THE HINTERLAND CONCEPT AND PORT DEVELOPMENT IN GHANA

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ABSTRACT

The hinterland - the port's collecting and distributing area - is a significant part of every port's development. The large body of literature on the subject attests to this fact. Following previous studies on the subject, this thesis sets out to demonstrate the significance of the hinterland to port development in Ghana. The study concentrated on two spatial levels. The first was the national level; between the two Ghanaian ports of Takoradi and Tema, while, the other, at the international level, compared the Ghanaian ports with the East African ports of Mombasa (Kenya) and Dar es Salaam (Tanzania). Based on the premise that a port's overall traffic is a function of its performance and hinterland, the ports' performance contribution to their overall traffic were assessed using regression analysis and the shift-and-share technique. At the national level the results showed that Takoradi's performance contributed 53 per cent to its overall traffic as against Tema's 38 per cent. At the international level, the Ghanaian ports were found to have performed better than their East African counterparts on the shift-and-share technique, yet, they lag behind their East African ports in terms of overall traffic. At both levels, the answer to the differences in throughputs was found to lie in their hinterlands. While Tema enjoyed access to much of the economically prosperous areas of the country, Takoradi did not — the result of accessibility and image problems, among others. The East African ports also have access to a much wider hinterland beyond their national boundaries; a phenomenon the Ghanaian ports lack.

To remedy the situation, for Takoradi in particular and the Ghanaian port system in general, the following policy recommendations were suggested. In the case of Takoradi there is the need to rehabilitate the road and rail network of the port, embarking on a new public image of the port as both an import and export port, and the need to establish a Customs and Excise office at the port. For the Ghanaian port system there is the need to tap into the landlocked market consisting of Burkina Faso, Niger and Mali. This can be achieved by improving the road network connecting Ghana and these countries. In addition, there is the need for additional berths with alongside depths to accommodate bigger vessels, container terminals and lower competitive tariffs. Furthermore, the port authorities in conjunction with the government must resolve the problems surrounding the implementation of the intermodal and inland container concepts to ensure their speedy operation.

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CHAPTER ONE
PORT INFRASTRUCTURE: ITS ECONOMIC AND GEOGRAPHICAL SIGNIFICANCE

1.0 Introduction

The importance as well as policy implications to port growth and development of analysis both of port performance and hinterlands cannot be over-emphasised. The works of Boerman (1951), Weigend (1956,1958), Hance and Van Dongen (1957), Rodgers (1958), Carter (1962), Rimmer (1964, 1966a, 1966b), Ward (1966), Hoyle (1967, 1981), Hoyle and Charlier (1995), Schulze (1970), and Hayuth (1981) amply demonstrate this. The *raison d'être* of this thesis is to emphasise the importance of hinterland to port development. To illustrate this theme — the twin pillars of the Ghana port system (Hilling, 1977) — Tema and Takoradi are the subjects of detailed enquiry. The many geographical contributions of the study include an updated map of the ports' hinterland structure as well as the nature and state of condition of the transport network linking the ports and their hinterlands. Policy recommendations for the ports' development will follow naturally from this work. This study falls within the broad field of transport geography, a nebulous field in need of refinement. At its essence is the question: what is the connection, if any, between geography and transportation in general and ports in particular? The next section attempts to be forthcoming with answers.

1.1 Geography and Transportation

Traditionally, transportation has been part of geographical studies. The geographical aspect of transportation has usually been concerned with "the provision of transport systems, the use of those systems for the movement of people and commodities, and the relationships between transport and other geographical phenomena (Hay, 1991:641-642). In the nineteenth century, for example, Friedrich Ratzel and Alfred Hettner emphasised the role of transport in shaping the landscape and as an agent of geographical change. At the dawn of the twentieth century, the French school led by P. Vidal de la Blache and J. Brunhes also developed transport geography as an integral part of what they called the 'geography of circulation', which studied the permanent landscape features and the transient movement of goods and people. Subsequently, through to the 1950s when interest in the individual modes of transport gathered momentum, transportation geography progressed slowly. The 1960s saw the use of quantitative models in transportation geography by North American geographers led by E. L Ullman, W. L Garrison, E. J. Taaffe and others, a development which not only led to a rapid expansion in transport geography studies but which brought transport geography close to urban planning. However, the use of such quantitative techniques began to be criticised in the 1970s as it was considered an impediment to a critical study of transport systems. All in all, transportation and geography meet at three main points. The first is geography's concern with the transport sector itself. This is defined as follows:

a. Network Analysis - This is concern with the geographical pattern of transport networks (roads, railways, air, and canals). The dominant descriptive technique for network analysis is graph theory. In terms of explanation, emphasis is placed on the spatial association between network forms or structure and other geographical phenomena.
b. Provision of Scheduled Services - Geographical studies of scheduled services have focused on accessibility provided by these services using the same network analysis technique. Much emphasis has been on frequency in time and density in space; however, recent studies have focused on the impact of deregulation policies on scheduled services.
c. Movement of People – Early studies in this area were mainly descriptive but recent studies have been more explanatory. In much of the explanatory studies the effort is directed at accounting for:
   - the number of trips originating and terminating within an area
   - the flows between these areas and
   - the allocation of this traffic between competing modes.

   Aggregate models like those of gravity and intervening opportunity are the most frequently used techniques in this area. There is, however, now a shift towards disaggregated travel demand models where the trip-making behaviour of individuals is related to the perceived utility of alternative destinations.

d. Movement of Commodities – Geographers have also been involved in commodity flow analysis using techniques such as transaction flow analysis and factor analysis. In terms of explanation, Ullman's[1] triad has often been used. The main operational models have been linear programming, input-output analysis, and the gravity model. Modal split is another dimension of commodity studies. Recently, the role of firms as initiators and agents of commodity flow has become a major concern in this area of study.
e. Terminal Analysis – Attention on terminal analysis is focused on the development of the terminal facilities over time, their morphology as well as inter- and intra-facility competition. Ports and airports have dominated most studies of terminal facilities.

