefore no population figure has been attached to it. Instead, its weighting has been subjectively determined.

7.10.10 The black population was used as the base for weighting the RGs; black groups were assigned weights of 1. All other groups, being more important than the blacks in the eyes of the DG, were given a proportionately greater weighting. (Such groups have greater "relevance", in terms of the definition in 5.15).

7.10.11 The non-white/white ratio in SA, the homelands and the newly independent black states is 5.1/1. (Table 7D). It was therefore decided that the white groups, to be given an "importance" in DG policies exceeding that of the non-whites, should be weighted by a factor of 6. The Afrikaans segment of the whites should be more "important" than the English-speaking in the DG's eyes, and therefore their factor was increased by 50% to 9. In addition, it was decided that the white rural group's factors should be increased by a further 50%, i.e. white English-speaking rural to 9, and white Afrikaans-speaking rural to 13,5. (See 7.6).

7.10.12 The Coloured and Asian groups have been allocated a factor of 2. They have been given this arbitrary figure in view of (i) the Coloured's language identification with the

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white Afrikaners, and (ii) the *possible* future identification of these two groups with the whites in attempted survival in the face of the black masses.[434]

7.10.13 Because adjustments were made to the factors in the "racial/locational" sector of Table 7D, it is necessary to weight the other sectors by a similar amount. A group-weighted average for all white groups, and for all black groups was obtained as follows:

$$\text{White average} = \frac{9ER + 13{,}5AR + 6EU + 9AU}{ER + AR + EU + AU} = 8{,}3951359$$

$$\text{"Others" average} = \frac{2C + 2As + Bw + Bb}{C + As + Bw + Bb} = 1{,}1437632$$

where: ER is English rural, AR is Afrikans rural, EU is English urban, AU is Afrikaans urban, C is Coloureds, As is Asian, Bw is blacks in white areas, Bb is blacks in black areas.

7.11 RELEVANT GROUPS GOALS AND WEIGHTINGS

7.11.1 RG's goals can to a large extent, be derived from the DG goals. The main difference between the DG goals and RG's goals is one of emphasis -- the DG goals are politically oriented, whereas the RG goals are more personally, individually oriented. The DG is more concerned with overall, or macro problems that it faces -- for example, the more direct pressures of groups opposing it; international relations; and issues concerning the national economy, such as inflation and the balance of payments. The RG's however, will not be as concerned with many of these "high level" DG goals. They will be more directly concerned with their own individual well-being. The highest level of goals that any RGs are likely to have will be in the opposition of some of them to the current DG.

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[434] Worrall, (1975), Pp.223-225.

TABLE 7D. SA, HOMELANDS, AND NEW BLACK STATE POPULATION (1977)

			Population	Factor	Population x Factor	Weighting (as a %)
A	1.	White English speaking rural	97 429	9	876 861	1,41
	2.	White Afrikaans speaking rural	498 900	13,5	6 735 150	10,85
	3.	White English speaking urban	1 628 024	6	9 768 144	15,74
	4.	White Afrikaans speaking urban	2 138 647	9	19 247 823	31,02
	5.	Coloureds	2 431 000	2	4 862 000	7,84
	6.	Asians	765 000	2	1 530 000	2,47
	7.	Blacks resident in white areas	8 670 000	1	8 670 000	13,97
	8.	Blacks resident in homelands and newly independent black states	10 365 000	1	10 365 000	16,70
		GRAND TOTAL:	26 594 000		62 054 978	100,00

				Population	Factor	Population x Factor	Weighting (as a %)
B	1.	Agriculture	: white	113 000	8,39	948 650	1,53
	2.		: others	2 941 000	1,14	3 363 808	5,42
	3.	Mining	: white	73 000	8,39	612 845	0,99
	4.		: others	761 000	1,14	870 404	1,40
	5.	Commerce and finance	: white	467 000	8,39	3 920 528	6,32
	6.	(Note 8)	: others	571 000	1,14	653 089	1,05
	7.	Services (Note 7)	: white	365 000	8,39	3 064 225	4,94
	8.		: others	1 501 000	1,14	1 716 789	2,77
	9.	Manufacturing, Electricity	: white	639 000	8,39	5 364 492	8,64
	10.	Construction, Transport	: others	1 633 000	1,14	1 867 765	3,01
	11.	Tourist	: white	11 000	8,39	92 346	0,15
	12.		: others	67 000	1,14	76 632	0,12
	13.	RSS (Note 6)	: white	12 000	8,39	100 742	0,16
	14.		: others	26 000	1,14	29 738	0,05
	15.	OC	: white	7 000	8,39	58 766	0,09
	16.		: others	5 000	1,14	5 719	0,01
	17.	Others (Note 5)	: white	2 676 000	8,39	22 465 383	36,21
	18.		: others	14 726 000	1,14	16 843 056	27,14
		TOTAL WHITE		4 363 000		36 627 977	
		TOTAL OTHERS		22 231 000		25 427 000	
		GRAND TOTAL		26 594 000		62 054 977	100,00

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TABLE 7D (continued)

		Population	Factor	Population x Factor	Weighting (as a %)
1. Controlled directly by DG	: white	525 000	8,39	4 407 446	7,10
2. (Note 1)	: others	738 000	1,14	844 097	1,36
3. Private productive sector	: white	1 139 000	8,39	9 562 060	15,41
4. (Note 2)	: others	5 684 000	1,14	6 501 150	10,48
5. Others (Note 3)	: white	2 699 000	8,39	22 658 471	36,51
6.	: others	15 809 000	1,14	18 081 752	29,14
TOTAL WHITE		4 363 000		36 627 977	
TOTAL OTHERS		22 231 000		25 427 000	
GRAND TOTAL		26 594 000		62 054 975	100,00
EXTERNAL GROUPS		(VARIES)	*	*	

NOTES:

1. Comprises central government, provincial administration, local authorities, Bantu authorities, SAA, SAR and H, GPO, and all other public companies.
2. Comprises private employers and employees.
3. Comprises non-profit organisations, private households, the unemployed, and the not economically active.
4. Source: "South African Statistics 1978", Department of Statistics - Sections 1 and 15.16. Where figures for 1970 were provided, they were extrapolated, *pro rata,* to 1977.
5. Includes the unemployed and not economically active.
6. All RSS except company-owned RSS.
7. Excludes tourist industry.
8. Less all RSS except company-owned.

7.11.2 Note that different goals have not been isolated for each separate RG. This is because it is likely that most RGs have similar goals, with the major differences being on emphasis. Consistent differences will be found only in group ideologies. (See below)

7.12 RG IDEAL 1

7.12.1 The RG will wish to allow each of its individual members to maximise their monetary and social benefits, (and consequently the political power of the group) within the existing social/economic structure.(435) The group's political power will then in turn bolster each member.

7.12.2 The RG will wish to extend the economic development of its individual members. In the short term this will mean income maximisation through the numerous means by which a government can affect the incomes of individual groups -- ie. economic regulation, see Ch. 5. In the long term, this will involve the development of the group to make it inherently more capable of being able to earn a larger slice of the national cake. Long term policies will include the education and training of the group, and the strategic manoeuvering of the group in terms of geographical, social and economic positioning.(436)

7.12.3 The RG will wish to maximise its political power in terms of voting power, and in terms of rights in the legal framework of the country.(437) RGs will often press the DG for specific legal changes.(438)

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(435) Each RG will not only wish to maximise the monetary and social benefits accruing to its members in absolute terms, but also relative to other groups (particularly those groups which oppose the achievement of their goals, or which they regard as competitors).

(436) See 7.6 for a discussion on the manoeuverings of SA's white groups.

(437) See 7.5 and 7.6 for a discussion on voting power, and the legal framework.

(438) The essence of Stigler's theory discussed in 5.8.

7.12.4 An RG will wish to have the maximum possible independence to make decisions concerning itself.

7.12.5 The RG will wish to minimise involuntary unemployment among its members.

7.12.6 The RG will normally desire growth and development of the economy. Exceptions will occur when economic growth and development is not synonymous with the group's security (see discussion in 7.5), or when the group is able to gain more wealth or power by other means (for example, by going on strike).

7.13 RG IDEAL 2

7.13.1 The RG will wish to propagate any ideological beliefs which the majority of its members have. A list of objectives to achieve this ideal will not be given because of the variability of different groups' ideologies. Two essential methods of the propagation of ideological beliefs emerge however. First, an RG may try to extend its ideology by attempting to get other groups to *accept* that ideology, or possibly even desire it. This involves the provision of information, or of propaganda. Second, the RG may *impose* its ideology on other groups. (A "strong" group may use legal power, a "weak" group might resort to terrorism, for example).

7.14 WEIGHTING OF RG GOALS

7.14.1 Different RGs will obviously not agree on the weights to be placed on each of the above objectives. For nearly all RGs however, the major emphasis will be on the more pragmatic objectives of wealth and political power, rather than ideologies. Any group which is not the DG will aspire to some extent to the DG's position; non-DG will also have less ability to propagate their ideological objectives.

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7.14.2 The weights suggested below will be for the average RG as *perceived by the DG* . (Don't forget that this theory of regulation is designed to simulate the *DG's* decision making).

7.14.3 Because it is almost impossible to ascertain with any accuracy what the DG considers each RG goal weight to be, a computer model has been designed to evaluate a variety of weights, and thus provide a rapid method of testing weighting (and other) sensitivities.

TABLE 7E. SUGGESTED STARTING WEIGHTS FOR RG GOALS

		Weight %
7.12.2	Individual's economic development	60
7.12.3	Maximise political power and rights of the group	12
7.12.4	Decision independence	5
7.12.5	Minimise unemployment	10
7.12.6	Maximise macroeconomic growth and development	3
7.13.1	Propagation of ideological beliefs	10
		100%

7.15 EVALUATION MATRICES FOR EXISTING RSS/OC REGULATIONS

7.15.1 The three methods of evaluating Hill's goals achievement matrices were discussed in 5.15. This chapter will evaluate the DG and RG goals, using a modified "weighted index of goals achievement" approach. Instead of using simply +1, -1 or 0 depending on whether the goals achievement is enhanced, decreased or unaffected, values of +2, +1, 0, -1, -2 will be used to indicate whether the degree of achievement was "high" or "low", because

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it is felt that many of the cells in the DG and RG evaluation matrices can provide this additional information. Where they cannot, it will simply be assumed that only a low value has been achieved. It is the summation of costs and benefits which is shown in each cell.

7.15.2 Rather than having a narrative for the derivation of each cell, (which could provide somewhat long reading in this chapter), each regulation will be described in terms of DG and RG goal achievement, and the reader will be left to refer to the matrices for any specific results in which he is interested.

7.15.3 Should the reader disagree with any of the values inserted in the evaluation matrices, he is asked to refer to Chapter 8. In this chapter, most hypotheses have been evaluated using methods other than the DG goals theory, and their results have also been used in the evaluation matrices. In addition, sensitivity analyses have been run in 8.3.18 on the computer model.

7.15.4 RATIONALISATION

(a) The primary effect of this regulation is that it provides a direct barrier to entry, and limit on the number of RSS. This provides a means of realising the potential economies of scale of the RSS (See 3.10) by increasing throughput per RSS, and therefore of increasing OC/RSS profits, and thus their attraction to SA.[439]

(b) It allows the "swopping" of sites -- giving the industry some freedom to operate in the most profitable areas, and ensuring movement towards the efficient use of local resources.

(c) It promotes the use of local capital and enterprise. This has positive effects on the security goal, the stable development of the economy goal, and the balance of payments goal.

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(439) "...average throughput in SA is already the highest in the world, four times more than in UK, for example". Financial Mail, 1st quarter 1975, P.93.

(d) It stimulates the smaller, rather than larger OC. This reduces the (potential) monopoly power of the larger OC, and it also increases security of supply through the stimulation of alternative suppliers.

(e) It promotes the DG favoured country and Bantu areas through additional quotas. Again, this represents a transfer of income to DG supporters, and an attempt to make the homelands self-sufficient within the DG apartheid policy.

(f) It provides direct protection to the RSS from competition from general dealer stores. This therefore represents a transfer of wealth from the stores to the RSS.

(g) It prohibits restrictive clauses in non-fuel contracts. This reduces potential OC monopoly power, and encourages the efficient use of resources.

(h) It increases direct DG control of the industry, and the number of policy decisions that the DG makes.

(i) It has a negative effect on RSS customers through decreasing locational convenience to them. (See Ch.8).

(j) It has its primary impact on the private (RSS customer) sector rather than government, or the bulk supplied productive sector.

7.15.5 <u>UROTA</u>

(a) The most important effect of this regulation is that it provides for compulsory supply of fuel to any RSS -- the objective being to reduce the potential monopoly power of the OCs over the RSS industry. It has the concurrent effect of promoting small businesses in the motor industry, and thus increasing the level of employment (and of security) of that particular segment of the population. It will also increase the proportion of locally-owned RSS.

(b) The maintenance of minimum standards ensures that the applicable RSS also become repair garages. This means that certain RSS, particularly in low sales areas, will be larger than otherwise. A stimulus to the economy of those areas is provided, being an effective transfer of wealth from the RSS/OC to such areas, (primarily to persons owning cars in such areas).

(c) Minimum standards provide a form of barrier to entry. Limiting competition provides a means of achieving economies of scale, it also enhances RSS/OC profits, and thus their attraction to South Africa.

(d) It directly increases the demand for qualified mechanics. This will increase their incomes, and decrease their unemployment level. This therefore suggests that the majority of motor mechanics are DG supporters.

(e) Relaxed UROTA requirements in "country" and "Bantu" areas will entice more RSS to locate in them. This is effectively a transfer of wealth to such areas. It is done for two reasons: firstly, the rural whites tend to be DG supporters; secondly, the DG is attempting to make the homelands self-sufficient within its policy of apartheid.

(f) It increases DG direct control of a strategic industry, and increases the number of policy decisions made by the DG.

7.15.6 SITING CONTROLS

(a) The prime objective of these regulations is to ensure that the RSS comply with the DG urban growth plan, which desires, *inter alia*, to ensure efficient use of local resources; and maintain standards of "character" within urban areas. (Of particular importance will be the maintenance of the "character" of the areas in which the rich live). These controls may be used to promote DG-favoured sites, and could conceivably be used to directly increase the wealth of DG supporters.

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(b) Siting controls can be used to ensure compliance with DG civil defence, safety and security goals.

(c) They provide a form of barrier to RSS entry (and therefore economies of scale and increased OC/RSS profits).

(d) They increase direct DG control in the industry, and also the number of policy decisions that they make. This has the concomitant effect of reducing potential OC monopoly power.

(e) As with the rationalisation plan, these regulations will reduce RSS customer convenience. This will primarily affect the private customer, rather than government or productive sectors. (7.15.8).

(f) They will obviously negatively affect potential RSS which have discovered high profit locations, but are prevented from doing business in them.

7.15.7 PETROL PRICE/MARGIN CONTROLS

(a) The primary aim of these controls is to ensure a high level of petroleum prices inside SA relative to world prices, in order to provide protection for locally-owned refineries, local coal production, the Sasol plants, the nuclear plant, and of course, to provide an "attractive" level of profits to the OC. (See 8.3.29).

(b) They are used to create an "orderly trading environment" with which to attract the OC into SA -- the OC place particular value on secure profits. (See 3.6.6).

(c) The control of, and number of policy decisions made within the oil industry by the DG is increased. They are provided with the tools to control the size and the distribution of the consumer surplus and the producer surplus in the oil industry. Profits of the OC are directly influenced, meaning:

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(i) a limit on potential OC monopoly power;
(ii) increased security of supply through the ability to attract OC to SA through stable and positive profits;
(iii) the viability of SA-located refineries; (see Ch.8)
(iv) a means of influencing the balance of payments.

(d) Petrol prices tend to "lead" other petroleum product prices in SA, ie. the "special" petrol prices in the non-RSS markets, and the prices of oils, bituments, etc. DG petrol price control therefore ensures stability throughout the economy among other petroleum produce consumers.

(e) They mean that prices in low profit/volume areas (ie. rural and "black" areas, generally) will be lower than otherwise. Lack of price control would mean that many "marginal" RSS would be forced to close, causing hardship within local communities. This represents a transfer of wealth to DG supporters, and also a supporting of apartheid through a contribution to homeland self-sufficiency.

(f) Price controls are applied with the ancillary objectives of ensuring the efficient use of local resources and maximising economic growth and development, by providing, so the argument goes, an essential commodity at uniform prices in various price grids in SA.

(g) Price controls will be seen by most RGs in SA as an attempt to minimise inflation.

(h) They ensure a more stable base on which the petrol taxes in SA can be levied. (See 3.5).

(i) They negatively affect that group of consumers who are prepared to search (see 4.2) for low prices.

(j) They negatively affect the more price efficient RSS/OC which might be able to exclude competitors under price competition.

(k) The private RSS customer sector is negatively affected relative to the productive, and government sectors, which pay lower fuel prices.

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7.15.8 CONTROLS ON PRIVATE STORAGE AND TRANSPORTATION, TRADING HOURS, AND SPEED LIMITS. (CONSUMPTION CURBS).

(a) The primary aim of these controls is at the total level of fuel consumption, and thus the DG balance of payments objective.

(b) They increase direct DG control of the industry, and the number of policy decisions that the DG makes. Additional security is gained from this control over a strategic resource.

(c) Limited trading hours generally benefit the RSS in that approximately the same total volume is sold, but in a shorter period each day. Variable resources are therefore better employed.

(d) Control of trading hours allows the DG to impose on SA its alleged belief in resting on the Sabbath, making a contribution towards DG Ideal 4.

(e) The private RSS customer is the most negatively affected.[440] He suffers lost temporal convenience, increased travelling time, and reductions in ability to travel, particularly on long journeys. The tourist industry, and rural travellers are also affected. The private productive sector is affected, but not to as great an extent, primarily because many businesses have access to bulk supply sources. The government sector is relatively unaffected.

(f) They have a negative effect on the DG growth and development objectives, in that the productive movements of goods and people will be inhibited to some extent.

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(440) 70-80% of the petrol consumed in SA is used by private motorists -- Financial Mail, 2nd quarter 76, P.1135.

7.15.9 ADVERTISING AND SALES PROMOTION CONSTRAINTS.

(a) Their primary aim is to reduce "wasteful" fuel consumption, particularly by the private sector. The only ASP allowed is informational, or that emphasising economy. This is once again aimed at the DG balance of payments objective.

(b) They attempt to promote a more efficient use of local resources through eliminating "wasteful" advertising. The largest (established) OC benefit through this reduction in competition.

(c) The private sector is denied information concerning improvements in the power and performance of petrols.

7.15.10 PATRIOTIC APPEALS

These appeals are made primarily to the private sector, with the aim of reducing "unnecessary" petrol consumption, and thus affecting the balance of payments.

See Appendix 10 for DG and RG Evaluation Matrices

7.16 EVALUATION MATRICES FOR REMOVAL OF PRICE CONTROL

7.16.1 The proposal to drop the DG price and margin controls will be tested on the model. The expected result is obviously a strong rejection of such freedom.