Secondly, geography and transportation are related to the extent that transport serves as an agent of geographical change. This connection arises from the correlation that has existed between geographical patterns of transport networks and urban growth and the geography of manufacturing and service industry. It is this relationship that has led to the conclusion that transport investment leads to geographical change. However, the search for evidence to support such a conclusion often runs into two problems, viz.:

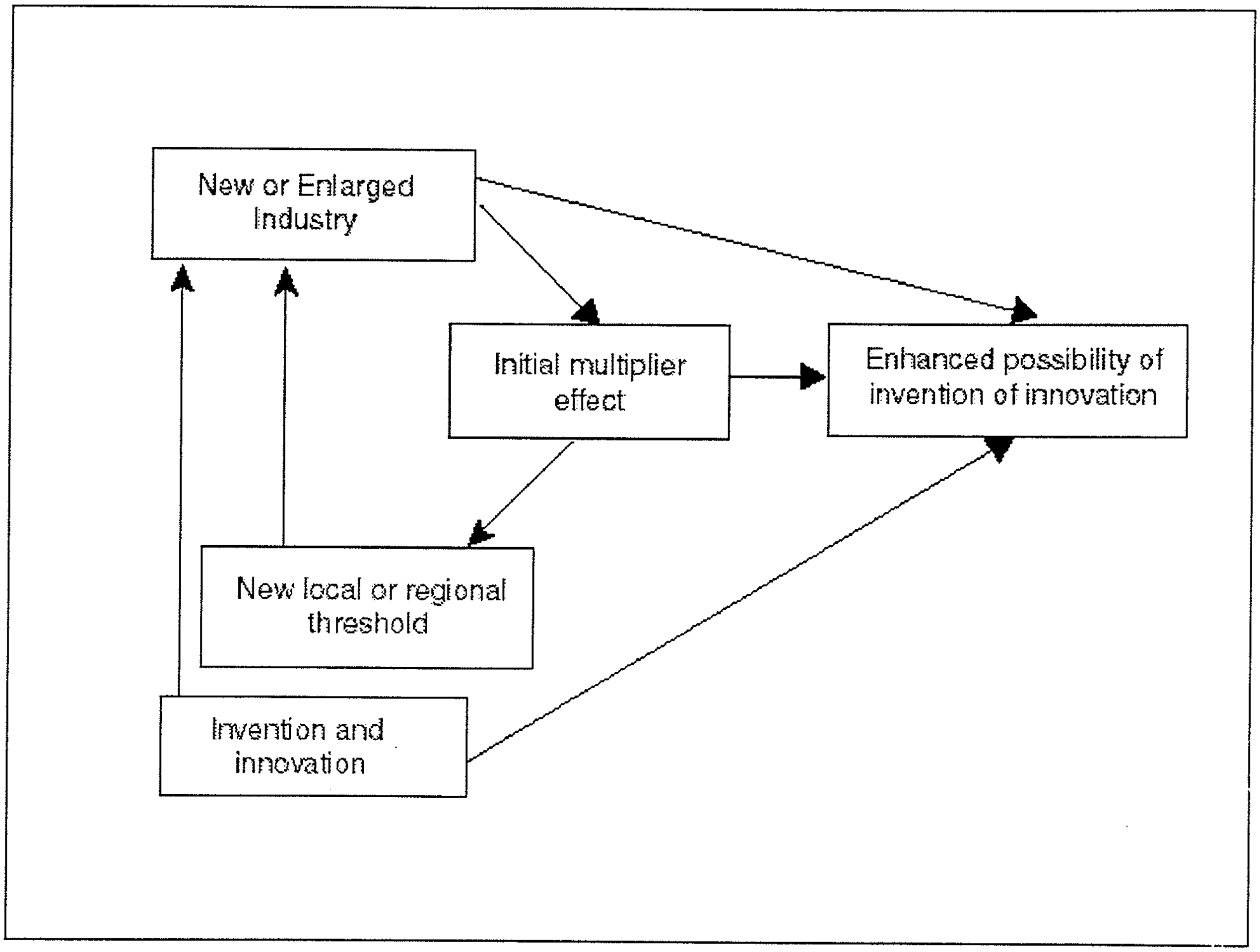
[1] Ullman's triad is a concept developed by Edward L Ullman to explain the differential linkages and flows between centres. Three main concepts; namely, complementarity, transferability and intervening opportunities underlie the triad. Complementarity, or specific complementarity as it is referred to by Lowe and Moryadas (1975), postulates that movement or trade between two places will only occur if there is a need for a particular product in one region for which the other region has the capacity to produce and supply. Lowe and Moryadas (1975) cite the relation between urban industrial and rural agricultural regions and the industrialised and non-industrialised nations specialising in agricultural production and mineral resource extraction as examples of complementarity. Complementarity, therefore, emphasises the importance of *need* and *ability* to supply to movement rather than mere spatial differentiation between places. However, it is possible for complementarity to exist between two places without any movement or trade occurring between them. This can happen as a result of the existence of an alternative, closer and more accessible source of supply between two complementary regions. This alternative source of supply is known as intervening opportunity. The existence of intervening opportunity serves to restrict or prevent movement between two complementary regions. Because of this some writers consider the concept negative. In addition, it can encourage suboptimisation, including their ability to encourage people to choose inferior but yet adequate alternative rather than the farther but best location. Transferability, on the other hand, revolves around the cost of movement and the existence of a transportation facility. For example, complementarity may exist between two places, yet no movement or trade will take place between them as a result of lack of a transportation facility linking the two places. Transferability, measured by the real cost of transfer, is dependent on the commodity in question. For example, sand and gravel are said to have low transferability compared with diamond because of the low value per unit of weight of the former.

a. The effects generated by transport investment are difficult to separate from the effects generated by other causes.
b. Although transport investment may lead to urban growth, urban growth itself may be the cause of transport expansion. This flux of interdependency is what Myrdal refers to as circular and cumulative causation. Pred has applied Myrdal's circular and cumulative causation idea to urban and industrial growth (Figure 1.1), which indirectly bears on transport investment.

The establishment of each new firm in the city adds to the initial multiplier effect, permitting the city to reach a new set of thresholds and expand its local and regional markets. This has the tendency of attracting other new firms to the city. The process is reinforced by the effects of the intensified information on the probability of invention or innovation (Taaffe and Gauthier, 1973:46). So, while there is a spatial correlation between geographical pattern and the transport network, the causal link between the two is nonetheless complex.

Figure 1.1

Circular and cumulative causation
Transportation and spatial processes



Source: Taaffe and Gauthier, 1973

Thirdly, geography and transport share mutual interest in environmental matters. The transport sector now is a major source of environmental pollution, notably from the internal combustion engine. Among the pollutants emitted are hydrocarbons, additives, and the products of combustion (oxides of nitrogen and carbon dioxide). The environmental problems caused by the transport sector raise two important questions, viz.:

a. What new geographical patterns will emerge if the use of transport has to be restrained for environmental reasons?

b. What new geographical patterns would contribute to such a restraint? (Hay, 1991:641-643).

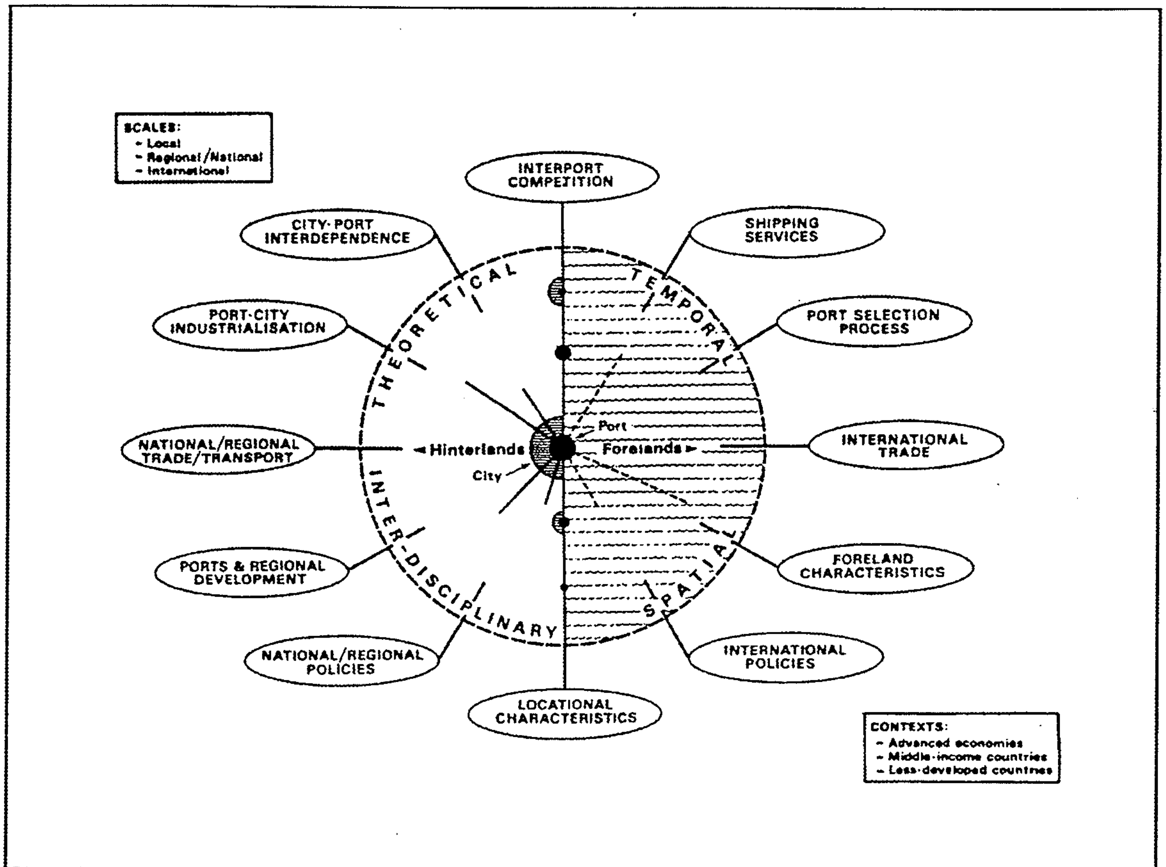
The above clearly demonstrates the connection between geography and transportation. It is this connection which has been referred to as transportation geography or geography of transportation. Having explained the nature of transportation, I am now in a position to specify to which aspect of transportation geography the present study belongs. It is obvious from the discussion hitherto that the present study is concerned with points *(d)* and *(e)*. Specifically, the emphasis is on port terminals and the movement of commodities. This is part of the sub-discipline of transportation geography referred to as port geography. In the following section I shall discuss port geography and the various approaches to its analysis.

1.2 Port geography and the analytical approaches addressing it

According to Hilling and Hoyle (1984:1), port geography is primarily concerned with "what happens at the waterfront, across the frontier between land and maritime space, wherever trade is regularly carried out, whether that interface is set in a technologically primitive context or in the context of advanced transport systems". Other concerns of port geography beyond the land/maritime interface are depicted in Figure 1.2. The port here is considered as a node located at the interface of the land/maritime dimensions and, together with other ports, experiences differential growth and development. Ports also differ in size and in the extent to which they are associated with urban development. Locational characteristics of various kinds, notably the conditions of land and water site and the characteristics of hinterland transport systems, are some of the main factors that affect inter-port competition.