(a) The primary effect of dropping these controls will be that SA's prices will no longer consistently be above world market prices (providing protection to SA's refineries and energy industries such as coal -- see 8.3.29). Prices in certain areas could well rise above such levels, but there would no longer be the *consistent* protection available under the present system.

(b) The dropping of petrol price and margin controls will mean a decrease in the "orderly trading environment" so desired by both the DG and the OC. The attraction of SA to the OC, and the oil supply security provided by them would be diminished.

(c) The increased competition would cause marginal RSS to leave the industry -- resulting ultimately in a more efficient supply network, but with a less thorough coverage of SA. The "rural" and "black" areas would be particularly hard hit. Certain DG support would therefore be lost, and black homeland self-sufficiency would be diminished.

(d) The price leadership provided to non-RSS petrol consumers, and to non-petrol products, would be removed. The stability throughout the oil industry based on the widely available yardstick of controlled petrol prices would fall away, affecting the whole economy.

(e) The removal of price controls, and the consequent incentive for customers to search between RSS would likely mean an erosion of fuel consumption curbing measures (with negative effects on the balance of payments).

Again, see Appendix 10 for the Evaluation Matrices.

8. THE EFFECT OF THE GOVERNMENT UPON THE RSS

"The suggestion is sometimes made that the government in SA has favoured its own political allies and associates on every possible occasion". (441)

"Of course we would prefer to have an entirely free enterprise system, but as long as the opportunity to run one's business profitably is not taken away we cannot complain". (442)

8.1 INTRODUCTION

8.1.1 Chapters 5 and 7 of this thesis have developed the theory that regulation originates from the goals of the DG. The objective of this chapter is to test the following major hypotheses:

(a) That the DG is able to effectively control all aspects of the SA oil industry.

(b) That *all* the controls and regulations over the oil industry make a substantial contribution towards DG goals.

(c) That competition is constrained in the SA oil industry.

(d) That SA's petrol prices are considerably above world market prices.

(e) That these deviations from the free market in the SA oil industry are primarily at the expense of the consumer.

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(441) Harris, in P.270, Worrall, (1975).

(442) W. Beck, M D Mobil, Sunday Times, 26/11/72.

8.1.2 It is important to note that the peculiar characteristics of today's oil industries, and in particular SA's oil industry, make them suitable as an area in which to apply the DG-goals theory. The reason, obviously, is that changes in any of the oil supply, price, distribution or other marketing aspects of the industry, whether endogenously or exogenously determined, will more directly affect DG goals than most other industries.

8.2 THE MODEL

8.2.1 The DG-goals model is a computer programme designed to do the calculations required by the formula in 5.15 in a neat, accurate, and most importantly, rapid manner. It provides a formatted listing of the input data for each regulation tested, and options on the amount of output required. The user is also able to select any input variable, and iterate the model over a user-specified range of the variable.

8.2.2 Appendix 11 provides a listing of the model, which is written in Fortran IV. Appendix 12 explains the input format required, and the options available, and Appendix 13 provides a flow diagram.

8.3 EVALUATION OF HYPOTHESES

8.3.1 HYPOTHESIS: The DG is able to effectively control all aspects of the SA oil industry.

8.3.2 METHOD: An examination of the scope of the legislation governing the SA oil industry.

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8.3.3 RESULTS: A wide range of acts could theoretically be used to enforce various controls on the oil industry. The most important of these acts are mentioned below. The Petroleum Products Act, however, is now the legislation which will be used to control most aspects of the oil industry (with the exception of the provisions of the National Building Regulations and Building Standards Act).

8.3.4 The Regulation of Monopolistic Conditions Act No. 24 of 1955 empowers the Minister of Economic Affairs to prevent or control "monopolistic" conditions (defined in Section 2 of the Act). It allows such conditions to exist if they are in the "public interest" (not defined).

8.3.5 The Import and Export Control Act No. 45 of 1963 gives the Minister of Economic Affairs power to control the import and export of goods, including control over their source, "channels" of import, final destination, their values, prices and any other conditions.

8.3.6 The Price Control Act No. 25 of 1964 empowers the Minister of Economic Affairs to control the prices of goods and services in SA.

8.3.7 The National Supplies Procurement Act No. 89 of 1970 was promulgated to

> "...empower the Minister of Economic Affairs to manufacture, produce, acquire, hire or import goods, to acquire, hire or supply services, and to exercise control over goods and services and the manufacture, production, processing and treating of goods..." where necessary for "...the security of the Republic..."

It also provides for the establishment of a fund to enable various provisions of the Act to be applied to any product.

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8.3.8 The Trade Practices Act No. 76 of 1976 empowers the Minister of Economic Affairs to control advertising in the economy.

8.3.9 The National Building Regulations and Building Standards Act, No. 103 of 1977, empowers the Minister of Economic Affairs, and the "local authorities" for various areas to control the location and erection of all buildings, and gives them power to alter or remove any buildings according to their assessment of the desirability of such buildings.

8.3.10 The *Petroleum Products Act* No. 120 of 1977 gives the Minister of Economic Affairs, the Secretary for Commerce and the Controller of Petroleum Products power to regulate or provide for, "...as they deem fit...", the use, purchase, sales, supply, storage and transport of any petroleum products, and to control the persons, outlets, movements, prices and standards involved. The Minister has power to make exemptions, and he also has power to prohibit the entry of new OC or RSS into the oil industry. It effectively gives him "...unlimited powers to control the oil industry".(443)

8.3.11 HYPOTHESIS: Regulations are imposed upon the oil industry in accordance with the DG-goals theory developed in 5.15 and in Chapter 7.

8.3.12 METHOD: The existing major regulations governing the oil industry (listed in 7.2) were each evaluated in the model. It is expected that positive decision values would result for all of them. The model was also run to determine the decision value of the proposal to remove an existing piece of legislation -- obviously, a negative value is expected.

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(443) Financial Mail, 1st quarter 1977, P.373.

8.3.13 RESULTS: Table 8A summarises the results of the model's runs. The initial run used an α value of 1, which produced positive decision values for all the regulations except E. The α value was increased to 1,75 to ensure that E's decision value became positive. All regulations were then rerun.

TABLE 8A. REGULATORY MODEL'S INITIAL RESULTS

		$\alpha = 1$	$\alpha = 1{,}75$
A.	UROTA	1,2	1,6
B.	Rationalisation plan	0,4	1,0
C.	Siting controls	0,5	1,2
D.	Price and margin controls	1,0	1,6
E.	Various consumption curbs	-0,6	0,01
F.	ASP controls	0,1	0,3
G.	Patriotic appeals	0,1	0,3
H.	Removal of price and margin controls	-1,1	-1,7

8.3.14 The data input into the model to achieve these results is shown in Appendix 10.

8.3.15 Table 8A indicates that UROTA[444] and price and margin controls have the highest decision values -- ie. the DG has greater incentives to implement these two regulations than any others. It can be concluded from this result that the DG, in regulating the SA oil industry has placed a high priority on

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(444) As mentioned in Chapter 7, UROTA is now included in the Rationalisation plan. However, UROTA will be considered as a separate regulation for the purposes of this analysis.

(a) minimising OC policy power in the industry;

(b) propagating their own controls over the industry, particularly the price and margin controls.

8.3.16 These two goals are not desired for their own sake. Chapter 7 discussed a wider range of DG goals, and also mentioned some of their complex interrelationships. The minimisation of OC monopoly power, and the extension of DG price and margin controls will positively contribute towards other DG goals such as:

(a) Increased DG security of tenure through their effective control of a strategic resource; also through their use of price controls as a taxation mechanism (see 7.7). DG security is also bolstered through the stabilisation of a strategic industry -- the OC are attracted by stable margins (7.5).

(b) A diversion of producer surplus from the OCs to various consumers, and ultimately, to some extent, to the DG.

(c) An extension of DG control over the economy generally, and particularly the oil industry.

(d) The DG control of the oil industry provides an additional policy tool to be used for the achievement of certain macroeconomic objectives -- primarily the areas of balance of payments, inflation, and efficient use of local resources (7.7).

8.3.17 It can also be concluded from Table 8A that there is no evidence of regulatory mismanagement, or gross regulatory inefficiency. This negates the proposals of Lindblom and Wilson (5.7) and Chant and Acheson (5.13).

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8.3.18 It is possible that the reader may disagreé with some of the goal and group weightings that have been used to achieve the results in Table 8A. A sensitivity analysis has therefore been conducted on some of the weights thought likely to be the most contentious. The procedure was to vary the selected weight through a range of increases relative to all the other weights. Note, however, that after each of the individual weight changes, all weights for the vector under scrutiny must be readjusted to enable them to sum to unity. i.e.: (using a set of weights from the model)

initially
for DGGOAL(I), I = 1,2,3...IDGO

$$\sum_{I=1}^{IDGO} \mathrm{DGGOAL}(I) = 1.0$$

Let us increase DGGOAL(12)

Then,

$$\sum_{I=1}^{IDGO} \mathrm{DGGOAL}(I) > 1$$

In order to enable the vector to sum to unity,

$$F = \frac{1}{\sum_{I=1}^{IDGO} \mathrm{DGGOAL}(I)}$$

$$\left[\sum_{I=1}^{IDGO} \mathrm{DGGOAL}(I)\right] . \quad F = 1.0$$

The "actual increase" on the model's printout is DGGOAL(12) after all adjustments, divided by the input DGGOAL(12).

The results of a series of runs are summarised in Table 8B.

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TABLE 8B. SENSITIVITY ANALYSIS FOR SELECTED WEIGHTS

Ratio: increased/original weight		1,000	1,25	1,50	2,00	5,00	10,00
UROTA							
DG Goal Weight	12 (growth)	1,608	1,624	1,639	1,670	1,856	2,166
	14 (BOP)	1,608	1,596	1,584	1,560	1,413	1,169
	15 (inflation)	1,608	1,599	1,589	1,570	1,454	1,261
RG Goal Weight	4 (unemployment)	1,608	1,596	1,584	1,560	1,423	1,221
	5 (macro growth)	1,608	1,603	1,598	1,589	1,533	1,444
RG Weight	1 (Eng. rural)	1,608	1,609	1,609	1,609	1,610	1,613
	2 (Afrik. rural)	1,608	1,609	1,610	1,612	1,623	1,642
	8 (Black/black)	1,608	1,608	1,608	1,608	1,608	1,608
PRICE AND MARGIN CONTROLS							
DG Goal Weight	12 (growth)	1,642	1,647	1,655	1,665	1,739	1,869
	14 (BOP)	1,642	1,647	1,651	1,660	1,712	1,800
	15 (inflation)	1,642	1,664	1,686	1,729	1,989	2,423
RG Goal Weight	4 (unemployment)	1,642	1,643	1,644	1,646	1,656	1,672
	5 (macro growth)	1,542	1,646	1,649	1,657	1,701	1,777
RG Weight	1 (Eng. rural)	1,642	1,644	1,645	1,648	1,663	1,689
	2 (Afrik. rural)	1,642	1,652	1,661	1,680	1,798	2,014
	8 (Black/black)	1,642	1,649	1,656	1,670	1,757	1,912
VARIOUS CONSUMPTION CURBS							
DG Goal Weight	12 (growth)	0,015	0,021	0,027	0,040	0,115	0,240
	14 (BOP)	0,015	0,042	0,070	0,124	0,453	1,001
	15 (inflation)	0,015	0,001	-0,015	-0,044	-0,222	-0,517
RG Goal Weight	4 (unemployment)	0,015	0,027	0,039	0,062	0,205	0,444
	5 (macro growth)	0,015	0,018	0,022	0,030	0,077	0,154
RG Weight	1 (Eng. rural)	0,015	0,015	0,015	0,014	0,012	0,009
	2 (Afrik. rural)	0,015	0,016	0,017	0,018	0,032	0,081
	8 (Black/black)	0,015	0,011	0,007	0,001	-0,044	-0,116

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8.3.19 HYPOTHESIS: Competition within the oil industry is restrained by the DG.

8.3.20 METHOD: Restraints on the two primary methods by which economic bodies compete (price and quality) will be examined. There are other forms of interference in the oil industry by the DG which have the effect of erecting barriers to RSS entry. It will be shown that (in a test area) the number of RSS is below a free market equilibrium.

8.3.21 RESULTS:

(a) Price controls[445] place a near complete limit on price competition -- it seems (3.9) that there are certain circumstances in which price variations are allowed by the DG, but these remain confidential.

(b) The scope for quality competition in petrol selling is limited. The product itself is often viewed by customers as homogeneous (see 3.4, 4.1). The benefits obtained from increasing competitive costs such as service, advertising and additional facilities are limited by somewhat inflexible sales areas sizes. (See 6.7). Advertising is constrained. (7.2).

(c) The number of RSS, generally speaking, is fewer than that which would be obtained in a free market equilibrium situation.[446] The rationalisation plan, the controls on the siting of RSS, and the limitations on trading hours tend to limit the RSS capacity available over time. That trading hour limits constrain RSS competitive activity today becomes clear when SA's RSS are examined prior to the 1973 "crisis" -- virtually all RSS were open longer hours, and a large portion of the urban and national route RSS provided a 24 hour service.[447]

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(445) Discussed in 3.5, 3.9, 7.2.

(446) Average RSS throughput in SA is the highest in the world -- See 7.15.4; 7.7.4.

(447) See Table 8E.

8.3.22 The effects on the number of RSS resulting from the rationalisation plan and siting controls are difficult to quantify. However, a regression of the data from Table 3E indicates that the "average"[(448)] Cape suburban RSS has a break even volume of 98kl pm. The actual volumes of the five RSS in Chapter 6's survey were: 1:146; 2:156; 3:136; 4:178: and 5:149kl pm. This is a total of 765kl pm in the test area. It could therefore support 7,8 hypothetical break even RSS -- or possibly more if the increased locational convenience to customers solicited additional sales.

8.3.23 This figure of 7,8 may be increased even further if the minimum standards required by UROTA and the siting controls are removed. Table 8C is a repeat of Table 3E, except that building costs have been reduced by a half, and the equipment, overheads and rates and taxes costs by a third. These reductions are an untested estimate of the amounts by which regulations have increased the above costs (through requiring minimum standards and through interfering with optimal resource allocation, especially with regards to land). A regression similar to that above was applied to Table 8C,[(449)] and a break even volume of 64kl pm was calculated. This increases the hypothetical number of RSS that could exist in the test area to 11,95.

8.3.24 Note that neither Tables 3E nor 8C explicitly include an allowance for profits. However, a required rate of return of 12% pa for all fixed assets, and management costs at a market rate have been used in the tables -- the objective being to include an allowance for "normal" profits. Variations by actual RSS from the figures in the table indicate, *ceteris paribus*, positive or negative pure profits.

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(448) The logs of the volumes of the forty RSS in the larger survey were regressed with the log of c/L costs as the IV. An r^2 of 0,98 was obtained for the equation Log(Vol)= -1,97240 Log (cpl)+5,80567. See Table 3E's notes.

(449) Log(Vol)=-2,08895 Log (cpl)+5,45405 r^2=0,98.

8.3.25 In summary, the test area contains five RSS; however, under the following conditions eleven RSS could be supported:

(a) Resource prices remain constant.

(b) All interference with the free market mechanism is removed.

(c) Adequate time is allowed for the establishment of the new RSS.

(d) The possible effects of unrestrained competition in reducing RSS numbers are ignored.

8.3.26 It is likely that even more than eleven RSS could emerge under the above conditions if the sales of the area increased because of the improved customer convenience resulting from the greater RSS numbers.[450]

8.3.27 HYPOTHESIS: SA's petrol prices are above world market prices.

8.3.28 METHOD: An analysis of effective protection provided to SA petroleum refineries.

8.3.29 NOTES: The SA DG will attempt to achieve several objectives by raising internal petrol prices:

(a) The provision of protection to locally-owned and located refineries. There are four crude oil refiners in SA, primarily owned by the oil majors.[451] Although the ownership is mainly external, the location is local, and foreign exchange savings result (equal to the difference in price between crude imports and refined imports, for which figures are not available). An additional foreign exchange saving and local export industry exists in that there is a "...sizeable surplus for exports to other African countries".[452]

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(450) Especially as the figure is already almost 12, ie. 11,95.

(451) Petroleum Economist, (Feb.78), P.58: Sapref owned by Shell/BP; Mobil refinery; Natref owned by Sasol (52,5%), Total (30%), and National Iranian OC; Caltex refinery.

(452) Petroleum Economist, (Feb.78), P.58.

TABLE 8C: RSS ECONOMIES OF SCALE

RAND/MONTH ATTRIBUTABLE TO PETROL SALES WITH NO REGULATION

	10	50	100	150	200	250	500
Site Costs	70	80	100	150	250	370	630
Buildings	50	100	100	120	140	175	200
Pumps, tanks, canopy, sign	47	60	120	160	193	220	320
Pump attendants	160	160	320	480	640	800	960
Other personnel inc. manager	-	350	450	500	600	700	800
Overheads	113	160	200	220	240	267	433
Rates and taxes	40	47	107	120	140	153	233
TOTAL	480	957	1 397	1 750	2 203	2 685	3 576
c/L	4,80	1,91	1,40	1,17	1,10	1,07	0,72

(b) The DG wishes to provide protection to SA energy industries, namely coal, the Sasol plants, and nuclear power. SA meets three quarters of its energy requirements from indigenous coal -- with minimal hydro-electricity production, the balance is met almost entirely from imported oil.[453] In view of the SA DG goals isolated in Chapter 7, there will be a very strong incentive to fully exploit and protect coal as an energy source.[454] The fact that SA has the only large scale, operational oil from coal plants in the world is derived logically from this.

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(453) *Ibid*, P.56.

(454) In many democratic, coal-producing countries, with large numbers of coal industry voters, there are additional political reasons for protecting coal. This does not however, feature strongly in SA coal protection.

Again, there will be a strong incentive to protect the Sasol investments from imported oil's competition. Lastly, SA is emerging as a nuclear power producer, with the first power station due for completion in the early 1980s. Protection from oil will again assist this industry.

(c) High internal petrol prices (as mentioned in 7.5.11c) will provide the DG with the means to ensure that the OC in SA can be guaranteed a high and stable enough level of profits to ensure their continued operation as desired by the DG.

(d) High internal petrol prices, combined with extensive DG control of the oil industry, enables the SA DG to raise large tax revenues (see 7.7). There is no data available on the direct taxation of the refineries in SA.

8.3.30 Two potential constraints to the raising of internal petrol prices have been suggested by Adelman.[455] First, large price increases may have a considerable negative effect on the general inflation rate (7.7.16). However, the rapid petrol price increases illustrated in Table 3B indicate that the DG has to a large extent compensated for the crude price increases shown in Table 7B, in spite of the negative effect on the inflation goal,[456] and the macro-growth goal. (The OC are also bearing some of the weight of the crude price increases -- see 7.5.11c). With nearly all of SA's crude oil being imported at the time of the oil crisis, the DG had no alternative but to let internal petrol prices rise. Even so, it is interesting to note that Tables 3B and 7B show that crude prices have increased faster than SA's petrol prices. Table 8D, based on Table 3C, shows the changing price "cuts".

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(455) Adelman, (1972), P.231.

(456) The DG policy of price controls in a large number of industries throughout the the economy no doubt is designed, *inter alia,* to mitigate the effects of such petrol price rises.

TABLE 8D: PETROL PRICES BREAKDOWN BY %

	1971	1978
Costs ex Refinery	23%	44%
OC margin	23%	5%
RSS margin	10%	7%
Taxes	44%	43%

NOTES:

(1) Source -- See Table 3C.

(2) The percentages above are for December, 1978. During March, 1979, the petrol price was increased by 6c/L. It is not known how this increase was allocated, except that the RSS GM was increased from 1,86 to 2,51 c/L, virtually restoring the RSS to their position in 1971.

8.3.31 The second constraint to internal price increases suggested by Adelman is consumer resistance. The considerable economic control by the DG, and lack of cohesive resistance to it, have been discussed in Ch. 7. The results of the DG goals model runs in Table 8A indicate that such resistance is not significant in SA.

8.3.32 RESULT: Du Plessis[457] has estimated the nominal rate of protection of the SA "petroleum refineries" industry at 56,2%, when excise duties are ignored. If they are included, the nominal rate is closer to an estimate made by Holden and Holden[458] of 71%. Du Plessis estimates effective tariff protection for the petroleum refineries at 93,5%, and if excise duties had been included in his calculations, his estimate would probably be over 100%.[459]

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(457) S.P.J. du Plessis, SAJE, (1976).

(458) M. Holden and P. Holden, SAJE, (Sept. 75).

(459) These rates are calculated from 1963/4 data.

8.3.33 Du Plessis warns of certain dangers in the interpretation of effective tariffs. A comparison of effective rates for different industries should be used with caution, because the reaction to the growth stimulus of the tariffs may vary from industry to industry, and "...it is generally speaking not permissible to conclude that an industry with a higher effective tariff...necessarily benefitted more...than an industry with a lower effective tariff".(460) He also mentions that quantitative import restrictions will distort the conclusions that can be drawn solely from an examination of nominal and effective rates. Unfortunately, the oil industry is one that is subject to considerable and effective intervention.

8.3.34 In spite of these problems, the "petroleum refineries" industry had both the highest nominal and effective tariff rates for all 79 sectors calculated by du Plessis. Such protection is to the immediate and direct expense of petrol consumers (ignoring the benefits that such consumers may obtain through the concomitant achievement of DG goals that might occur).

8.3.35 HYPOTHESIS: The effects of government interference in the SA oil industry are primarily at the expense of oil product consumers, particularly RSS consumers.

8.3.36 METHOD (1): An examination of the price premium paid by SA oil product consumers.

8.3.37 METHOD (2): An estimate of the inconvenience to RSS consumers as a result of the limits on numbers of RSS will be made. The method will be to examine changes in weighted average customer deterrence from the "actual"

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(460) Du Plessis, (1976), P.162.

situation in the Rondebosch test area when six additional RSS are placed in the area. The locational model has been modified to generate the additional RSS at random locations in the test area. A large number of "sets" of new RSS will be generated, and the range of the results examined.(461)

8.3.38 METHOD (3): The effects of the National Supplies Procurement Act and the Petroleum Products Act upon the customer convenience will be examined.

8.3.39 RESULT (1): Nominal tariffs indicate the extent to which domestic tariffs in a country have been increased above free trade world prices. It must be borne in mind that nominal tariffs are not the only distortion on free trade -- quantitative restrictions will affect tariff protection(462) and may also distort internal price levels (and therefore nominal, and again, effective tariff protection).

8.3.40 Ignoring the effects of quantitative restrictions on petroleum product imports into SA, du Plessis has estimated the nominal protection of the "petroleum refineries" to be over 70%. This calculation was however, for 1963/64. It is suggested that the figure of 70% grossly underestimates the rate of nominal protection today, for which figures are not available. Holden and Holden estimated nominal protection for the "petrol and coal" industry to be 40,4% in 1956/57; and 71% in 1963/64. If the rate of increase between 1956/57 and 1963/64 is continued up to the present, today's nominal protection for the industry would be a little over 200%.

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(461) Data input to the model is described in Appendix 2. A program listing is provided in Appendix 15. The "Actual Sales" required by the model were obtained as follows: actual sales for the area was divided by 11 -- the result was used for each random RSS. The difference between the total for the random RSS and the actual RSS was then allocated to the actual RSS in proportion to their sales.

(462) Du Plessis, (1976), P.163.

8.3.41 RESULT (2): When the RSS locational model was set up as in Ch. 6, and it was calibrated using "live" composite attraction values; actual and synthesised sales for each of the five RSS varied by less than 0,2%. In this case, the average customer deterrence(463) calculated by weighting with synthesised sales was 13,7719, and by weighting with the numbers of customers a figure of 14,2820 was obtained.

8.3.42 The number of RSS in the model was then increased to eleven. The "actual" five RSS were retained in their original locations, and a set of six additional RSS were introduced. These six RSS were placed randomly in the study area, and the model was run in simulation mode. The six new RSS were then assigned new random positions, and the model was rerun. This procedure was repeated sixty five times.(464)

8.3.43 The minimum and maximum average deterrence functions resulting from these runs were:

	MINIMUM	MAXIMUM
Customer weighted :	8,10	10,73
Synthesised sales weighted :	7,69	10,43

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(463) Note that deterrence used in the model was not distance, but rather a rank-distance ratio developed for the model in equation E79, Ch.4. Essentially, this measure is the distance multiplied by the ratio of equation E78. Distances were input into these two equations in 500m units. Therefore a very rough estimate of customer to RSS distances in km can be obtained by dividing the deterrence figures above by 2.

(464) A random number generator was programmed into the RSS model. Random numbers IR and JR were selected such that

$$1 \leqslant IR \leqslant 36$$
$$1 \leqslant JR \leqslant 5$$

There are 36 customer zones and five RSS in the "live" model; the random numbers IR and JR are therefore able to randomly pick deterrence figures from this matrix. These random figures were used as deterrence figures for the "new" RSS. The programming required to do this is shown in Appendix 15. Attraction figures of unity were used for the new RSS.

8.3.44 Minimum customer average deterrence figures will *tend* to coincide with optimal RSS locations, because an RSS will desire to locate itself as conveniently as possible for its potential customers, in view of the importance customers attach to convenience (see Ch. 6). However, there is no reason why optimal RSS location MUST coincide with minimum average customer deterrence. For example, it may be advantageous to an RSS to relocate using the competitive logic of a Cournot or Bertrand model.

8.3.45 Assume, however, that the optimal locations for the new RSS coincide with the minima calculated above. This means that, depending on the method of weighting used, average customer deterrence in the Rondebosch test area was increased by government regulation as follows:

(Synthesised sales weighting)	13,7719/7,6925 = 1,79
(Numbers of customers weighting)	14,2820/8,0983 = 1,76

Bearing in mind note (463) on the previous page, this means that the average *distance* a customer had to travel in the test area to fill his car has increased by 76% because of governmental regulation.

8.3.46 <u>RESULT (3)</u>: The primary effects of the promulgations under the National Supplies Procurement Act and the Petroleum Products Act since mid-1973 are summarised in Table 8E. Note that there are benefits that may offset some of the costs resulting to RSS consumers from these regulations. Maximum speed limits may reduce accident casualties, and limited trading hours may mean better utilisation of RSS capacity, for example.

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TABLE 8E. "CONSUMPTION CURBS" : THE IMPORTANT CHANGES

Gazette No.	Notice No.	Date	
4084	R2204	16/11/3	Maximum speed reduced to 80 km ph. No racing, water skiing. Private carriage of 10L max. Selling hours: 0600 Monday to 1800 Saturday.
4097	R2303	30/11/3	No private carriage of petrol.
4101	R2359	10/12/3	Selling hours : 0600-1800 Monday to Friday
4151	R 149	25/1/4	Private carriage of 10L maximum.
4672	R 744	18/4/5	Easing on racing and water skiing restrictions.
4712	R1026	19/5/5	Speed limit increased to 90 km ph. Additional selling on Saturdays 0800-1300 allowed.
5293	R1743	24/9/6	Selling hours : Monday-Friday 0700-1800, Saturday 0800-1300.
5321	R1974	22/10/7	Maximum fuel tank size of 80L on passenger vehicles, 200L on other vehicles. Selling hours : Monday-Thursday 0600-1800, Friday 0600-1200. No private carriage of petrol allowed, maximum possession 5L.
5898	R 386	3/3/8	Selling hours : Monday-Saturday 0800-1800. Maximum private possession of petrol 10L. Sales of petrol on credit prohibited.
6272	R 30	12/1/9	Private possession of petrol only with a permit.
6355	R 529	16/3/9	Selling hours Monday-Saturday 0700-1800, except Wednesdays, which close 1200. Lorries exceeding 9000 Kg -- maximum speed 80 Km ph.