Figure 1.2

<u>Some Elements in Port Geography</u>



Source: Hoyle and Hilling, 1984

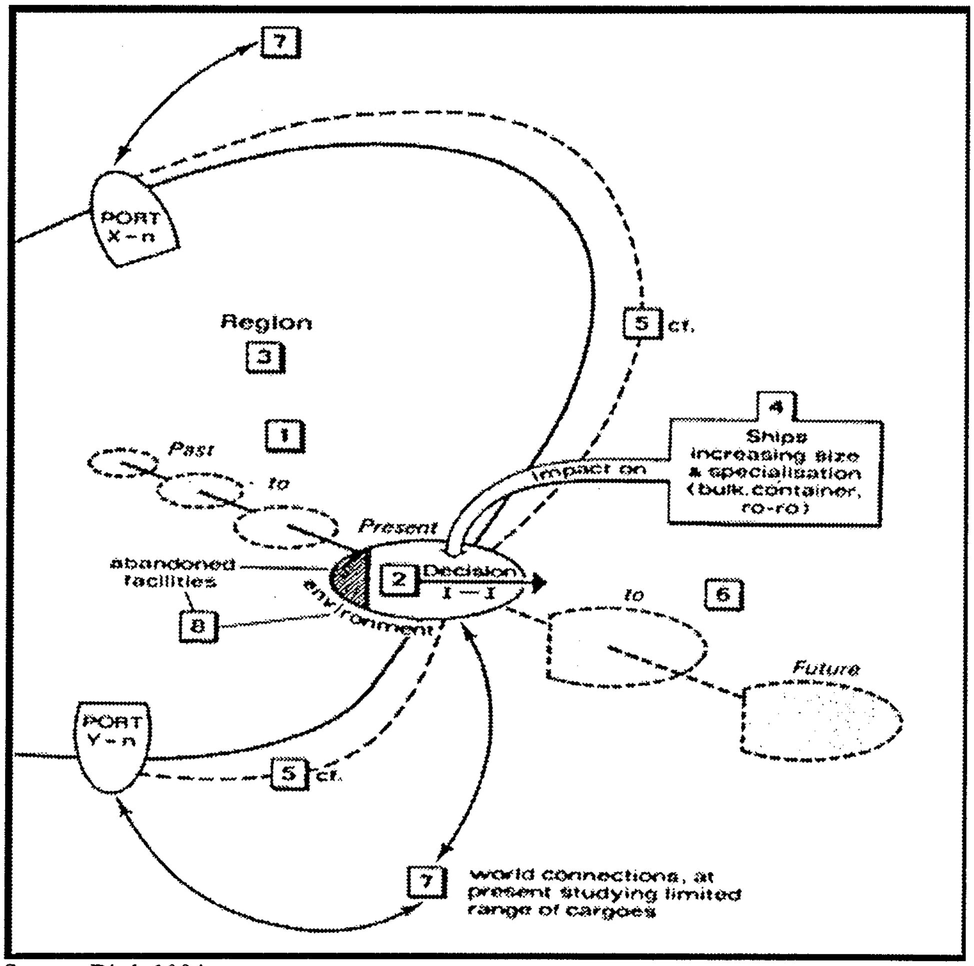
In the study of port geography a distinction is made between elements which come from the landward side or the hinterland and those which come from the maritime side or the foreland (Weigend, 1958). Research on the landward side tends to focus on city-port interdependence, port-city industrialisation, transport networks and trade patterns, ports and regional development relationships, and the policy formulation and decision-making impact at various levels on the port-development process. On the maritime side, ships – in terms of their design and services – and the process of port selection by the ship-operating companies are considered to be the main determinants of port development and, hence, have been the focus of research. Other areas of interest in port geography include the patterns of global international trade, the specific characteristics of the foreland areas, and international organisations, .such as the World Trade Organisation (WTO), the European Union (EU), the Economic Community of West African States

(ECOWAS), the North American Free Trade Agreement (NAFTA) and the Latin American Free Trade Agreement (LAFTA) (Hilling and Hoyle, 1984).

Figure1.3

Development of Seaports over Spatial and Temporal

Scales and Associated Types of Study



Source: Bird, 1994

The numbers in square boxes refer to the study types classified in Table 1.1 '2 Decision refers to problems of when to invest in port expansion, usually in a downstream or seaward direction; whereas '2 I-I' refers to port-linked industrial development, again usually in a seaward direction, and symbolised here diagrammatically by the port area extending beyond the coastline.

Bird (1984) also offers an account of the development of port studies since 1950 (Figure 1.3. He notes that early studies of seaports emphasised past-to-present causality, explaining how present functions had been shaped by past decisions. The general thrust of later port studies, he notes, has emphasised the development of ports from the spatial perspective. Table 1 shows examples of port studies. The categories are not discrete. The placing of certain studies in some categories, according to Bird, is due to the thrust of their study. Having justified the sub-discipline of port geography I now turn my attention to the issue of transport and the development process, emphasising specially the port infrastructure.