APPENDIX I.

```
C
C  RSS GRAVITY MODEL PROGRAM  MODIFIED CULLEN AND CORDEY HAYES FORMULA
C DNJ MILLERS FORMULATION AND PROGRAMMING  VERSION OCTOBER 78
      COMMON/AA/T,M,N/BB/C,S,ALPHA,BETA,LAMBDA,YC,ATR,ATRA,SUM3/
     1CC/R/DD/DSQ/EE/A
      DIMENSION P(50),Y(50),YC(50),S(50,20),A(20),T(20),
     1AVT(50,20),CD(50,20),SUMTL(20),ATR(20),SUMT(20),FRTMK(20),
     2SLSMK(20),ASLSMK(20),TMKT(20),SUM3(50),ATRA(50,20)
     3,C(50,20),PER(20)
      REAL*4LAMBDA
C
      READ 1000,N,M,NA,CONS
      PRINT 1050,N,M,NA,CONS
      DO 20 I=1,N
   20 READ 1007,(C(I,J),J=1,M)
      READ 1004,(P(I),I=1,N)
      PRINT 1054,(P(I),I=1,N)
      READ 1005,(Y(I),I=1,N)
      PRINT 1055,(Y(I),I=1,N)
      READ 1006,(A(J),J=1,M)
      PRINT 1056,(A(J),J=1,M)
      READ 1011,(ATR(J),J=1,M)
      PRINT 1057,(ATR(J),J=1,M)
      DO 30 I=1,N
      READ 1002,(ATRA(I,J),J=1,M)
   30 PRINT 1058,(ATRA(I,J),J=1,M)
C
      IF (CONS)40,40,70
   40 SUM1=0.0
      DO 50 I=1,N
   50 SUM1 = SUM1 + Y(I)*P(I)
      SUM2 = 0.0
      DO 60 J=1,M
   60 SUM2 = SUM2+A(J)
      CONS=SUM2/SUM1
C
   70 DO 80 I=1,N
   80 YC(I)=Y(I)*CONS*P(I)
C
      KK=0
      IF (NA) 120,120,90
C
C                                   CALIBRATION
   90 READ 2000,ALMIN,ALMAX,BEMIN,BEMAX,AAMIN,AAMAX
      PRINT 2005
      PRINT 2001,ALMIN,BEMIN,AAMIN
      PRINT 2004,ALMAX,BEMAX,AAMAX
      READ 2002,MGSIT,MOIT,MGF,F
      PRINT 2003,MGSIT,MOIT,MGF,F
   92 PRINT 1008
      PRINT 1023
      PRINT 1009
      PRINT 1010,CONS
      PRINT 1009
      PRINT 1012
      PRINT 1075
      K=0
      KB=0



  200 IF(K.EQ.MOIT) GO TO 126
      IF(KB.EQ.0) GO TO 210
      ALMIN=ALMIN/F
      ALMAX=ALMAX*F
      BEMIN=BEMIN/F
      BEMAX=BEMAX*F
      AAMIN=AAMIN/F
      AAMAX=AAMAX*F
  210 CONTINUE
      KB=1
      KC=0
      PRINT 1070
  212 CONTINUE
      VMIN=ALMIN+(0.382*(ABS(ALMAX-ALMIN)))
      VMAX=ALMIN+(0.618*(ABS(ALMAX-ALMIN)))
      ALPHA=VMIN
      BETA  =(BEMIN+BEMAX)/2.0
      LAMBDA=(AAMIN+AAMAX)/2.0
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      COCOR=R
      CSQR =DSQ
      KC=KC+1
      PRINT 1074,KC,CSQR,COCOR,ALPHA,BETA,LAMBDA
      ALPHA=VMAX
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      PRINT 1074,KC,DSQ,R,ALPHA,BETA,LAMBDA
      IF(MGF.EQ.0) GO TO 220
      IF(CSQR.LT.DSQ) GO TO 230
      ALMIN=VMIN
      GO TO 240
  230 ALMAX=VMAX
      GO TO 240
  220 IF(COCOR.GT.R) GO TO 222
      ALMIN=VMIN
      GO TO 240
  222 ALMAX=VMAX
  240 CONTINUE
      IF(KC.LT.MGSIT) GO TO 212
      PRINT 1071
      KC=0
  245 VMIN=BEMIN+(0.382*(ABS(BEMAX-BEMIN)))
      VMAX=BEMIN+(0.618*(ABS(BEMAX-BEMIN)))
      BETA=VMIN
      ALPHA=(ALMIN+ALMAX)/2.0
```

```
      KC=0
  245 VMIN=BEMIN+(0.382*(ABS(BEMAX-BEMIN)))
      VMAX=BEMIN+(0.618*(ABS(BEMAX-BEMIN)))
      BETA=VMIN
      ALPHA=(ALMIN+ALMAX)/2.0
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      COCOR=R
      CSQR=DSQ
      KC=KC+1
      PRINT 1074,KC,CSQR,COCOR,ALPHA,BETA,LAMBDA
      BETA=VMAX
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      PRINT 1074,KC,DSQ,R,ALPHA,BETA,LAMBDA
      IF(MGF.EQ.0) GO TO 320
      IF(CSQR.LT.DSQ) GO TO 330
      BEMIN=VMIN
      GO TO 340
  330 BEMAX=VMAX
      GO TO 340
  320 IF(COCOR.GT.R) GO TO 322
      BEMIN=VMIN
      GO TO 340
  322 BEMAX=VMAX
  340 CONTINUE
      IF(KC.LT.MGSIT) GO TO 245
      PRINT 1072
      KC=0
  345 VMIN=AAMIN+(0.382*(ABS(AAMAX-AAMIN)))
      VMAX=AAMIN+(0.618*(ABS(AAMAX-AAMIN)))
      LAMBDA=VMIN
      BETA =(BEMIN+BEMAX)/2.0
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      COCOR=R
      CSQR=DSQ
      KC=KC+1
      PRINT 1074,KC,CSQR,COCOR,ALPHA,BETA,LAMBDA
      LAMBDA=VMAX
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      PRINT 1074,KC,DSQ,R,ALPHA,BETA,LAMBDA
      IF(MGF.EQ.0) GO TO 420
      IF(CSQR.LT.DSQ) GO TO 430
      AAMIN=VMIN
      GO TO 440
  430 AAMAX=VMAX
      GO TO 440
  420 IF(COCOR.GT.R) GO TO 422
      AAMIN=VMIN
      GO TO 440
  422 AAMAX=VMAX
  440 CONTINUE
      IF(KC.LT.MGSIT) GO TO 345
      K=K+1
      SUM4=0.0
      SUM5=0.0
      DO 104 J=1,M
      DO 104 I=1,N
      SUM4=SUM4+(S(I,J)*C(I,J))
  104 SUM5=SUM5+S(I,J)
      ASTL=SUM4/SUM5
      PRINT 1009
      PRINT 1023
      PRINT 1013
      PRINT 1015,K,DSQ,R,ASTL,ALPHA,BETA,LAMBDA
      PRINT 1016,ALMIN,BEMIN,AAMIN
      PRINT 1017,ALMAX,BEMAX,AAMAX
      PRINT 1009
      PRINT 1023
      PRINT 1075
      GO TO 200
C
  120 CONTINUE
  125 READ 1021,ALPHA,BETA,LAMBDA
  126 PRINT 1022
      PRINT 1023
      PRINT 1033
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      PRINT 1024
      PRINT 1025,DSQ,R,ALPHA,BETA,LAMBDA,N,M,CONS
      DO 150 J=1,M
      DO 150 I=1,N
      CD(I,J)=S(I,J)/(Y(I)*CONS)
  150 CONTINUE
C
      DO 162 J=1,M
      TMKT(J)=0.0
      DO 162 I=1,N
      TMKT(J)=TMKT(J)+CD(I,J)
  162 CONTINUE
C
      DO 163 J=1,M
      DO 163 I=1,N
      AVT(I,J)=C(I,J)*CD(I,J)
```

```
      DO 163 J=1,M
      DO 163 I=1,N
      AVT(I,J)=C(I,J)*CD(I,J)
  163 CONTINUE
      DO 164 J=1,M
      SUMTL(J)=0.0
      DO 164 I=1,N
      SUMTL(J)= SUMTL(J)+AVT(I,J)
      SUMT(J)= SUMTL(J)/TMKT(J)
  164 CONTINUE
C
      TL=0.0
      DO 165 J=1,M
      TL=TL+SUMT(J)
      T12=TL/M
  165 CONTINUE
C
C
      SUM4=0.0
      SUM5=0.0
      DO 166 J=1,M
      DO166 I=1,N
      SUM4=SUM4+(S(I,J)*C(I,J))
  166 SUM5=SUM5+S(I,J)
      ASTL=SUM4/SUM5
      PRINT 1009
      PRINT 1040,ASTL
      PRINT 1009
      T4=0.0
      T5=0.0
      T6=0.0
      T9=0.0
      T10=0.0
      T11=0.0
      DO 167 J=1,M
      T4=T4+TMKT(J)
      T5=T5+T(J)
      T6=T6+A(J)
  167 CONTINUE
      DO 170 J=1,M
      FRTMK(J)=TMKT(J)/T4*100.0
      T9=T9+FRTMK(J)
      SLSMK(J)=T(J)/T5*100.0
      T10=T10+SLSMK(J)
      ASLSMK(J)=A(J)/T6*100.0
      T11=T11+ASLSMK(J)
  170 CONTINUE
      DO 171 J=1,M
  171 PER(J)=(A(J)/T(J))*100.0
      PRINT 1039
      PRINT 1023
      PRINT 1026
      PRINT 1027
      PRINT 1028,(J,SUMT(J),TMKT(J),FRTMK(J),ASLSMK(J),SLSMK(J),T(J),
     1A(J),ATR(J),PER(J),J=1,M)
      PRINT 1009
      PRINT 1029,T12,T4,T9,T11,T10,T5,T6
      PRINT 1009
      PRINT 1032
      PRINT 1020
      PRINT 1030
      PRINT 1009
      PRINT 1031,(I,YC(I),I=1,N)
      MA=1
      MB=12
      IF(MB.GT.M)MB=M
  172 CONTINUE
      PRINT 1034,(J,J=MA,MB)
      PRINT 1009
      DO 173 I=1,N
  173 PRINT 1035,I,(S(I,J),J=MA,MB)
      IF(MB.EQ.M)GO TO 175
      MA=MA+12
      MB=MB+12
      IF(MB.GT.M)MB=M
      GO TO 172
  175 CONTINUE
      MA=1
      MB=15
      IF(MB.GT.M)MB=M
  176 CONTINUE
      PRINT 1036,(J,J=MA,MB)
      PRINT 1037
      DO 177 I=1,N
  177 PRINT 1037,I,(CD(I,J),J=MA,MB)
      IF(MB.EQ.M) GO TO 181
      MA=MA+15
      MB=MB+15
      IF(MB.GT.M)MB=M
      GO TO 176
  181 PRINT 1041
      MA=1
      MB=9
      IF(MB.GT.M)MB=M
  182 CONTINUE
      PRINT 1009
      PRINT 1042,(J,J=MA,MB)
      PRINT 1009
      DO 183 I=1,N
  183 PRINT 1043,I,(C(I,J),J=MA,MB)
      IF(MB.EQ.M) GO TO 185
      MA=MA+9
      MB=MB+9
      IF(MB.GT.M)MB=M
      GO TO 182
  185 CONTINUE
```

```
      GO TO 182
  185 CONTINUE
```

```
      KK=KK+1
      IF(KK.NE.1)GO TO 186
      MGF=1
      GO TO 90
  186 PRINT 1020
 1000 FORMAT (2I3,I2,F8.6)
 1002 FORMAT (7F10.4)
 1003 FORMAT (7F10.0)
 1004 FORMAT (8F10.0)
 1005 FORMAT (10F8.2)
 1006 FORMAT (7F10.0)
 1007 FORMAT (7F10.2)
 1008 FORMAT('1',50X,'CALIBRATION RUN')
 1009 FORMAT('0')
 1010 FORMAT('0',1X,'CONSUMPTION CONSTANT=',1X,F15.13)
 1011 FORMAT (7F10.7)
 1012 FORMAT('0',65X,'PARAMETERS')
 1013 FORMAT('0','ITER',6X,'DIFF SQ',11X,'CORR',7X,'TRIP AVCOST',
     17X,'ALPHA',9X,'BETA',8X,'LAMBDA')
 1015 FORMAT('0',I3,1X,F15.6,8X,F10.6,3X,F10.6,5X,F9.6,5X,F9.6,5X,F9.6)
 1016 FORMAT('0',45X,'MINIMUM',3X,F9.6,2(5X,F9.6))
 1017 FORMAT('0',45X,'MAXIMUM',3X,F9.6,2(5X,F9.6))
 1020 FORMAT('1')
 1021 FORMAT(3F10.7)
 1022 FORMAT('1',50X,'SIMULATION RUN')
 1023 FORMAT(' ',40X,'**************************************')
 1024 FORMAT('0',7X,'DIFF SQ',9X,'CORR',9X,'ALPHA',7X,'BETA',
     18X,'LAMBDA',7X,'I',6X,'J',10X,'C')
 1025 FORMAT('0',F15.6,2X,F11.9,4X,F9.6,4X,F9.6,4X,F9.6,4X,
     1I3,4X,I3,4X,F9.6)
 1026 FORMAT('0','SITE',4X,'AVE TRIP',4X,'NO OF',5X,'% OF',3X,
     1'% OF ACT',3X,'% OF SYN',3X,'SYNTHESISED',7X,'ACTUAL',3X,
     2'ATTRACTION',3X,'% ACT/SYNTH')
 1027 FORMAT('0',12X,'COST',5X,'CUST',5X,'CUST',6X,'SALES',6X,
     1'SALES',9X,'SALES',8X,'SALES',9X,'OF J',9X,'SALES')
 1028 FORMAT('0',2X,I2,2X,F10.6,1X,F8.0,4X,F5.2,6X,F5.2,6X,F5.2,3X,
     1F11.0,2X,F11.0,4X,F9.6,6X,F9.4)
 1029 FORMAT('0','ALL J',1X,F10.6,1X,F8.0,3X,F6.2,5X,F6.2,5X,F6.2,3X,
     1F11.0,2X,F11.0)
 1030 FORMAT('0','ZONAL RETAIL SPENDING')
 1031 FORMAT(' ',3X,I2,4X,F10.2)
 1032 FORMAT('0','NOTE:AVE TRIP COST=C(I,J) WEIGHTED BY NO OF','
     1CUSTOMERS')
 1033 FORMAT('0',37X,'ATR',7X,'ATRA',13X,'C')
 1034 FORMAT('1',1X,'CASH FLOWS TO'//4X,12I10)
 1035 FORMAT('0',I2,2X,12F10.2)
 1036 FORMAT('1',1X,'CUSTOMER FLOWS TO'//4X,15I8)
 1037 FORMAT('0',I2,2X,15F8.0)
 1039 FORMAT('0',50X,'SUMMARY SITE INFORMATION')
 1040 FORMAT('0','AVE OF    C(I,J)      WEIGHTED BY SYNTH SALES',1X,F10.6)
 1041 FORMAT('1','INPUT DETERRENCE FUNCTION')
 1042 FORMAT('0',11X,9('J=',I2,9X))
 1043 FORMAT('0','I=',I2,1X,9F13.6)
 1050 FORMAT ('0','N,M,NA,C,=',2I3,I2,F8.6)
 1054 FORMAT ('0','       P(I)=',8F10.0)
 1055 FORMAT ('0','       Y(I)=',10F8.2)
 1056 FORMAT ('0','       A(J)=',7F10.0)
 1057 FORMAT ('0','     ATR(J)=',1X,7F10.7)
 1058 FORMAT('0','ATRA(I,J) =',1X,7F10.4)
 1070 FORMAT('0','ALPHA')
 1071 FORMAT('0','BETA')
 1072 FORMAT('0','LAMBDA')
```

```
 1074 FORMAT('0',13X,I3,3X,F11.5,2X,F13.11,3(2X,F10.7))
 1075 FORMAT('0',9X,'ITERATION',5X,'DIFFSQ',4X,'CORRELATION',7X,'ALPHA',
     18X,'BETA',6X,'LAMBDA')
 2000 FORMAT(8F10.8)
 2001 FORMAT('0','MINIMA',4F10.6)
 2002 FORMAT(3I10,F10.7)
 2003 FORMAT('0','MGSIT,MOIT,MGF,F',3I10,F10.7)
 2004 FORMAT('0','MAXIMA',4F10.6)
 2005 FORMAT ('0',11X,'ALPHA',4X,'BETA',6X,'LAMBDA')
      STOP
      END
```

```
      SUBROUTINE CALC
      COMMON/AA/T,M,N/BB/C,S,ALPHA,BETA,LAMBDA,YC,ATR,ATRA,SUM3
      DIMENSION C(50,20),S(50,20),YC(50),SUM3(50),T(20),ATR(20)
     1,ATRA(50,20)
      REAL*4LAMBDA
      DO200I=1,N
      SUM3(I)=0.0
      DO200J=1,M
      S(I,J)=(EXP((ATR(J)*ALPHA)+(ATRA(I,J)*BETA)-(C(I,J)*LAMBDA)))
  200 SUM3(I)=SUM3(I)+S(I,J)
      DO201J=1,M
      T(J)=0.0
      DO201I=1,N
      S(I,J)=YC(I)*S(I,J)/SUM3(I)
  201 T(J)=T(J)+S(I,J)
      RETURN
      END
C
```

```
      SUBROUTINE DIFFSQ
      COMMON/AA/T,M,N/DD/DSQ/EF/A
      DIMENSION A(20),T(20)
      DSQ1=0.0
      DO300J=1,M
  300 DSQ1=DSQ1+(ABS(A(J)-T(J))**2)
      DSQ=DSQ1/1000000.0
      RETURN
      END
```

```
 1036 FORMAT('1',1X,'CUSTOMER FLOWS TO'//4X,15I8)
 1037 FORMAT('0',I2,2X,15F8.0)
 1039 FORMAT('0',50X,'SUMMARY SITE INFORMATION')
 1040 FORMAT('0','AVE OF    C(I,J)      WEIGHTED BY SYNTH SALES',1X,F10.6)
 1041 FORMAT('1','INPUT DETERRENCE FUNCTION')
 1042 FORMAT('0',11X,9('J=',I2,9X))
 1043 FORMAT('0','I=',I2,1X,9F13.6)
 1050 FORMAT ('0','N,M,NA,C,=',2I3,I2,F8.6)
 1054 FORMAT ('0','          P(I)=',8F10.0)
 1055 FORMAT ('0','          Y(I)=',10F8.2)
 1056 FORMAT ('0','          A(J)=',7F10.0)
 1057 FORMAT ('0','        ATR(J)=',1X,7F10.7)
 1058 FORMAT('0','ATRA(I,J) =',1X,7F10.4)
 1070 FORMAT('0','ALPHA')
 1071 FORMAT('0','BETA')
 1072 FORMAT('0','LAMBDA')



 1074 FORMAT('0',13X,I3,3X,F11.5,2X,F13.11,3(2X,F10.7))
 1075 FORMAT('0',9X,'ITERATION',5X,'DIFFSQ',4X,'CORRELATION',7X,'ALPHA',
     18X,'BETA',6X,'LAMBDA')
 2000 FORMAT(8F10.8)
 2001 FORMAT('0','MINIMA',4F10.6)
 2002 FORMAT(3I10,F10.7)
 2003 FORMAT('0','NGSIT,MOIT,MGF,F',3I10,F10.7)
 2004 FORMAT('0','MAXIMA',4F10.6)
 2005 FORMAT ('0',11X,'ALPHA',4X,'BETA',6X,'LAMBDA')
      STOP
      END



      SUBROUTINE CALC
      COMMON/AA/T,M,N/BB/C,S,ALPHA,BETA,LAMBDA,YC,ATR,ATRA,SUM3
      DIMENSION C(50,20),S(50,20),YC(50),SUM3(50),T(20),ATR(20)
     1,ATRA(50,20)
      REAL*4LAMBDA
      DO200I=1,N
      SUM3(I)=0.0
      DO200J=1,M
      S(I,J)=(EXP((ATR(J)*ALPHA)+(ATRA(I,J)*BETA)-(C(I,J)*LAMBDA)))
  200 SUM3(I)=SUM3(I)+S(I,J)
      DO201J=1,M
      T(J)=0.0
      DO201I=1,N
      S(I,J)=YC(I)*S(I,J)/SUM3(I)
  201 T(J)=T(J)+S(I,J)
      RETURN
      END
C



      SUBROUTINE DIFFSQ
      COMMON/AA/T,M,N/DD/DSQ/EE/A
      DIMENSION A(20),T(20)
      DSQ1=0.0
      DO300J=1,M
  300 DSQ1=DSQ1+(ABS(A(J)-T(J))**2)
      DSQ=DSQ1/1000000.0
      RETURN
      END



      SUBROUTINE CORR
      COMMON/AA/T,M,N/CC/R/EE/A
      DIMENSION A(20),T(20)
      XM=M
      SUMX=0.0
      SUMY = 0.0
      SUMXX=0.0
      SUMYY=0.0
      SUMXY=0.0
      DO 400J=1,M
      SUMX=SUMX+A(J)
      SUMY = SUMY+T(J)
      SUMXX= SUMXX+A(J)**2
      SUMYY=SUMYY+T(J)**2
  400 SUMXY=SUMXY+(A(J)*T(J))
      XBARX=SUMX/XM
      XBARY=SUMY/XM
      R=(SUMXY/XM-(XBARX*XBARY))/
     1SQRT((SUMXX/XM-XBARX**2)*(SUMYY/XM-XBARY**2))
      RETURN
      END
```

APPENDIX 2: LOCATIONAL MODEL'S INPUT AND OPTIONS.

Instructions for the input of data on punch cards are listed below. The cards must be arranged in the sequence in which they are described. The model's various options are outlined as they appear.

An additional card is required by the program when the random position generator is used (Appendix 15); it is shown below. If the standard locational program is being used (Appendix 1) simply ignore this additional card (marked *).

The description below for each card or group of cards comprises: a heading, the applicable columns, the variables used, their FORTRAN format, and a short explanation.

CONTROL CARD #1.

1-3	N	I3	Number of I zones.
4-6	M	I3	Number of J (including the additional random RSS if such a run is being made).
7-8	NA	I2	0 specifies a simulation run, 1 a calibration run.
9-16	CONS	F8.6	Consumption constant - ie the proportion of income spent at RSS in the study area. If this field is left blank it will be calculated automatically, thus providing a useful check on the model's results.

CONTROL CARD #2. *

1-4	IZ	I4	Four digit seed for the random number generator - must comprise positive intigers.
5-8	IK	I4	Number of iterations required.
9-12	L	I4	The actual number of RSS in the study area, ie the number for which deterrence data will be input.

DETERRENCE CARDS #3.

1-10 11-20 etc	C(I,J)	7F10.2	Deterrence cards. First card for I=1, next card for I=2, etc. The first 10 columns of each card are for J=1, the second 10 for J=2, etc.

POPULATION CARDS #4.

1-10 11-20etc.	P(I)	8F10.0	Number of consumers in each I zone. 10 columns per zone, maximum 8 zones / card.

APPENDIX 2 Cont.

INCOME CARDS #5.

1-8 etc	Y(I)	10F8.2	Average annual income (Rand) per capita in I. 8 columns per zone, maximum 10 zones per card.

ACTUAL SALES CARDS #6.

1-10 etc.	A(J)	7F10.0	Actual sales for each J. 10 columns per J, maximum 7 fields per card.

ATTRACTION FACTOR CARD #7.

1-10 etc.	ATR(J)	7F10.7	Attraction factors for each J. 10 columns per J, maximum 7 J per card.

DISTANCE TO NEXT OPPORTUNITY CARDS #8.

1-10	ATRA(I,J)	7F10.4	First card for I=1, next card for I=2 etc. The first 10 columns are for J=1, the next 10 columns for J=2, etc. (Note: the program will only read this data for the actual RSS).

THE FOLLOWING CARDS ARE REQUIRED BY THE CALIBRATION OPTION ONLY.

CALIBRATION PARAMETER CARD # C1.

1-10	ALMIN	F10.8	Lower alpha value.
11-20	ALMAX	F10.8	Upper alpha value.
21-30	BEMIN	F10.8	Lower beta value.
31-40	BEMAX	F10.8	Upper beta value.
41-50	AAMIN	F10.8	Lower lambda value.
51-60	AAMAX	F10.8	Upper lambda value.

CALIBRATION CONTROL CARD # C2.

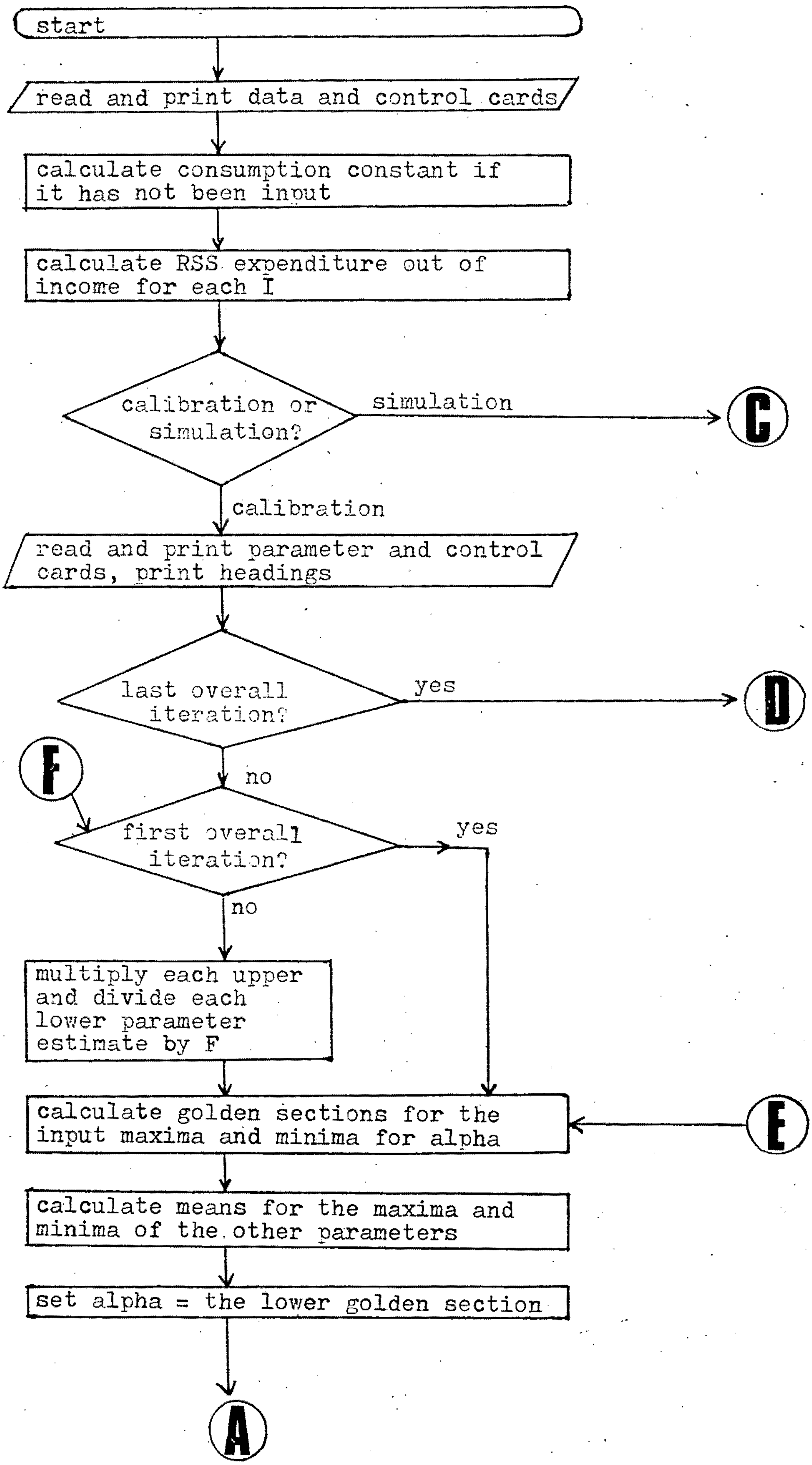
1-10	MGSIT	I10	Number of golden section iterations per parameter.
11-20	MOIT	I10	Number of overall iterations.
21-30	MGF	I10	Calibration method selector: 0 to use coefficiant of correlation, 1 to use the sum of squares.
31-40	F	F10.7	Parameter "widening" factor on overall iterations.

THE FOLLOWING CARDS ARE REQUIRED BY THE SIMULATION OPTION ONLY.