Table 1.1

Development of Seaport Studies

Study Type No.	Study Types (with examples)
1.Historico-genetic (including studies with hinterland and foreland emphases – centres generated by regions rather than to and for regions).	Weigend (1956), Bird (1963), Hoyle (1968), Vigariè (1964), Elliot (1969), Hilling (1969).
2. Economic: ports recognised as most economic points for industrial location; investment appraisal of port developments.	(location incl. diagrams) Hoover (1948), Linberg (1953), Alonso (1964). (investment appraisal) Omtvedt (1963), Goss (1968), Klassen and Vanhove (1970), Gilman (1977).
3. Ports and regional development.	Ghana – Taafe *et al.* (1963); California – Smolensky and Ratajczak (1965); Australia – Rose (1966); developing countries – Weinand (1972); South Wales – Humphrys (1976a; 1976b); regional development and underdevelopment – Smith (1977, 124-5; general Hoyle and Pinder (1981).
4. Technical orientation (general cargo to containers and growth of bulk carriers).	(both) Beaver (1967), Couper (1972, chapters 7 and 8), Mayer (1973); containers, van den Burg (1969), Johnson and Garnett (1971), Gilman (1977); bulk, Takel (1974).
5. Set comparisons (i.e insights gained from comparative studies of groups of ports or port forelands, systems approaches).	Carter (1962), Britton (1965), Ogundana (1972), Sun and Bunamo (1973), Robinson (1976), Chu (1978).
6. Future-orientation (aids to decision-making or studies thereof).	Shaffer (1965), Portbury Report (1966), Tanner and Williams (1967), Bird and Pollock (1978), Chu (1978).
7. World system (via world lake).	Oil, Odell (1963, chapter 7); iron ore, Manners (1967), wool in a feedback loop system model,
8. Retreat from the waterfront and retreat from growth.	Greenwood (1975).Pinder (1981), Hayuth (1981), Hayuth (1982).

Source: Bird, 1984

1.3 Transport infrastructure and development

There is a close relation between volumes of transport and levels of economic activity (Barber, 1970, Best, 1966, Chinitz, 1960, Gaủthier, 1970, Leinbach, 1979, Rowstow, 1960, Scarperlanda, 1966, Todd and Hseuh, 1990, Todd, 1993). This close correlation is attributed to the fact that most economic activities take place only if transport is available to permit them to do so. Hence governments all over the world devote a fairly uniform proportion of total investment to transport, irrespective of economic conditions (Owen, 1959). As a matter of fact there is no fundamental disagreement concerning the importance of transport in the development process. This consensus, however, is lost when it comes to the question of the precise role of transport in fostering greater economic and social development. To some, transport investment is a *sine qua non* to development and must therefore be given utmost attention in the development process. Others are of the opinion that transport's role in economic development is passive, while yet others also think that transport's role in the economy is rather negative. In the ensuing paragraphs I discuss these strands of the transport-development debate, focusing on eventually port infrastructure and African development.

The thrust of the positive school of thought is that transport is the formative power of economic growth and that a lack of transport facilities can considerably retard exploitation of natural resources, industrialisation, expansion of trade and, in some cases, national unity – in a nutshell economic growth – (Hoyle and Hilling 1970b:1). Lord Lugard (*see* O'Connor 1965), for example, believed that Africa's material development could be summed up in the one word – transport. Others like Baxter (*see* Button 1982:245) also claim that the railway has been the most powerful agent in the progress of commerce, in improving the conditions of the working classes, and in developing the agricultural and mineral resources of the United Kingdom. Perhaps the most powerful comment to come from this school was that of Rostow (1960). In his thesis *the stages of economic growth,* Rostow wrote, "the introduction of railroads has historically been the most powerful single indicator of take-off. It was decisive in the United States, France, Germany, Canada and Russia". Good transport, according to Button (1982), offers low shipping costs, which permit wider markets to be served and the exploitation of large-scale production in an extensive range of activities. He cites Hunter (1965), who argues that there is a causative link between inexpensive or low-cost transport and economic growth and that the industrial revolution owéd its success to *a prior* revolution in transport technology. From the same perspective Owen (1964 in Addo, 1979) also argued that a widening of the domestic market through improved transport services is a prerequisite for national economic development.

The benign view of transport suffered a blow to its credibility as a result of the work of economic historians like Fogel. This group assigned a 'lag' rather than a 'lead' role to transportation. They argued that transport facilities tend to expand to meet needs, and will not in themselves generate new economic growth, thus, casting doubt on the role of the railroad in sparking the economic development of the United States. They held the view that similar growth could have been achieved if water transportation had remained dominant. Out of their analysis emerged a new view of transport; that is, good transport does not cause but rather permits economic development (*see* Taaffe, 1973, Button 1982). Transportation can become the catalyst for economic growth only where there are resources to be developed and people capable of developing them. In short, easy predictions of outcomes are ruled out because so many variables are involved in the development equation. Transport plays its part by permitting the natural resources and talents of a country to be exploited. Transport can help release working capital from one area, which can be used more productively elsewhere, although a necessary prior condition is the existence of suitable productive opportunities in potential markets. Transport, therefore, is not a *necessary* but rather a *sufficient* condition for development.

The third school of thought argues that an excessive amount of scarce resources tends to be devoted to transport investment to the detriment of other sectors of the economy. As with other scarce inputs, this school believes that it is possible to determine an optimal threshold or provision of transport investment needed to generate economic development such that resources are not wasted on transport. Its adherents believe that, due to political and other reasons, transport tends to receive more investment than can be justified economically. According to Hirschman (1958), the transport sector is the object of over-investment because it is difficult to prove mistakes economically even after major projects have been completed. Wilson also comments that it is difficult to point out the cost and benefits of transport investments owing to the large sums of capital involved, its longevity, and associated externalities. Though they accept that an adequate basic level of transport investment is needed for economic development these scholars question whether the opportunity costs involved in further improving transport are necessarily justified (*see* Button 1982).

1.4 Port infrastructure and African development

Ports have contributed significantly to the development of their host countries. Many writers have noted this observation. Hilling, for example, has emphasised the close relationship that has emerged between seaports and the development process in Africa. He writes, "the provision of port facilities has been a necessary pre-condition of modern economic growth in Africa", and that, "the stage of development reached in a given part of Africa is in a considerable measure a function of the capacity and degree of sophistication of the port facilities available" (Hilling, 1970b:127, Hilling, 1990). Button (1982:245-246) also adds, "most undeveloped countries are, for a variety of geographical, economic and historic reasons dependent upon international trade and an expansion of this trade is an essential prerequisite for growth. In these circumstances the provision of efficient port facilities will positively assist development".