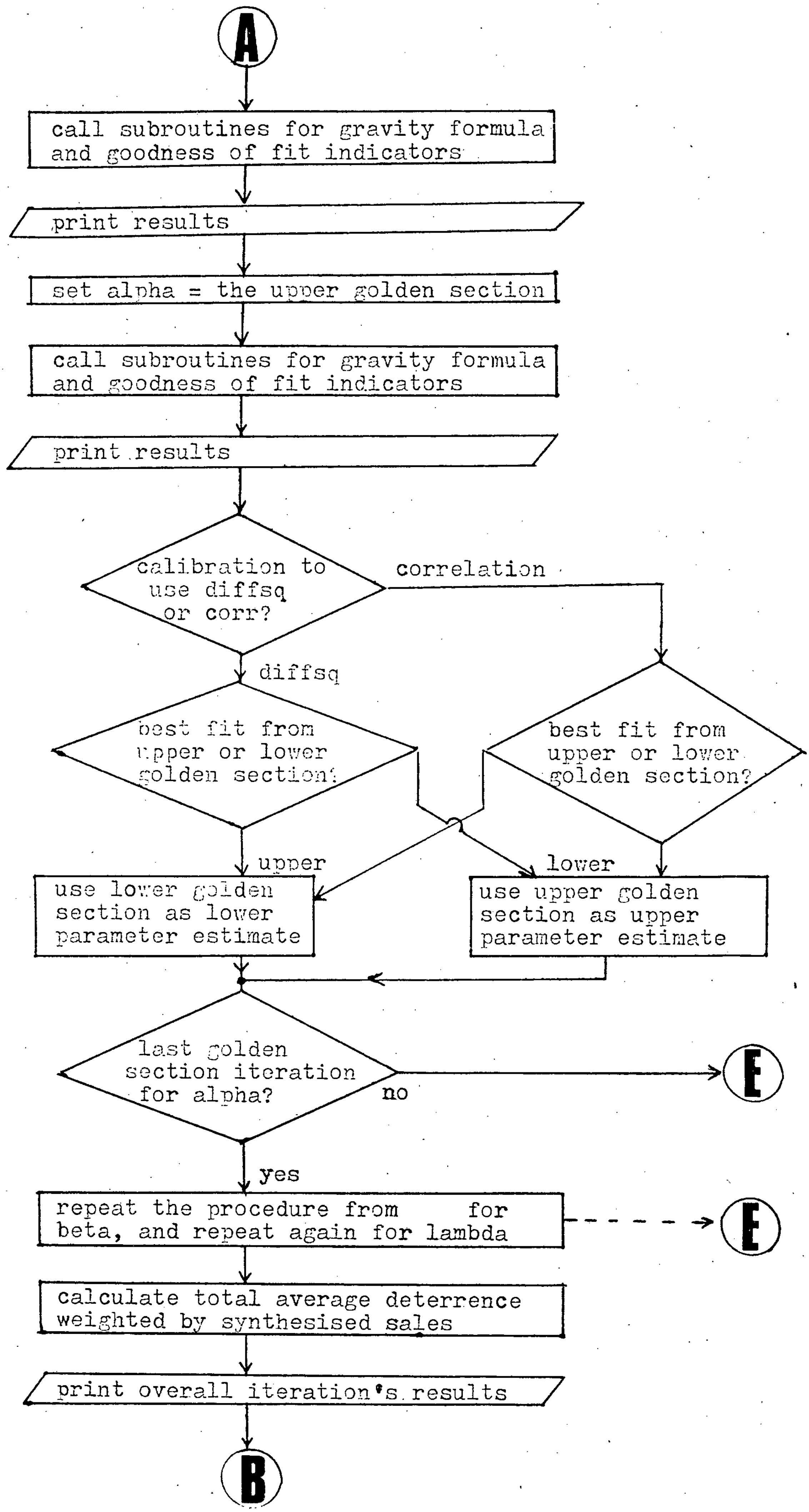
SIMULATION PARAMETER CARD # S1.

1-10	ALPHA	F10.7	Input alpha value.
11-20	BETA	F10.7	Input beta value.
21-30	LAMBDA	F10.7	Input lambda value.

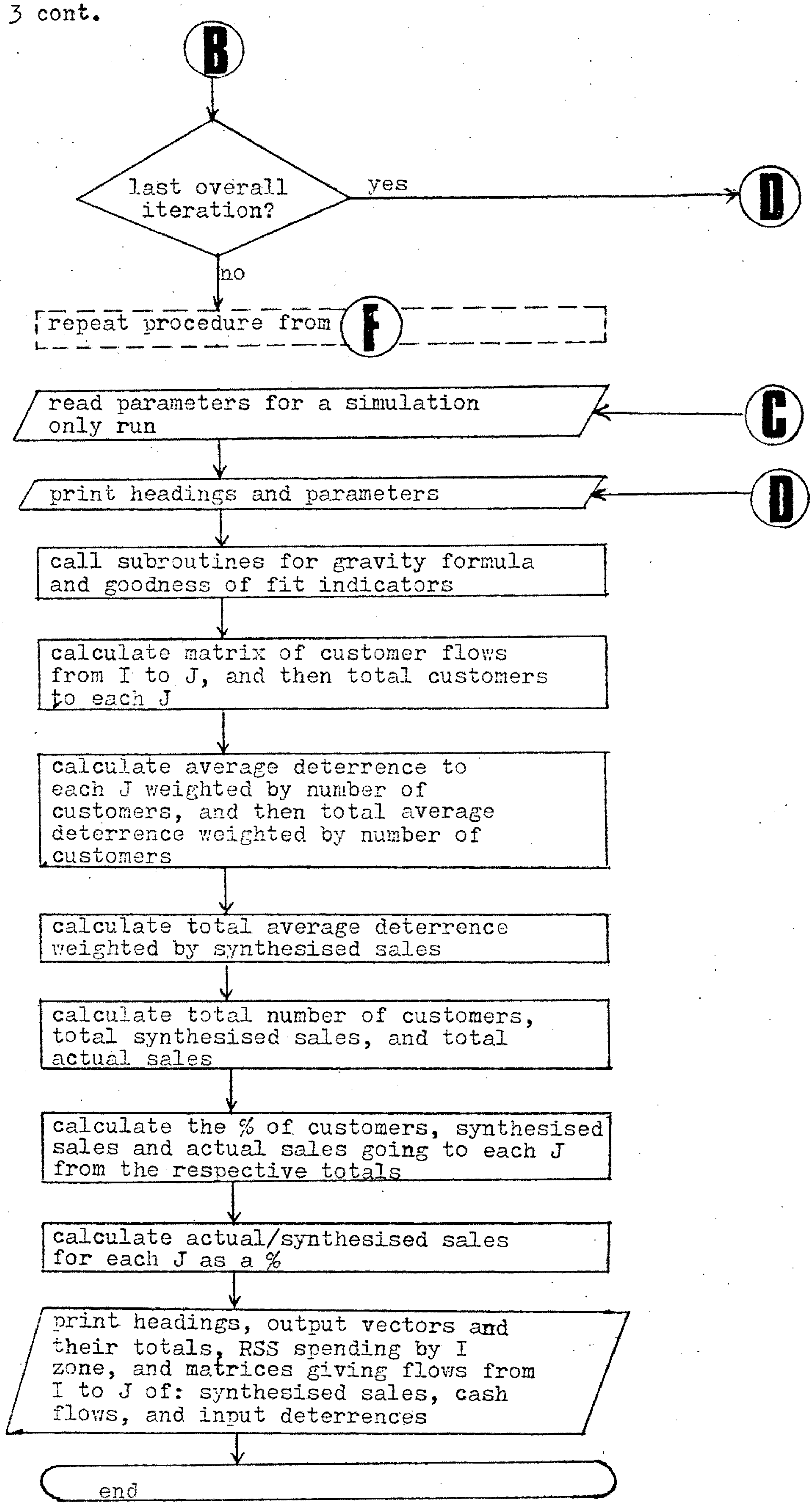
APPENDIX 3. SIMPLIFIED LOCATIONAL MODEL FLOW DIAGRAM.



Appendix 3 cont.



Appendix 3 cont.



APPENDIX 4.

SIMULATION RUN
****

DIFF SQ	CORR	ATR ALPHA	ATRA BETA	C LAMBDA	I	J	C
5391.388184	.877108477	1.000000	.000020	.241557	36	5	.027258

AVE OF C(I,J) WEIGHTED BY SYNTH SALES, 13.729058

SUMMARY SITE INFORMATION
****

SITE	AVE TRIP COST	NO OF CUST	% OF CUST	% OF ACT SALES	% OF SYN SALES	SYNTHESISED SALES	ACTUAL SALES	ATTRACTION OF J	% ACT/SYNTH SALES
1	14.660617	7126.	23.05	19.08	19.25	473596.	469536.	1.000000	99.1428
2	14.790051	7151.	23.13	20.39	20.43	502554.	501696.	1.000000	99.8293
3	15.333991	4964.	16.05	17.78	15.53	382001.	437376.	1.000000	114.4960
4	13.602245	6070.	19.63	23.27	23.37	574930.	572448.	1.000000	99.5684
5	13.114431	5606.	18.13	19.48	21.43	527159.	479184.	1.000000	90.8993
ALL J	14.300267	30917.	100.00	100.00	100.00	2460240.	2460240.		

NOTE:AVE TRIP COST=C(I,J) WEIGHTED BY NO OF CUSTOMERS

APPENDIX 5.

SIMULATION RUN

DIFF SQ	CORR	ATR ALPHA	ATRA BETA	C LAMBDA	I	J	C
3.253417	.999988593	1.088056	.000035	.236698	36	5	.027258

AVE OF C(I,J) WEIGHTED BY SYNTH SALES 13.790120

SUMMARY SITE INFORMATION

SITE	AVE TRIP COST	NO OF CUST	% OF CUST	% OF ACT SALES	% OF SYN SALES	SYNTHESISED SALES	ACTUAL SALES	ATTRACTION OF J	% ACT/SYNTH SALES
1	14.656116	7065.	22.85	19.08	19.10	469932.	469536.	.991428	99.9157
2	14.769315	7137.	23.08	20.39	20.40	501801.	501696.	.998293	99.9791
3	15.437968	5649.	18.27	17.78	17.82	438404.	437376.	1.144960	99.7655
4	13.562190	5997.	19.40	23.27	23.21	571028.	572448.	.995684	100.2487
5	13.081005	5069.	16.39	19.48	19.47	479075.	479184.	.908993	100.0228
ALL J	14.301319	30917.	100.00	100.00	100.00	2460240.	2460240.		

NOTE:AVE TRIP COST=C(I,J) WEIGHTED BY NO OF CUSTOMERS

APPENDIX 6.

SIMULATION RUN

	ATR	ATRA	C			
DIFF SQ	CORR	ALPHA	BETA	LAMBDA	I	J	C
1018.652695	.959931207	.873568	.000017	.201910	36	5	.027258

OF C(I,J) WEIGHTED BY SYNTH SALES 14.098078

SUMMARY SITE INFORMATION

:	AVE TRIP COST	NO OF CUST	% OF CUST	% OF ACT SALES	% OF SYN SALES	SYNTHESISED SALES	ACTUAL SALES	ATTRACTION OF J	% ACT/SYNTH SALES
	14.916131	7147.	23.12	19.08	19.44	478380.	469536.	1.026000	98.1512
2	15.024192	6789.	21.96	20.39	19.45	478638.	501696.	.942000	104.8174
3	15.754103	5443.	17.61	17.78	17.38	427512.	437376.	1.106000	102.3073
4	13.928581	6208.	20.08	23.27	23.62	581201.	572448.	1.036000	98.4940
5	13.703385	5330.	17.24	19.48	20.10	494509.	479184.	.930000	96.9010
J	14.665278	30917.	100.00	100.00	100.00	2460240.	2460240.		

I:AVE TRIP COST=C(I,J) WEIGHTED BY NO OF CUSTOMERS

IAL RETAIL SPENDING

1	44777.21
2	50405.86
3	65805.87
4	84251.55
5	48472.49
6	43079.66
7	87253.00
8	55863.83
9	59650.96
10	40996.90
11	32680.42
12	90218.79
13	132675.75
14	67215.37
15	63743.70
16	80062.76
17	53100.67
18	114002.83
19	124626.43
20	130988.91
21	89408.59
22	89325.89
23	20947.14
24	49588.79
25	127578.29
26	75850.19
27	58849.58
28	64023.03
29	16636.31
30	60254.36
31	78424.68
32	63656.47
33	46693.70
34	48311.49
35	44918.24
36	42904.30

CASH FLOWS TO

	1	2	3	4	5
1	28380.81	14923.74	548.59	474.09	449.97
2	2047.75	1799.60	13912.98	18559.45	13686.09
3	415.34	1723.07	25061.82	20467.91	18137.73
4	56049.04	20574.62	2291.49	2965.57	2370.82
5	30501.24	14704.82	998.64	1108.55	1159.23
6	805.66	2524.46	12980.17	16036.29	10733.08
7	1681.90	2402.74	45713.73	22309.96	15144.67
8	453.56	1006.24	22094.98	16510.94	15798.12
9	27519.13	25571.44	2462.67	2149.84	1947.87
10	9338.66	25819.11	1862.87	1738.28	2237.97
11	5217.00	12547.87	2639.83	5833.62	6442.09
12	7662.71	24450.85	9835.17	25492.65	31777.41
13	651.06	1951.41	26607.47	54126.38	49339.42
14	188.69	10210.61	23936.26	18288.59	14591.22
15	25736.59	32902.58	2111.68	1700.40	1292.46
16	31520.01	39891.59	4710.83	4440.35	3499.99
17	7665.50	14180.43	6322.69	10899.47	14032.58
18	1008.79	2136.50	15768.12	42469.54	52619.87
19	1381.00	4560.47	22612.03	42860.95	53211.97
20	1083.40	3732.65	21188.52	54920.78	50063.57
21	1853.45	2762.50	18282.13	34793.84	31716.66
22	42617.33	42846.34	1115.18	808.48	1938.57
23	6513.96	12828.45	686.52	513.02	405.19
24	4592.05	9025.32	9377.43	22285.21	4308.78
25	382.34	25.53	13814.36	83610.79	29745.28
26	10792.61	19724.87	16280.61	14978.47	14073.63
27	9179.10	16111.97	13597.26	10773.55	9187.71
28	11012.46	18640.17	16051.70	10498.44	7820.27
29	9656.42	5202.21	484.10	714.37	579.22
30	38561.66	14979.70	1834.31	1691.01	3168.68
31	52324.97	19053.17	2295.99	1878.84	2871.81
32	33269.19	24509.49	1582.56	1476.71	2819.51
33	5135.88	6068.72	17856.62	10046.78	7605.69
34	1413.28	981.94	24684.98	12903.31	8327.99
35	622.87	861.54	24398.05	9478.14	6557.66
36	10745.09	27402.17	1529.93	1396.24	1826.87

CUSTOMER
FLOWS

	1	2	3	4	5
1	556.	293.	11.	9.	9.
2	43.	31.	242.	323.	238.
3	5.	23.	329.	269.	238.
4	655.	241.	27.	35.	28.
5	542.	262.	18.	20.	21.
6	14.	43.	224.	276.	185.
7	21.	30.	573.	280.	190.
8	8.	18.	392.	293.	281.
9	329.	306.	29.	26.	23.
10	126.	350.	25.	24.	30.
11	66.	159.	33.	74.	82.
12	82.	260.	105.	271.	338.
13	5.	15.	203.	413.	377.
14	3.	139.	326.	249.	199.
15	362.	462.	30.	24.	18.
16	549.	694.	82.	77.	61.
17	87.	162.	72.	124.	160.
18	8.	16.	121.	327.	405.
19	11.	37.	186.	352.	437.
20	8.	29.	163.	423.	386.
21	18.	27.	181.	345.	315.
22	521.	524.	14.	10.	24.
23	82.	161.	9.	6.	5.
24	38.	74.	77.	182.	35.
25	3.	0.	103.	626.	223.
26	125.	229.	189.	174.	164.
27	126.	220.	186.	147.	126.
28	159.	269.	232.	152.	113.
29	287.	155.	14.	21.	17.
30	520.	202.	25.	23.	43.
31	763.	278.	33.	27.	42.
32	744.	548.	35.	33.	63.
33	90.	107.	314.	177.	134.
34	25.	17.	429.	224.	145.
35	10.	14.	388.	151.	152.
36	154.	303.	22.	20.	26.

INPUT DETERRENCE FUNCTION

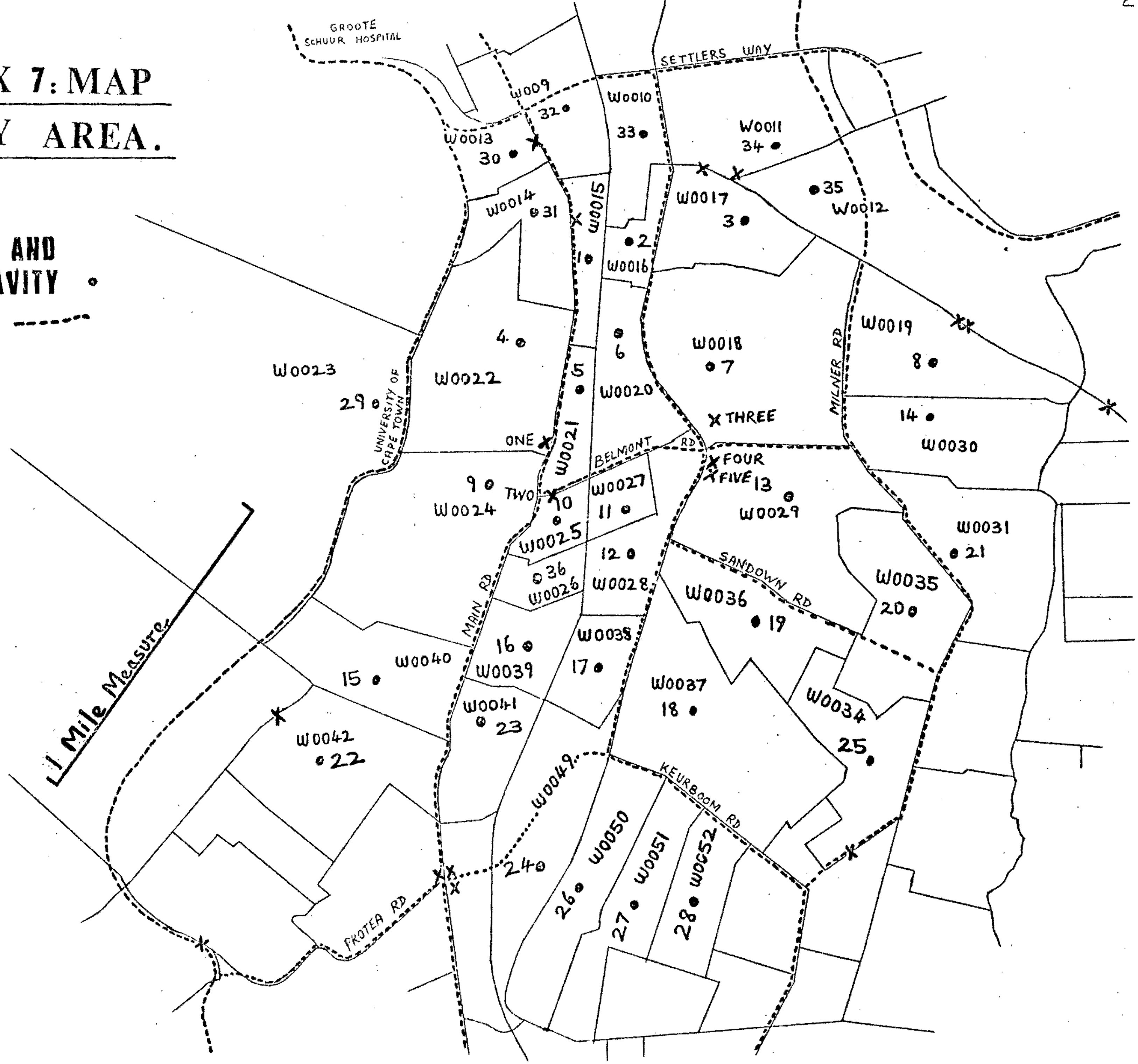
	J= 1	J= 2	J= 3	J= 4	J= 5	I=
I= 1	11.130000	13.950000	31.020000	31.440000	31.240000	
I= 2	21.900000	23.060000	13.640000	11.910000	12.960000	
I= 3	32.760000	25.350000	12.800000	13.500000	13.640000	
I= 4	5.000000	9.600000	21.180000	19.600000	20.250000	
I= 5	3.000000	6.250000	20.280000	19.460000	18.780000	
I= 6	21.770000	15.750000	8.350000	7.000000	8.530000	
I= 7	19.010000	16.880000	3.000000	6.250000	7.710000	
I= 8	34.900000	30.590000	16.000000	17.140000	16.900000	
I= 9	4.000000	4.000000	16.300000	16.670000	16.700000	
I=10	6.400000	1.000000	14.730000	14.770000	13.060000	
I=11	7.710000	3.000000	11.430000	7.200000	6.250000	
I=12	12.460000	6.350000	11.570000	6.550000	5.000000	
I=13	24.850000	19.050000	6.820000	3.000000	3.000000	
I=14	39.350000	19.220000	15.710000	16.740000	17.400000	
I=15	16.900000	15.320000	29.630000	30.400000	31.300000	
I=16	9.530000	8.000000	19.290000	19.280000	20.000000	
I=17	12.410000	9.000000	13.710000	10.710000	9.000000	
I=18	30.000000	25.920000	16.730000	11.520000	10.000000	
I=19	25.500000	19.220000	12.000000	8.530000	7.000000	
I=20	29.400000	22.910000	15.020000	10.000000	10.000000	
I=21	25.480000	23.140000	14.490000	11.000000	11.000000	
I=22	27.340000	26.950000	45.730000	47.020000	42.230000	
I=23	14.520000	10.800000	26.010000	27.150000	27.860000	
I=24	33.700000	29.990000	30.510000	25.920000	33.600000	
I=25	39.640000	52.680000	22.220000	13.000000	17.660000	
I=26	27.850000	24.500000	26.160000	26.270000	26.120000	
I=27	30.420000	27.270000	28.820000	29.670000	30.000000	
I=28	32.150000	29.180000	30.630000	32.430000	33.430000	
I=29	13.000000	15.700000	28.170000	25.940000	26.520000	
I=30	20.570000	24.890000	36.000000	36.100000	32.500000	
I=31	14.890000	19.530000	30.720000	31.410000	29.950000	
I=32	21.910000	25.060000	37.340000	37.380000	33.720000	
I=33	24.850000	23.660000	19.030000	21.570000	22.490000	
I=34	29.950000	31.590000	16.130000	19.040000	20.750000	
I=35	32.110000	30.140000	14.290000	18.670000	18.170000	
I=36	9.000000	3.000000	18.000000	18.150000	16.360000	

APPENDIX 7: MAP OF STUDY AREA.

RSS X

ESD NUMBERS AND CENTRE OF GRAVITY •

MAIN ROADS - - - - -



APPENDIX 8: RSS ATTRACTIVE ELEMENTS FROM SURVEY.

	RSS1	RSS2	RSS3	RSS4	RSS5
Amenities within 500m: (note 1)	C,S, W	C,P, L,S	O,W	O,W P,S	O,W P,S
Appeal of area within 500m:	3	2	1	2	1
No of driveway attendants:	3	4	4	5	3.5
No of mechanics:	2	12	0	3	1.5
Total no of staff:	10	55	6	11	14
Attendants/equipment clean/neat?	N	Y	Y	Y	Y
Accounts available?	Y	Y	Y	Y	Y
Credit cards accepted?	Y	Y	Y	Y	Y
Courtesy vehicle available?	Y	Y	N	Y	Y
Dealer's service (years)	8	2	15	17	1
Average customer stop (seconds)	201	197	241	249	279
Brand (note 2)	B	M	B	C	S
Cheapest polish per litre: (cents)	478	580	533	320	480
Price 5l of brand's oil (cents)	520	494	400	500	490
Price to balance 1 wheel (cents)	250	300	239	150	255
Reputation (subjective) (3=poor)	1	3	2	2	2
Insurance available?	N	Y	N	N	N
Spares shop?	N	Y	N	N	Y
General shop?	N	N	N	N	Y
Customer toilets?	Y	Y	Y	Y	Y
Motor car franchise?	Y	Y	N	N	N
Car Wash?	N	N	N	N	N
Dynamic balancing and alignment?	Y	Y	N	Y	Y
Canopy?	Y	Y	N	Y	Y
Age (years)	40	20	40	17	30
Frontage (m)	36	55	30	36	47
Pump layout (square/long)	L	L	S	S	S
Diagnostic bay?	Y	Y	N	N	Y
Multigrade octane?	Y	N	N	N	N
Ease of entry (3=poor)	3	1	2	2	2

Note 1: S = Shopping centre; P = Post office; C = Cinema;
L = Library; O = Large open area; W = Schools.

Note 2: B = BP; M = Mobil; C = Caltex; S = Shell.

APPENDIX 9: A LOW COST RSS LOCATIONAL MODEL.

The gravity models developed in Ch 4 are all based on some form of cost or deterrence function. It is costly and difficult to obtain reliable data for these functions, and sometimes, as in Ch 6, it is not available in the form required. The RSS model developed in Ch 4 has been modified to accept traffic flow data in place of the deterrence data. The model is set up as normal, except for a few program changes, which have been given below.

It would not be acceptable to develop a general shopping model using car counts at shop sites in place of the deterrence function. Customers may well go out of their way to visit a shopping centre - ie have a positive general shopping AVD. A variety of attraction factors which may cause such AVDs are discussed in 4.5. It has been shown however, (Chs 4, 6) how location is the prime factor affecting RSS customer allocation. The fact that petrol prices are controlled in SA, and that there is no reason to believe that RSS size and attraction are closely related, also enable the RSS model to accept car count data. Few SA customers are likely to move far off the major traffic flows specifically to visit an RSS, and especially to buy petrol. The car count will probably provide a good measure therefore, of the RSS potential in an area.

Most OC will already have car count data for any RSS under study. Indeed, car counts are at present one of the most important tools used by the OC in the analysis of sales potential. This should enable the build up of considerably larger study areas than that attempted in this thesis.

When using this new approach, it becomes important to take account of "external" RSS, especially if the study area is small. The critical point to examine is whether the external RSS have a higher or lower average AVD than those in the study area. If the external AVD is lower, this may cause the car count figures in the study area to be optimistic in their predictions.

It is also important to obtain an "ease of access" attractive element for each RSS under examination, to be included in the composite attractive variable. Once again, car count figures may be somewhat optimistic if an RSS has poor driveway access. Of course, all attractive elements may be subjected to the multiple regression described in Ch 4.

Although it is not done in the program changes below, it is suggested the distance to next opportunity factor included in the

APPENDIX 9 cont.

locational model could profitably be removed. It would simplify the program, its setting up, and cut down on computer time. It is unlikely to have much affect, if at all, on the model's predictive ability.

The following program changes are required; refer to Appendix 1.

LINE NO.	THE LINE NOW BECOMES.
9	3,C(20), PER(20)
14	remove
15	READ 1007,(C(J),J=1,M)
162-168	remove
200-228	remove
291	181 CONTINUE
292-305	remove
382	DIMENSION C(20),S(50,20),YC(50),SUM3(50),T(20),ATR(20)
388	S(I,J)=(EXP((ATR(J)*ALPHA)+(ATRA(I,J)*BETA)+(C(J)*LAMBDA)))

The model is now set up as normal, except that in place of the deterrence matrix, the vector of car count figures is read in, in 7F10.2 format. It will do the necessary calculations, and print zeros where deterrence based data was previously output.

NUMBER OF: DG OBJS; RG OBJS; RGS; ALPHA VALUE
16 6 32 1.750

FULL PRINT=1,PART PRINT=0. VALUE= 0
ITERATE=1,ONE RUN=0. VALUE= 0

NO ITERATIONS= 10 CUMULATIVE CHANGE= 1.100000

DG GOAL WEIGHTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
.20	.12	.09	.04	.03	.03	.04	.01	.04	.07	.06	.07	.01	.05	.04	.10

RG GOAL WEIGHTS

1	2	3	4	5	6
.60	.12	.05	.10	.03	.10

RG WEIGHTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
.01	.11	.16	.31	.08	.02	.14	.17	.02	.05	.01	.01	.06	.01	.05	.03	.09	.03	.00	.00

21	22	23	24	25	26	27	28	29	30	31	32
.00	.00	.00	.00	.36	.27	.07	.01	.15	.10	.37	.29

DG EVALUATION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.	0.	1.	0.	1.	1.	0.	1.	0.	2.	1.	1.	0.	0.	0.	1.

RG EVALUATION

UROTA

	1	2	3	4	5	6
1	1.	0.	1.	1.	1.	0.
2	1.	0.	1.	1.	1.	0.
3	1.	0.	0.	1.	0.	0.
4	1.	0.	0.	1.	0.	0.
5	1.	1.	0.	1.	0.	0.
6	1.	1.	0.	1.	0.	0.
7	1.	0.	0.	1.	0.	0.
8	1.	0.	1.	0.	1.	0.
9	1.	0.	0.	0.	0.	0.
10	1.	0.	0.	0.	0.	0.
11	1.	0.	0.	0.	0.	0.
12	1.	0.	0.	0.	0.	0.
13	1.	1.	1.	0.	0.	0.
14	1.	1.	1.	0.	0.	0.
15	1.	0.	0.	0.	0.	0.
16	1.	0.	0.	0.	0.	0.
17	1.	0.	0.	0.	0.	0.
18	1.	0.	0.	0.	0.	0.
19	1.	0.	0.	0.	0.	0.
20	1.	0.	0.	0.	0.	0.
21	2.	0.	-1.	2.	0.	0.
22	2.	0.	-1.	2.	0.	0.
23	-2.	0.	-2.	0.	0.	0.
24	-1.	0.	-2.	0.	0.	0.
25	1.	0.	0.	0.	0.	0.
26	1.	0.	0.	0.	0.	0.
27	1.	0.	0.	0.	0.	0.
28	1.	0.	0.	0.	0.	0.
29	1.	0.	0.	0.	0.	0.
30	1.	0.	0.	0.	0.	0.
31	1.	1.	1.	0.	0.	0.

DG EVALUATION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.	2.	0.	1.

RG EVALUATION

	1	2	3	4	5	6
1	0.	0.	0.	0.	0.	0.
2	-1.	0.	-1.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	-1.	0.	-1.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	1.
28	0.	0.	0.	0.	0.	1.
29	0.	0.	-1.	0.	0.	0.
30	0.	0.	-1.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.

PATRIOTIC APPEALS

1 1.750000 .210000 -.092213 .275287

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.	0.	1.	0.	0.	0.	0.	0.	0.	1.	0.	0.	2.	1.	0.	0.

RG EVALUATION

ASP

	1	2	3	4	5	6
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.
13	-1.	0.	0.	-1.	0.	0.
14	-1.	0.	0.	-1.	0.	0.
15	-1.	0.	0.	-1.	0.	0.
16	-1.	0.	0.	-1.	0.	0.
17	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.
21	-1.	0.	-1.	0.	0.	0.
22	-1.	0.	-1.	0.	0.	0.
23	-1.	0.	-1.	0.	0.	0.
24	-1.	0.	-1.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	1.	0.
28	0.	0.	0.	0.	1.	0.
29	-1.	0.	0.	0.	0.	0.
30	-1.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.

1 1.750000 .230000 -.086792 .315708

UG EVALUATION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.	0.	2.	0.	0.	0.	0.	-1.	0.	2.	2.	1.	1.	2.	0.	2.

RG EVALUATION

CONSUMPTION CURBS

	1	2	3	4	5	6
1	-2.	0.	-2.	-1.	-1.	-1.
2	-2.	0.	-2.	-1.	-1.	2.
3	-2.	0.	-2.	-1.	-1.	-1.
4	-2.	0.	-2.	-1.	-1.	2.
5	-2.	0.	-2.	-1.	-1.	-1.
6	-2.	0.	-2.	-1.	-1.	-1.
7	-2.	0.	-2.	-1.	-1.	-1.
8	-2.	-1.	-2.	-1.	-1.	-1.
9	-2.	0.	-2.	-1.	0.	0.
10	-2.	0.	-2.	-1.	0.	0.
11	-2.	0.	-2.	-1.	0.	0.
12	-2.	0.	-2.	-1.	0.	0.
13	-2.	0.	-2.	-1.	-1.	0.
14	-2.	0.	-2.	-1.	-1.	0.
15	-2.	0.	-2.	-1.	-1.	0.
16	-2.	0.	-2.	-1.	-1.	0.
17	-2.	0.	-2.	-1.	0.	0.
18	-2.	0.	-2.	-1.	0.	0.
19	-2.	0.	-2.	-2.	-1.	0.
20	-2.	0.	-2.	-2.	-1.	0.
21	-2.	0.	-2.	-2.	-1.	0.
22	-2.	0.	-2.	-2.	-1.	0.
23	-2.	0.	-2.	-2.	-1.	0.
24	-2.	0.	-2.	-2.	-1.	0.
25	-2.	0.	-2.	-1.	-1.	0.
26	-2.	0.	-2.	-1.	-1.	0.
27	-1.	0.	0.	0.	0.	0.
28	-1.	0.	0.	0.	0.	0.
29	-2.	0.	-2.	-1.	-1.	0.
30	-2.	0.	-2.	-1.	-1.	0.
31	-2.	0.	-2.	-1.	-1.	0.
32	-2.	0.	-2.	-1.	-1.	0.

1	1.750000	.810000	-1.402831	.014669

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.	0.	-2.	0.	-2.	-1.	0.	0.	0.	-2.	-2.	-1.	2.	-2.	-1.	-1.

RG EVALUATION

REMOVE PRICE / MARGIN CONTROLS

	1	2	3	4	5	6
1	-2.	0.	0.	-2.	-1.	-1.
2	-2.	0.	0.	-2.	-1.	-1.
3	1.	0.	0.	0.	2.	0.
4	1.	0.	0.	0.	2.	-1.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	1.	0.
8	-2.	0.	0.	-2.	-2.	0.
9	-1.	0.	1.	-1.	0.	0.
10	-1.	0.	1.	-1.	0.	0.
11	-1.	0.	1.	-1.	0.	0.
12	-1.	0.	1.	-1.	0.	0.
13	-1.	0.	1.	0.	0.	0.
14	-1.	0.	1.	0.	0.	0.
15	-1.	0.	1.	0.	0.	0.
16	-1.	0.	1.	0.	0.	0.
17	-1.	0.	1.	0.	0.	0.
18	-1.	0.	1.	0.	0.	0.
19	-1.	0.	0.	0.	0.	0.
20	-1.	0.	0.	0.	0.	0.
21	-1.	1.	1.	0.	0.	0.
22	-1.	1.	1.	0.	0.	0.
23	-1.	1.	2.	0.	0.	0.
24	-1.	1.	2.	0.	0.	0.
25	-1.	0.	0.	0.	0.	0.
26	-1.	0.	0.	0.	0.	0.
27	-1.	0.	0.	0.	0.	-1.
28	-1.	0.	0.	0.	0.	-1.
29	0.	1.	1.	0.	1.	0.
30	0.	1.	1.	0.	1.	0.
31	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.

1 1.750000 -.820000 -.249260 -1.684260

DG EVALUATION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.	0.	2.	0.	1.	1.	0.	0.	0.	2.	2.	1.	1.	1.	2.	1.

RG EVALUATION

PRICE / MARGIN CONTROLS

	1	2	3	4	5	6
1	2.	0.	0.	1.	1.	0.
2	2.	0.	0.	1.	1.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	1.	0.	0.	1.	1.	0.
9	1.	0.	0.	1.	1.	0.
10	1.	0.	0.	1.	1.	0.
11	1.	0.	0.	1.	1.	0.
12	1.	0.	0.	1.	1.	0.
13	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.
17	1.	0.	0.	1.	1.	0.
18	1.	0.	0.	1.	1.	0.
19	1.	0.	0.	1.	1.	0.
20	1.	0.	0.	1.	1.	0.
21	2.	0.	-1.	1.	0.	0.
22	2.	0.	-1.	1.	0.	0.
23	2.	0.	-2.	1.	0.	0.
24	2.	0.	-1.	1.	0.	0.
25	0.	0.	0.	0.	1.	0.
26	0.	0.	0.	0.	1.	0.
27	0.	0.	0.	0.	1.	0.
28	0.	0.	0.	0.	1.	0.
29	1.	0.	0.	1.	1.	0.
30	1.	0.	0.	1.	1.	0.
31	0.	0.	0.	0.	1.	0.
32	0.	0.	0.	0.	1.	0.

1 1.750000 .810000 .224744 1.642244

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0.	0.	2.	0.	2.	1.	0.	0.	1.	2.	2.	1.	2.	1.	0.	1.

RG EVALUATION

RATIONALISATION

	1	2	3	4	5	6
1	-1.	0.	0.	1.	0.	0.
2	-1.	0.	0.	1.	0.	0.
3	-1.	0.	0.	0.	0.	0.
4	-1.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	-1.	0.	0.	0.	0.	0.
8	0.	0.	0.	1.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.
13	1.	0.	0.	0.	0.	0.
14	1.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.
19	-1.	0.	0.	0.	0.	0.
20	-1.	0.	0.	0.	0.	0.
21	2.	0.	0.	-2.	0.	0.
22	2.	0.	0.	-2.	0.	0.
23	2.	0.	-1.	-2.	0.	0.
24	2.	0.	0.	-2.	0.	0.
25	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.
29	-1.	0.	0.	0.	0.	0.
30	-1.	0.	0.	0.	0.	0.
31	-2.	0.	0.	0.	0.	0.
32	-2.	0.	0.	0.	0.	0.

1 1.750000 .810000 -.435488 .982012

DG EVALUATION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2.	1.	1.	0.	2.	1.	0.	0.	0.	2.	2.	0.	2.	0.	0.	0.

RG EVALUATION

SITING LIMITS

	1	2	3	4	5	6
1	-1.	0.	0.	0.	0.	0.
2	-1.	0.	0.	0.	0.	0.
3	-1.	0.	0.	0.	1.	0.
4	-1.	0.	0.	0.	1.	0.
5	-1.	0.	0.	0.	0.	0.
6	-1.	0.	0.	0.	0.	0.
7	-1.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	-1.	0.	0.	0.	0.	0.
10	-1.	0.	0.	0.	0.	0.
11	-1.	0.	0.	0.	0.	0.
12	-1.	0.	0.	0.	0.	0.
13	-1.	0.	0.	0.	0.	0.
14	-1.	0.	0.	0.	0.	0.
15	-1.	0.	0.	0.	0.	0.
16	-1.	0.	0.	0.	0.	0.
17	-1.	0.	0.	0.	0.	0.
18	-1.	0.	0.	0.	0.	0.
19	-2.	0.	-1.	0.	0.	0.
20	-2.	0.	-1.	0.	0.	0.
21	-2.	0.	-2.	0.	0.	0.
22	-2.	0.	-2.	-1.	0.	0.
23	-2.	0.	-2.	0.	0.	0.
24	-2.	0.	-2.	-1.	0.	0.
25	-1.	0.	0.	0.	0.	0.
26	-1.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	2.	0.
28	0.	0.	0.	0.	2.	0.
29	0.	0.	0.	0.	0.	0.
30	-1.	0.	0.	0.	0.	0.
31	-1.	0.	0.	0.	0.	0.
32	-1.	0.	0.	0.	0.	0.