It must be mentioned that there is an alternative view which considers ports as an infrastructural tool used by the colonialists to exploit Africa's resources (Schulze, 1970). This writer adopts the view of ports as development tools. In this vein the role of the seaport in Africa that comes to mind first is the development of the mineral and forest resources. Schulze (1970) cites Liberia as a case in point. In 1934 a rich magnetite deposit was discovered in the Bomi Hills but W H. Mueller's Company, due to the lack of suitable port facilities, could not exploit the deposit. It was only in 1946 when the construction of the Free port of Monrovia was well advanced that the Liberia Mining Company was established, leading to the first shipment of iron ore in 1951. Iron ore is now the chief foreign exchange earner of Liberia. Hoyle and Charlier (1995) also cite the cases of coal and iron ore at Richards Bay and Saldanha Bay (South Africa), iron ore at Nouadhibou (Mauritania), phosphate at Lome and Kpemè (Togo), and the treatment of timber at San Pedro (Ivory Coast).

Besides this role, ports have also been instrumental in industrial and urban growth in many African countries. Couper (1971) and Scarperlanda (1966) have both observed this function. Scarperlanda (1966:206) wrote, "seaports and external trade are now vital factors in the emergence and growth of the money economy of developing countries, in the expansion of their urban populations, and in the growth of their market systems; increased trade has also assisted in creating conditions conducive to the development of modern agricultural systems and to the establishment and expansion of modern industry". The dense concentration of population in port cities and their burgeoning economic environment have made them all the more attractive for further investments, spawning Myrdal's circular and cumulative causation mentioned earlier.

In Ivory Coast, San Pedro is part of a development programme for the south-western part of the country (Hoyle and Charlier, 1995). So is Richards Bay and Saldanha Bay in South Africa (Wiese 1984) and Tema in Ghana. Even in industrialised countries the regional implications of ports are significant. Holocher (1990:63) notes this: "in many countries the ports are not very important compared with other trades or industries. On a regional or local scale [however] a seaport might be seen quite differently". He cites the case of Bremen, Germany, where in 1983 about 27 per cent of all jobs (93,000 jobs) were directly or indirectly dependent on the port and/or on the access to deep-water channels for ocean-going ships. What is more, an annual amount of about 150 million Deutsche Marks (DM) is paid by port-related jobs in the form of tax to the Bremen city. When taxes arising from jobs not directly related to the port are added, Bremen is estimated to get back more than its total expenditure on the port.

In Africa, South Africa (Figure 1.4) is often cited as the quintessential case of the significance of ports in regional development. Durban, for example, as a result of its port activities has become the leading industrial, service and financial city of Natal. Its 1970s growth rate of employment and per capita Gross Domestic Product (GDP) were above the national average. The Durban metropolitan area now boasts South Africa's second-largest concentration of industries, population and buying power.

Richards Bay is another port success-story in South Africa. In 1970 Richards Bay was a small fishing village of about 60 inhabitants. By mid 1979 it had developed into one of South Africa's major deep-water export ports with a population of about 7,300 people plus a satellite town of about 20,000 people. Richards Bay is now the world's largest coal export port with about 60 million tons per year. Port-related and unrelated industries include an aluminium plant (ALUSAF), the Triomf Fertiliser — with production capacity of 198,200 tons per day — milling companies, cable and wire companies and fencing material factories, to mention just a few. About 15 small service industries such as electrical and mechanical engineering have also been opened in factory buildings provided by the Industrial development centre (IDC) in the Alton industrial area and these serve the local and regional markets. These port-related activities have provided employment for many people in the region (Table 1.2). There are now plans by the TRANSNET, the Department of Planning, the Richards Bay Town Board, the IDC, and the Natal Provincial Administration to turn Richards Bay into an urban metropolitan complex to house a population of about 100, 000 by the year 2000. In the words of Wiese (1984), Richards Bay has become a clear case of the intertwining of shipping, port and regional development policy in a socio-economic development exercise.

Table1.2

Employment situation in Richards Bay, 1978-79

Company	Whites	Blacks	Coloureds	Asiatics	Total
ALUSAF	404	931	-	-	1 335
TRIOMF	148	495	-	-	643
Richards Bay Milling	25	281	-	9	315
Richards Bay Minerals	245	507	-	-	752
Small Industries	280	581	14	28	903
Total Industry	1 102	2 775	14	37	4 681
Construction	121	1 519	138	50	1 828
SAR & H	334	300	-	-	634
Richards Bay Coal Terminal	120	350	-	-	470
Empangeni Transport	31	293	-	-	
Government and Province	146	170	-	-	
Town Board	164	510	-	-	
Shops and Offices	167	129	-	8	
Private	214	190	12	14	
Domestic	-	718	2	-	
Total Services	1 176	2 660	14	22	
Agriculture	129	2 920	-	149	
Total	2 528	9 894	166	258	

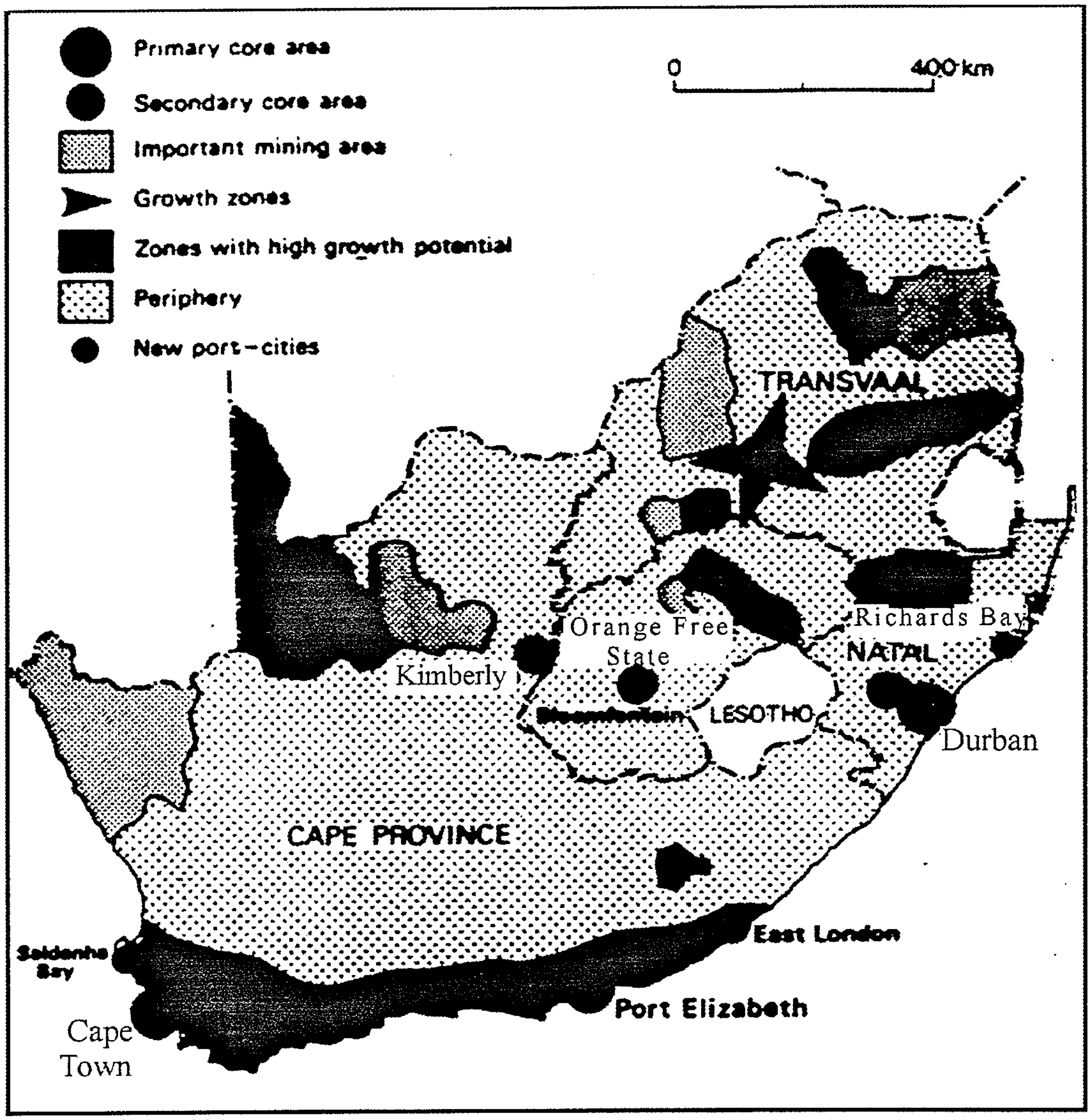
Source: Wiese, 1984

These success-stories are not limited to Durban and Richards Bay. Saldanha Bay is another case in point. A deep-water iron ore export port, Saldanha Bay has become a nucleus for growth in its region, especially for the Western Cape area, even though the government had not officially declared it such. The port, which is accessible for bulk carriers up to 250 000 tonnes and has an annual throughput of about 15 million tonnes (1978) of ore shipped mainly to Japan and north-western Europe, now ranks third amongst South Africa's ports. The developmental impact of the port and its shipping services is reflected in the Bay's industrial and population development growth. From a town of about 4,900 people, Saldanha Bay together with its regional administrative centre, Vredenburg, jointly grew to a population of about 27,000 people in 1979. With respect to industrial development linked directly to the port a 3 million tonne per annum-capacity steelworks was envisaged by ISCOR in 1970.

As a node for industrial and urban development Saldanha Bay has the advantage of being the port for import of coal and coke from Transvaal by way of Richards Bay and for export of products. Since bulk carriers of over 150 000 tonnes and tankers of up to 500 000 tonnes use the sea-route and the Cape, and given the great distance between existing repair facilities for the largest vessels in Bahrain and Lisbon, it has been suggested that large-capacity dry docks be built at Saldanha, and, promoting strong links with the steel industry. There are plans to construct a second bulk export terminal and related facilities, double the handling capacity, construct the steelworks, and develop the harbour-related urban-industrial metropolitan complex to attain a maximum of one million inhabitants. These would benefit from large-scale job opportunities in the port, on the railways, in heavy industries, related light industries, the Central Business District (CBD) and public services. As Wiese (1984:430) puts it, "it is easy to imagine the impact of these developments on employment, infrastructure, urbanisation in the Western Cape and, in particular, in the Greater Saldanha-Vredenberg area".