1	1.750000	.980000	-.513820	1.201180

```
      READ 100,IDGO,IRGO,IRG,ALPHA
      PRINT 501
      PRINT 502
      PRINT 503
      PRINT 500,IDGO,IRGO,IRG,ALPHA
      READ 102,KP,KI
      PRINT 541
      PRINT 542,KP
      PRINT 543,KI
      READ 103,NIT,PERIT
      PRINT 541
      PRINT 547,NIT,PERIT
      READ 105,(DGGOAL(I),I=1,IDGO)
      PRINT 541
      PRINT 504
      PRINT 506,(I,I=1,IDGO)
      PRINT 505,(DGGOAL(I),I=1,IDGO)
      DO 1023 I=1,IDGO
 1023 COPY(I)=DGGOAL(I)
      READ105,(RGGOAL(J),J=1,IRGO)
      PRINT 541
      PRINT 507
      PRINT 506,(J,J=1,IRGO)
      PRINT 505,(RGGOAL(J),J=1,IRGO)
      READ 106,(RGW(K),K=1,IRG)
      PRINT 541
      PRINT 508
      PRINT 506,(K,K=1,16)
      PRINT 505,(RGW(K),K=1,16)
      PRINT 541
      PRINT 506,(K,K=17,IRG)
      PRINT 505,(RGW(K),K=17,IRG)
 1002 READ 120,(DGEVAL(I),I=1,IDGO)
      ACTINC=1.0
      PRINT 541
      PRINT 510
      PRINT 506,(I,I=1,IDGO)
      PRINT 520,(DGEVAL(I),I=1,IDGO)
      PRINT 541
      PRINT 511
      PRINT 513,(J,J=1,IRGO)
      DO 1000 K=1,IRG
      READ 120,(RGEVAL(K,J),J=1,IRGO)
 1000 PRINT 521,K,(RGEVAL(K,J),J=1,IRGO)
      PRINT 541
      PRINT 541
 1001 SUMA = 0.0
      DO 1005 I=1,IDGO
      A(I)=DGGOAL(I)*DGEVAL(I)
 1005 SUMA=SUMA+A(I)
      SUMB=0.0
      DO 1010 K=1,IRG
      DO 1010 J=1,IRGO
      B(K,J)=RGEVAL(K,J)*RGGOAL(J)/3*RGW(K)
 1010 SUMB=SUMB+B(K,J)
      AALPHA=SUMA*ALPHA

      DGDV=AALPHA+SUMB
      IF(KP) 1013,1013,1012
 1012 PRINT 526
      PRINT 525,(I,I=1,IDGO)
      PRINT 530,(A(I),I=1,IDGO)
      PRINT 541
      PRINT 535,SUMA
      PRINT 541
      PRINT 527
      PRINT 528,(J,J=1,IRGO)
      DO 1015 K=1,IRG
 1015 PRINT 540,K,(B(K,J),J=1,IRGO)
      PRINT 541
      PRINT 537,SUMB
      PRINT 541
```

```
      PRINT 541
      PRINT 536,DGDV
      PRINT 502
 1013 IF(JJ.EQ.1) GO TO 1016
      PRINT 538
      PRINT 544
      PRINT 545
      JJ=JJ+1
 1016 PRINT 546,ITER,  ALPHA,SUMA,SUMB,DGDV,ACTINC
      IF (KI) 1018,1018,1017
 1017 IF (ITER.EQ.NIT) GO TO 1018
      ITER=ITER+1
      SUMC=0.0
      DGGOAL(15)=DGGOAL(15)+(COPY(15)*PERIT)
      DO 1022 I=1,IDGO
 1022 SUMC=SUMC+DGGOAL(I)
      SUMC=1/SUMC
      DO 1021 I=1,IDGO
 1021 DGGOAL(I)=DGGOAL(I)*SUMC
      ACTINC=DGGOAL(15)/COPY(15)
      GO TO 1001
 1018 CONTINUE
      DO 1024 I=1,IDGO
 1024 DGGOAL(I)=COPY(I)
      READ120,(DGEVAL(I),I=1,IDGO)
      DO 1020 K=1,IRG
 1020 READ 120,(RGEVAL(K,J),J=1,IRGO)
      ITER=0
      PRINT 538
      GO TO 1001
  100 FORMAT(3I2,F10.4)
  102 FORMAT(2I1)
  103 FORMAT(I3,F10.6)
  105 FORMAT(36F2.2)
  106 FORMAT(18F4.4)
  120 FORMAT(50F2.0)
  500 FORMAT('0',9X,3I9,F12.3)
  501 FORMAT('1','USER INPUT DATA')
  502 FORMAT('0','***********************')
  503 FORMAT('0','NUMBER OF: DG OBJS; RG OBJS;      RGS; ALPHA VALUE')
  504 FORMAT('0','DG GOAL WEIGHTS')
  505 FORMAT('0',30(F4.2))
  506 FORMAT('0',30I4)
  507 FORMAT('0','RG GOAL WEIGHTS')
  508 FORMAT('0','RG WEIGHTS')
  510 FORMAT('1','DG EVALUATION')
  511 FORMAT('0','RG EVALUATION')
  513 FORMAT('0',5X,10I5)
```

EXAMPLE OF AN ITERATION PROCEDURE— THIS WILL INCREMENT DGGOAL(15) RELATIVE TO THE OTHER DGGOALS.

```
  520 FORMAT('0',30F4.0)
  521 FORMAT('0',I2,3X,10F5.0)
  525 FORMAT('0',20I8)
  526 FORMAT('1','WEIGHTED DG EVALUATION')
  527 FORMAT('0','WEIGHTED RG EVALUATION')
  528 FORMAT('0',3X,10I10)
  530 FORMAT('0',20F8.4)
  535 FORMAT('0','TOTAL DG EVALUATION',F10.5)
  536 FORMAT('0','DECISION VALUE',F10.5)
  537 FORMAT('0','TOTAL RG EVALUATION',F10.5)
  538 FORMAT('1')
  540 FORMAT('0',I2,1X,10F10.5)
  541 FORMAT('0')
  542 FORMAT('0','FULL PRINT=1,PART PRINT=0. VALUE= ',I1)
  543 FORMAT('0','ITERATE=1,ONE RUN=0. VALUE= ',I1)
  544 FORMAT('0','ITER','     ALPHA               ','TOTAL DG',
     14X,'TOTAL RG',6X,'DECISION',4X,'ACTUAL')
  545 FORMAT(' ',23X,'EVALUATION',2X,'EVALUATION',5X,'VALUE',
     17X,'INCREASE')
  546 FORMAT('0',I3,4X,4(2X,F10.6),7X,F10.6)
  547 FORMAT('0','NO ITERATIONS= ',I3,4X,'CUMULATIVE CHANGE=',F9.6)
      STOP
      END
```

APPENDIX 12: THE REGULATORY MODEL'S INPUT AND OPTIONS.

Instructions for the input of data on punch cards are listed below. The cards must be arranged in the sequence in which they are described. The model's various options are outlined as they appear. The description below for each card or group of cards comprises: a heading, the applicable columns, the variables used, their FORTRAN format, and a short explanation.

CONTROL CARD #1.

1-2	IDGO	I2	Number of DG goals.
3-4	IRGO	I2	Number of RG goals.
5-6	IRG	I2	Number of RGs.
7-16	ALPHA	F10.4	Alpha value.

CONTROL CARD #2.

1	KP	I1	Print indicator. Punch 1 for a full print-out, or 0 for a limited print-out.
2	KI	I1	Iteration indicator. Punch 0 for a single run, or 1 if a routine has been inserted in the program, and it is desired to use it within a series of iterations (see App 11 for an example).

CONTROL CARD #3.

1-3	NIT	I3	Number of iterations required.
4-13	PERIT	F10.6	Factor to be used for the increment/decrement in the iteration procedure. Insert a blank card here during single runs.

DG GOAL WEIGHT CARD #4.

1-2 3-4 etc.	DGGOAL(I)	F2.2	DG goal weights: goal 1 in columns 1-2, goal 2 in columns 3-4 etc. Maximum 36 goals per card.

RG GOAL WEIGHT CARD #5.

1-2 3-4 etc.	RGGOAL(J)	F2.2	RG goal weights: goal 1 in columns 1-2, goal 2 in columns 3-4 etc. Maximum 36 goals per card.

RG WEIGHT CARD #6.

1-4 5-8 etc.	RGW(K)	F4.4	RG weights: group 1 in columns 1-4, group 2 in columns 5-8 etc. Maximum 18 groups per card.

APPENDIX 12 cont.

DG EVALUATION CARD #7.

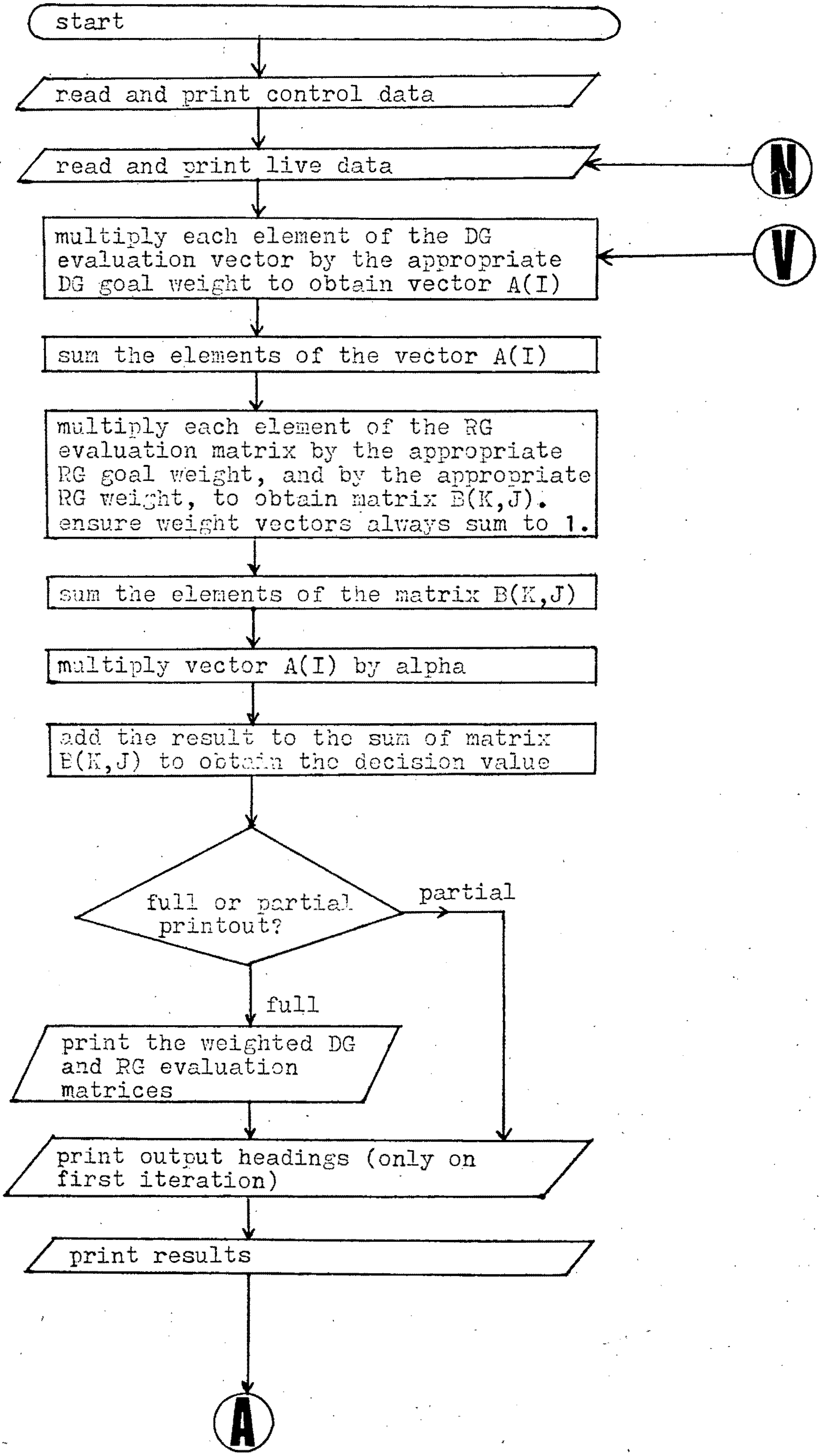
1-2 etc.	DGEVAL(I)	F2.0	DG evaluation vector. Goal 1 in columns 1-2, goal 2 in columns 3-4 etc.

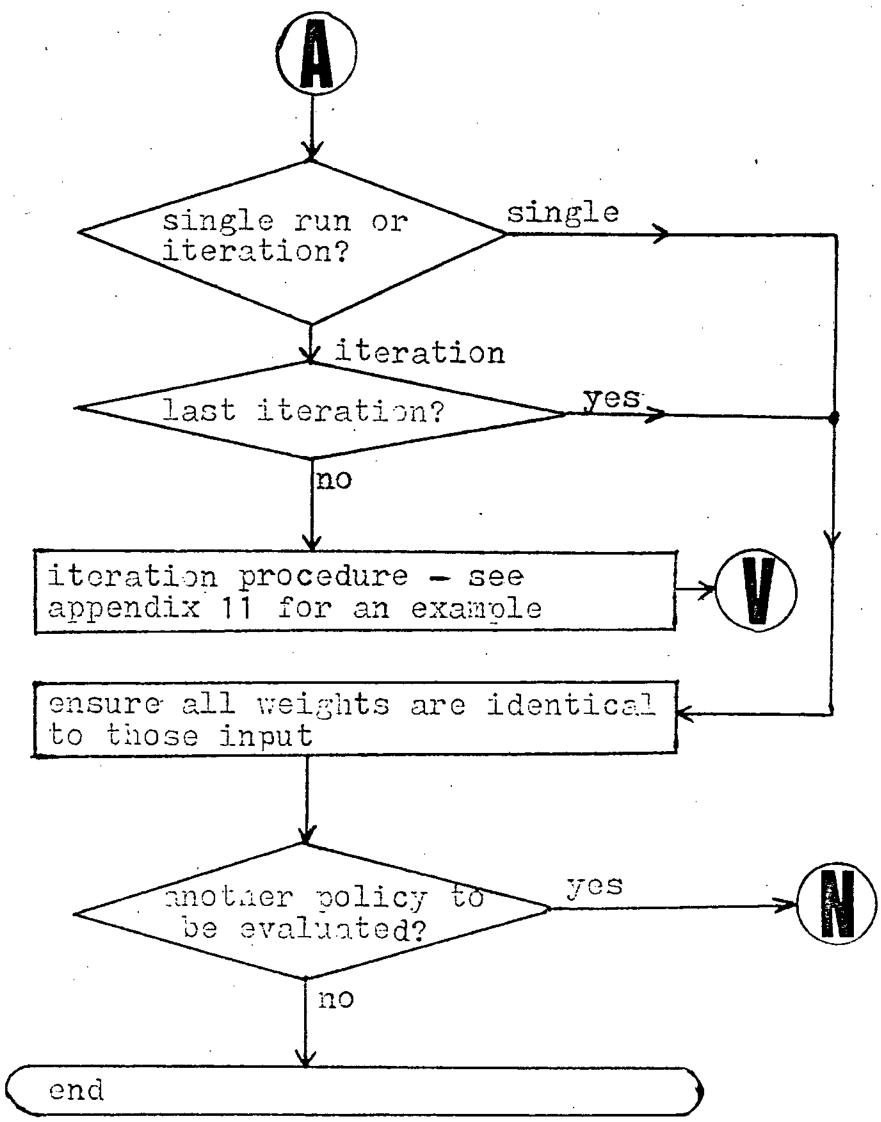
RG EVALUATION CARDS #8.

1-2	RGEVAL(K,J)	F2.0	RG evaluation matrix. For RG 1, its goal 1 evaluation will be in columns 1-2, goal 2 in columns 3-4 etc. (Maximum 50 goals per card). RG 2 will be repeated on a new card, etc.

It is possible that the user may wish to evaluate more than one set of matrices on a single run. In this case, cards #9 and#10 will follow the deck #8 described above. #9 is analogous to #7, and #10 is analogous to #8. Similar data may be added ad infinitum. The program has been written so that it will terminate with an attempt to read error - the most simple and flexible approach in the circumstances.

APPENDIX 13. SIMPLIFIED REGULATION MODEL FLOW DIAGRAM.




A
single run or iteration?
single
iteration
last iteration?
yes
no
iteration procedure - see appendix 11 for an example
V
ensure all weights are identical to those input
another policy to be evaluated?
yes
N
no
end

APPENDIX 14: TRADING AND PROFIT AND LOSS ACCOUNT AND BALANCE SHEET FOR THE AVERAGE NON COMPANY OWNED SA RSS IN 1970 (Rand).

Opening stocks		4 122	Sales		93 806
Purchases and transfers		81 352			
		85 474			
Closing stocks		(4 853)			
Cost of sales		80 621			
Gross profit c/d		13 185			
		93 806			93 806

Salaries and wages		15 004	Gross profit b/d		13 185
Other expenses		8 942	Revenue on services		12 787
			Other trading revenue		777
Net profit c/d		3 398	Non trading revenue		595
		27 344			27 344

Private capital		5 918	Fixed assets:		9 128
Share issues		1 359	Land and buildings		
Profit and loss a/c:		3 521		5 754	
Opening bal	123		Furniture/equip.		
Net profit b/d	3 398			3 374	
Loans and debentures		11 462	Current assets:		20 958
Reserves		1 175	Debtors	8 941	
Current liabilities		6 651	Stock, other	12 017	
		30 086			30 086

Notes.

1. Total number of non company-owned RSS in 1970 = 2 573.
2. Total number of proprietors in 1970 = 1 964.
3. Total number of employees in 1970: 21 068 black, 8 451 white.
4. Average black employee's wage in 1970 was R672.
5. Average white employee's earnings in 1970: R2 892.
6. Source:"South African Statistics 1978", Section 15.16.

APPENDIX 15.

```
      C  RSS GRAVITY MODEL PROGRAM  MODIFIED [illegible]
      C DNJ MILLERS FORMULATION AND PROGRAMMING  VERSION OCTOBER 78
            COMMON/AA/T,M,N/BD/C,S,ALPHA,BETA,LAMBDA,YC,ATR,ATRA,SUM3/
           1CC/R/DD/DSQ/EE/A
            DIMENSION P(50),Y(50),YC(50),S(50,20),A(20),T(20),
           1AVT(50,20),CD(50,20),SUMTL(20),ATR(20),SUMT(20),FRTMK(20),
           2SLSMK(20),ASLSMK(20),IMKJ(20),SUM3(50),ATRA(50,20)
           3,C(50,20),PER(20)
            REAL*4LAMBDA
      C
            READ 1000,N,M,NA,CONS
            PRINT 1050,N,M,NA,CONS
            READ 1001,IZ,IK,L
            PRINT 1014,IZ,IK,L
            LL=L+1
            IY=IZ
            DO 20 I=1,N
         20 READ 1007,(C(I,J),J=1,L)
            READ 1004,(P(I),I=1,N)
            PRINT 1054,(P(I),I=1,N)
            READ 1005,(Y(I),I=1,N)
            PRINT 1055,(Y(I),I=1,N)
            READ 1006,(A(J),J=1,M)
            PRINT 1056,(A(J),J=1,M)
            READ 1011,(ATR(J),J=1,M)
            PRINT 1057,(ATR(J),J=1,M)
            DO 30 I=1,N
            READ 1002,(ATRA(I,J),J=1,L)
         30 PRINT 1058,(ATRA(I,J),J=1,L)
            IF (CONS)40,40,70
         40 SUM1=0.0
            DO 50 I=1,N
         50 SUM1 = SUM1 + Y(I)*P(I)
            SUM2 = 0.0
            DO 60 J=1,M
         60 SUM2 = SUM2+A(J)
            CONS=SUM2/SUM1
      C
         70 DO 80 I=1,N
         80 YC(I)=Y(I)*CONS*P(I)
      C
            KK=0
            IF (NA) 120,120,90
      C
      C                         CALIBRATION
         90 READ 2000,ALMIN,ALMAX,BEMIN,BEMAX,AAMIN,AAMAX
            PRINT 2005
            PRINT 2001,ALMIN,BEMIN,AAMIN
            PRINT 2004,ALMAX,BEMAX,AAMAX
            READ 2002,MGSIT,MOIT,MGF,F
            PRINT 2003,MGSIT,MOIT,MGF,F
         92 PRINT 1008
            PRINT 1023
            PRINT 1009
            PRINT 1010,CONS
            PRINT 1009
            PRINT 1012

            PRINT 1075
            K=0
            KB=0
        200 IF(K.EQ.MOIT) GO TO 126
            IF(KB.EQ.0) GO TO 210
            ALMIN=ALMIN/F
            ALMAX=ALMAX*F
            BEMIN=BEMIN/F
            BEMAX=BEMAX*F
            AAMIN=AAMIN/F
            AAMAX=AAMAX*F
        210 CONTINUE
            KB=1
            KC=0
            PRINT 1070
        212 CONTINUE
            VMIN=ALMIN+(0.382*(ABS(ALMAX-ALMIN)))
            VMAX=ALMIN+(0.618*(ABS(ALMAX-ALMIN)))
            ALPHA=VMIN
            BETA  =(BEMIN+BEMAX)/2.0
            LAMBDA=(AAMIN+AAMAX)/2.0
            CALL CALC
            CALL DIFFSQ
            CALL CORR
            COCOR=R
            CSQR =DSQ
            KC=KC+1
            PRINT 1074,KC,CSQR,COCOR,ALPHA,BETA,LAMBDA
            ALPHA=VMAX
            CALL CALC
            CALL DIFFSQ
            CALL CORR
            PRINT 1074,KC,DSQ,R,ALPHA,BETA,LAMBDA
            IF(MGF.EQ.0) GO TO 220
            IF(CSQR.LT.DSQ) GO TO 230
            ALMIN=VMIN
            GO TO 240
        230 ALMAX=VMAX
            GO TO 240
        220 IF(COCOR.GT.R) GO TO 222
            ALMIN=VMIN
            GO TO 240
        222 ALMAX=VMAX
        240 CONTINUE
            IF(KC.LT.MGSIT) GO TO 212
            PRINT 1071
            KC=0
        245 VMIN=BEMIN+(0.382*(ABS(BEMAX-BEMIN)))
            VMAX=BEMIN+(0.618*(ABS(BEMAX-BEMIN)))
            BETA=VMIN
            ALPHA=(ALMIN+ALMAX)/2.0
            CALL CALC
            CALL DIFFSQ
            CALL CORR
            COCOR=R
            CSQR=DSQ
            KC=KC+1
            PRINT 1074,KC,CSQR,COCOR,ALPHA,BETA,LAMBDA
            BETA=VMAX
            CALL CALC
            CALL DIFFSQ
            CALL CORR
            PRINT 1074,KC,DSQ,R,ALPHA,BETA,LAMBDA
            IF(MGF.EQ.0) GO TO 320
```

```
      IF(CSQR.LT.DSQ) GO TO 330
      BEMIN=VMIN
      GO TO 340
  330 BEMAX=VMAX
      GO TO 340
  320 IF(COCOR.GT.R) GO TO 322
      BEMIN=VMIN
      GO TO 340
  322 BEMAX=VMAX
  340 CONTINUE
      IF(KC.LT.MGSIT) GO TO 245
      PRINT 1072
      KC=0
  345 VMIN=AAMIN+(0.382*(ABS(AAMAX-AAMIN)))
      VMAX=AAMIN+(0.618*(ABS(AAMAX-AAMIN)))
      LAMBDA=VMIN
      BETA =(BEMIN+BEMAX)/2.0
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      COCOR=R
      CSQR=DSQ
      KC=KC+1
      PRINT 1074,KC,CSQR,COCOR,ALPHA,BETA,LAMBDA
      LAMBDA=VMAX
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      PRINT 1074,KC,DSQ,R,ALPHA,BETA,LAMBDA
      IF(MGF.EQ.0) GO TO 420
      IF(CSQR.LT.DSQ) GO TO 430
      AAMIN=VMIN
      GO TO 440
  430 AAMAX=VMAX
      GO TO 440
  420 IF(COCOR.GT.R) GO TO 422
      AAMIN=VMIN
      GO TO 440
  422 AAMAX=VMAX
  440 CONTINUE
      IF(KC.LT.MGSIT) GO TO 345
      K=K+1
      SUM4=0.0
      SUM5=0.0
      DO 104 J=1,M
      DO 104 I=1,N
      SUM4=SUM4+(S(I,J)*C(I,J))
  104 SUM5=SUM5+S(I,J)
      ASTL=SUM4/SUM5
      PRINT 1009
      PRINT 1023
      PRINT 1015,K,DSQ,R,ASTL,ALPHA,BETA,LAMBDA
      PRINT 1016,ALMIN,BEMIN,AAMIN
      PRINT 1017,ALMAX,BEMAX,AAMAX
      PRINT 1009
      PRINT 1023
      PRINT 1075
      GO TO 200
  120 CONTINUE
```

```
  125 READ 1021,ALPHA,BETA,LAMBDA
  126 PRINT 1022
      PRINT 1023
      PRINT 1033
      DO 21 I=1,N
      DO 21 J=LL,M
   16 IZ=IZ+IY+IR+JR+(IXX*133)
      IZ=IZ*IZ/4
      IXX=IZ/100
      IIX=(IXX/100)*100
      IR=IXX-IIX
      IIX=(IXX/10000)*10000
      IZ=IXX-IIX
      IF(IR.LT.1) GO TO 16
      IF(IR.GT.N) GO TO 16
   17 IZ=IZ+IY+IR+JR+(IXX*133)
      IZ=IZ*IZ/4
      IXX=IZ/100
      IIX=(IXX/10)*10
      JR=IXX-IIX
      IIX=(IXX/10000)*10000
      IZ=IXX-IIX
      IF(JR.LT.1) GO TO 17
      IF(JR.GT.5) GO TO 17
   21 C(I,J)=C(IR,JR)
      CALL CALC
      CALL DIFFSQ
      CALL CORR
      PRINT 1024
      PRINT 1025,DSQ,R,ALPHA,BETA,LAMBDA,N,M,CONS
      DO 150 J=1,M
      DO 150 I=1,N
      CD(I,J)=S(I,J)/(Y(I)*CONS)
  150 CONTINUE
C
      DO 162 J=1,M
      TMKT(J)=0.0
      DO 162 I=1,N
      TMKT(J)=TMKT(J)+CD(I,J)
  162 CONTINUE
C
      DO 163 J=1,M
      DO 163 I=1,N
      AVT(I,J)=C(I,J)*CD(I,J)
  163 CONTINUE
      DO 164 J=1,M
      SUMTL(J)=0.0
      DO 164 I=1,N
      SUMTL(J)= SUMTL(J)+AVT(I,J)
      SUMT(J)= SUMTL(J)/TMKT(J)
  164 CONTINUE
C
      TL=0.0
      DO 165 J=1,M
      TL=TL+SUMT(J)
      TL2=TL/M
  165 CONTINUE
C
      SUM4=0.0
      SUM5=0.0
      DO 166 J=1,M
      DO166 I=1,N
      SUM4=SUM4+(S(I,J)* C(I,J))
```

```
  166 SUM5=SUM5+S(I,J)
      ASTL=SUM4/SUM5
      PRINT 1009
      PRINT 1040,ASTL
      PRINT 1009
      T4=0.0
      T5=0.0
      T6=0.0
      T9=0.0
      T10=0.0
      T11=0.0
      DO 167 J=1,M
      T4=T4+TMKT(J)
      T5=T5+T(J)
      T6=T6+A(J)
  167 CONTINUE
      DO 170 J=1,M
      FRTMK(J)=TMKT(J)/T4*100.0
      T9=T9+FRTMK(J)
      SLSMK(J)=T(J)/T5*100.0
      T10=T10+SLSMK(J)
      ASLSMK(J)=A(J)/T6*100.0
      T11=T11+ASLSMK(J)
  170 CONTINUE
      DO 171 J=1,M
  171 PER(J)=(A(J)/T(J))*100.0
      PRINT 1039
      PRINT 1023
      PRINT 1026
      PRINT 1027
      PRINT 1028,(J,SUMT(J),TMKT(J),FRTMK(J),ASLSMK(J),SLSMK(J),T(J),
     1A(J),ATR(J),PER(J),J=1,M)
      PRINT 1009
      PRINT 1029,T12,T4,T9,T11,T10,T5,T6
      PRINT 1009
      PRINT 1032
      IKI=IKI+1
      IF(IKI.NE.IK) GO TO 126
      PRINT 1020
      PRINT 1030
      PRINT 1009
      PRINT 1031,(I,YC(I),I=1,N)
      MA=1
      MB=12
      IF(MB.GT.M)MB=M
  172 CONTINUE
      PRINT 1034,(J,J=MA,MB)
      PRINT 1009
      DO 173 I=1,N
  173 PRINT 1035,I,(S(I,J),J=MA,MB)
      IF(MB.EQ.M)GO TO 175
      MA=MA+12
      MB=MB+12
      IF(MB.GT.M)MB=M
      GO TO 172
  175 CONTINUE
      MA=1
      MB=15
      IF(MB.GT.M)MB=M
  176 CONTINUE
      PRINT 1036,(J,J=MA,MB)
```

```
      PRINT 1009
      DO 177 I=1,N
  177 PRINT 1037,I,(CD(I,J),J=MA,MB)
      IF(MB.EQ.M) GO TO 181
      MA=MA+15
      MB=MB+15
      IF(MB.GT.M)MB=M
      GO TO 176
  181 PRINT 1041
      MA=1
      MB=9
      IF(MB.GT.M)MB=M
  182 CONTINUE
      PRINT 1009
      PRINT 1042,(J,J=MA,MB)
      PRINT 1009
      DO 183 I=1,N
  183 PRINT 1043,I,(C(I,J),J=MA,MB)
      IF(MB.EQ.M) GO TO 185
      MA=MA+9
      MB=MB+9
      IF(MB.GT.M)MB=M
      GO TO 182
  185 CONTINUE
  186 PRINT 1020
 1000 FORMAT (2I3,I2,F8.6)
 1001 FORMAT(3I4)
 1002 FORMAT (7F10.4)
 1003 FORMAT (7F10.0)
 1004 FORMAT (8F10.0)
 1005 FORMAT (10F8.2)
 1006 FORMAT (7F10.0)
 1007 FORMAT (7F10.2)
 1008 FORMAT('1',50X,'CALIBRATION RUN')
 1009 FORMAT('0')
 1010 FORMAT('0',1X,'CONSUMPTION CONSTANT=',1X,F15.13)
 1011 FORMAT (7F10.7)
 1012 FORMAT('0',65X,'PARAMETERS')
 1013 FORMAT('0','ITER',6X,'DIFF SQ',11X,'CORR',7X,'TRIP AVCOST',
     17X,'ALPHA',9X,'BETA',8X,'LAMBDA')
 1014 FORMAT('0','SEED,RANDOM ITERATIONS,LIVE RSS',3I10)
 1015 FORMAT('0',I3,1X,F15.6,8X,F10.6,3X,F10.6,5X,F9.6,5X,F9.6,5X,F9.6)
 1016 FORMAT('0',45X,'MINIMUM',3X,F9.6,2(5X,F9.6))
 1017 FORMAT('0',45X,'MAXIMUM',3X,F9.6,2(5X,F9.6))
 1020 FORMAT('1')
 1021 FORMAT(3F10.7)
 1022 FORMAT('1',50X,'SIMULATION RUN')
 1023 FORMAT(' ',40X,'*************************************')
 1024 FORMAT('0',7X,'DIFF SQ',9X,'CORR',9X,'ALPHA',7X,'BETA',
     18X,'LAMBDA',7X,'I',6X,'J',10X,'C')
 1025 FORMAT('0',F15.6,2X,F11.9,4X,F9.6,4X,F9.6,4X,F9.6,4X,
     1I13,4X,I3,4X,F9.6)
 1026 FORMAT('0','SITE',4X,'AVE TRIP',4X,'NO OF',5X,'% OF',3X,
     1'% OF ACT',3X,'% OF SYN',3X,'SYNTHESISED',7X,'ACTUAL',3X,
     2'ATTRACTION',3X,'% ACT/SYNTH')
 1027 FORMAT('0',12X,'COST',5X,'CUST',5X,'CUST',6X,'SALES',6X,
     1'SALES',9X,'SALES',8X,'SALES',9X,'OF J',9X,'SALES')
 1028 FORMAT('0',2X,I2,2X,F10.6,1X,F8.0,4X,F5.2,6X,F5.2,6X,F5.2,3X,
     1F11.0,2X,F11.0,4X,F9.6,6X,F9.4)
 1029 FORMAT('0','ALL J',1X,F10.6,1X,F8.0,3X,F6.2,5X,F6.2,5X,F6.2,3X,
     1F11.0,2X,F11.0)
 1030 FORMAT('0','ZONAL RETAIL SPENDING')
```

```
      1031 FORMAT(' ',3X,I2,4X,F10.2)
      1032 FORMAT('0','NOTE:AVE TRIP COST=C(I,J) WEIGHTED BY NO OF','
          1CUSTOMERS')
      1033 FORMAT('0',37X,'ATR',7X,'ATRA',13X,'C')
      1034 FORMAT('1',1X,'CASH FLOWS TO'//4X,12I10)
      1035 FORMAT('0',I2,2X,12F10.2)
      1036 FORMAT('1',1X,'CUSTOMER FLOWS TO'//4X,15I8)
      1037 FORMAT('0',I2,2X,15F8.0)
      1039 FORMAT('0',50X,'SUMMARY SITE INFORMATION')
      1040 FORMAT('0','AVE OF    C(I,J)       WEIGHTED BY SYNTH SALES',1X,F10.6)
      1041 FORMAT('1','INPUT DETERRENCE FUNCTION')
      1042 FORMAT('0',11X,9('J=',I2,9X))
      1043 FORMAT('0','I=',I2,1X,9F13.6)
      1050 FORMAT ('0','N,M,NA,C,=',2I3,I2,F8.6)
      1054 FORMAT ('0','       P(I)=',8F10.0)
      1055 FORMAT ('0','       Y(I)=',10F8.2)
      1056 FORMAT ('0','       A(J)=',7F10.0)
      1057 FORMAT ('0','    ATR(J)=',1X,7F10.7)
      1058 FORMAT('0','ATRA(I,J) =',1X,7F10.4)
      1070 FORMAT('0','ALPHA')
      1071 FORMAT('0','BETA')
      1072 FORMAT('0','LAMBDA')
      1074 FORMAT('0',13X,I3,3X,F11.5,2X,F13.11,3(2X,F10.7))
      1075 FORMAT('0',9X,'ITERATION',5X,'DIFFSQ',4X,'CORRELATION',7X,'ALPHA',
          18X,'BETA',6X,'LAMBDA')
      2000 FORMAT(8F10.8)
      2001 FORMAT('0','MINIMA',4F10.6)
      2002 FORMAT(3I10,F10.7)
      2003 FORMAT('0','MGSIT,MOIT,MGF,F',3I10,F10.7)
      2004 FORMAT('0','MAXIMA',4F10.6)
      2005 FORMAT ('0',11X,'ALPHA',4X,'BETA',6X,'LAMBDA')
           STOP
           END
```

```
           SUBROUTINE CALC
           COMMON/AA/T,M,N/BB/C,S,ALPHA,BETA,LAMBDA,YC,ATR,ATRA,SUM3
           DIMENSION C(50,20),S(50,20),YC(50),SUM3(50),T(20),ATR(20)
          1,ATRA(50,20)
           REAL*4LAMBDA
           DO200I=1,N
           SUM3(I)=0.0
           DO200J=1,M
           S(I,J)=(EXP((ATR(J)*ALPHA)+(ATRA(I,J)*BETA)-(C(I,J)*LAMBDA)))
       200 SUM3(I)=SUM3(I)+S(I,J)
           DO201J=1,M
           T(J)=0.0
           DO201I=1,N
           S(I,J)=YC(I)*S(I,J)/SUM3(I)
       201 T(J)=T(J)+S(I,J)
           RETURN
           END
     C
```

```
           SUBROUTINE DIFFSQ
           COMMON/AA/T,M,N/DD/DSQ/EE/A
           DIMENSION A(20),T(20)
           DSQ1=0.0
           DO300J=1,M
       300 DSQ1=DSQ1+(ABS(A(J)-T(J))**2)
           DSQ=DSQ1/1000000.0
           RETURN
           END
```

```
           SUBROUTINE CORR
           COMMON/AA/T,M,N/CC/R/EE/A
           DIMENSION A(20),T(20)
           XM=M
           SUMX=0.0
           SUMY = 0.0
           SUMXX=0.0
           SUMYY=0.0
           SUMXY=0.0
           DO 400J=1,M
           SUMX=SUMX+A(J)
           SUMY = SUMY+T(J)
           SUMXX= SUMXX+A(J)**2
           SUMYY=SUMYY+T(J)**2
       400 SUMXY=SUMXY+(A(J)*T(J))
           XBARX=SUMX/XM
           XBARY=SUMY/XM
           R=(SUMXY/XM-(XBARX*XBARY))/
          1SQRT((SUMXX/XM-XBARX**2)*(SUMYY/XM-XBARY**2))
           RETURN
           END
```

22 JAN 1980