Figure 1.4

Ports and core-periphery structure of South Africa's space economy

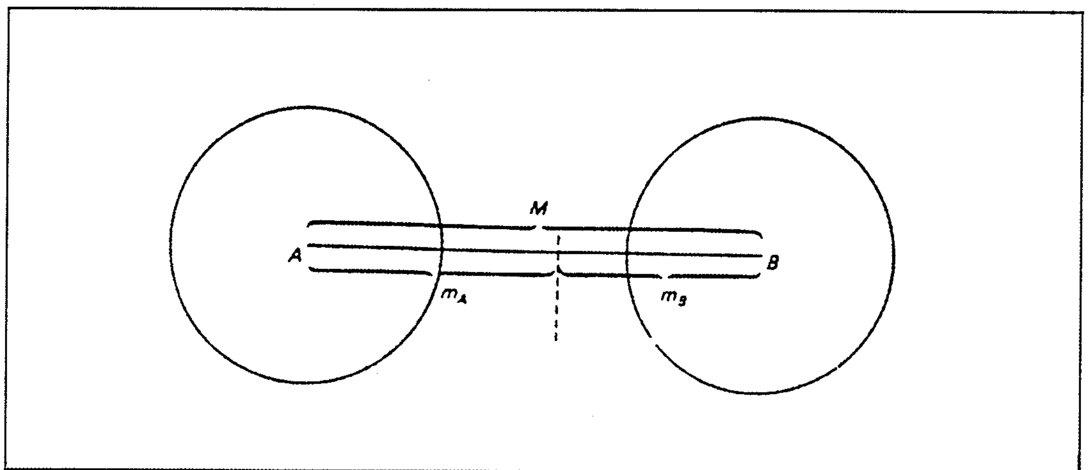


Source: Wiese, 1984

Behind the port-regional growth exercise is the theory of transport and regional development. Figure 1.5 illustrates the theory.

Figure 1.5

Transport and regional development



Source: Button, 1982

The theory assumes two regions, A and B, producing a single homogeneous commodity. The centres of the regions are M km apart and the commodity is transported over the area at a constant money cost per km of \$t per ton. The regions serve different markets and it costs \$$C_A$ to produce a ton of the commodity in region A and \$$C_B$ in region B. Assuming further that no production centres exist between the two regions, one can determine a distribution boundary (the dotted line) which is m_A km from the centre of A and m_B km from the centre of B (where $m_A + m_B = M$). The boundary is determined by the relative production cost of the regions and the costs of overcoming distance (i.e $CA + tm_A = CB + tm_B$). A manipulation of the algebra results in the following formula:

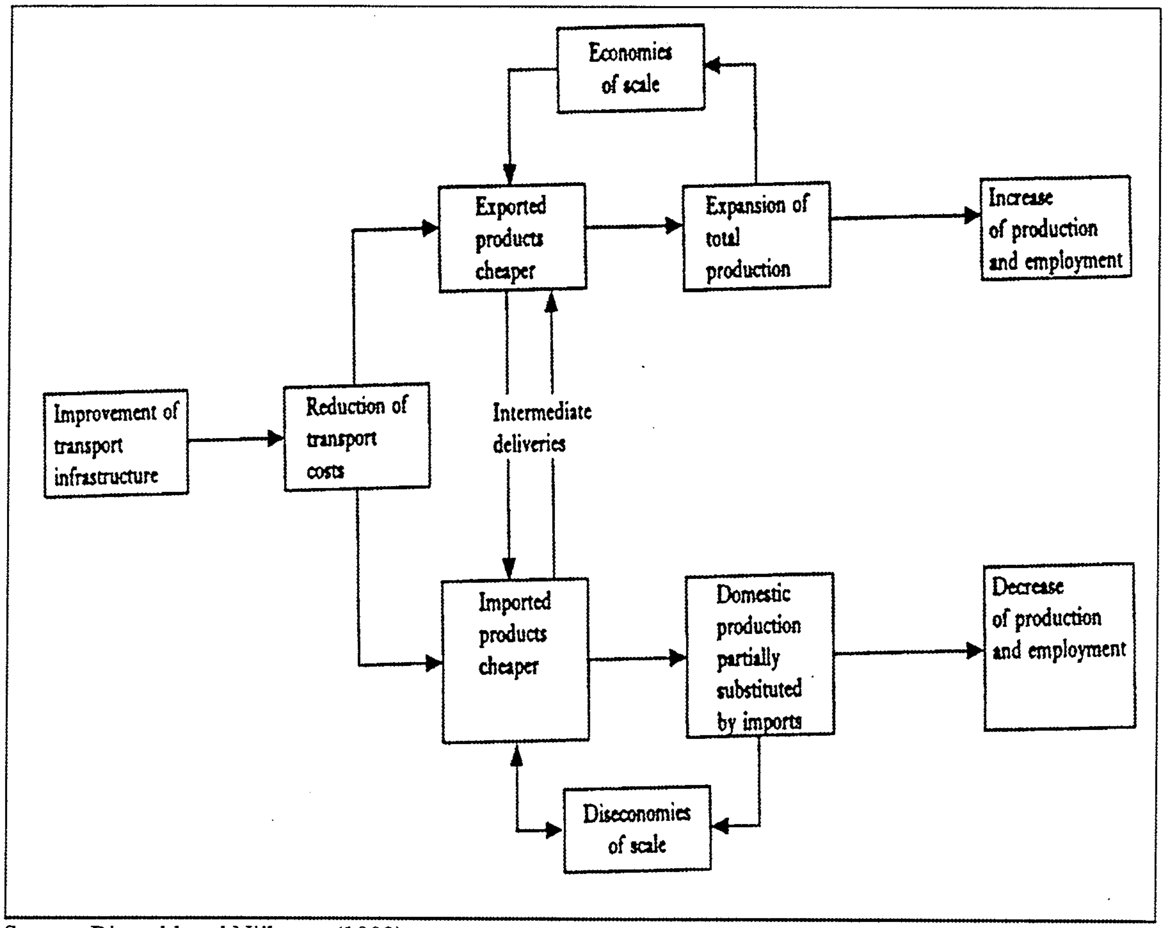
$$m_A = 0.5\,M + \frac{CB-CA}{t}$$

Thus if production is relatively cheaper in region A, then m_A will increase if infrastructure reduces the cost of transport. If region A happens to be the depressed area, then improvements in transport infrastructure could help in expanding its potential market and thus generate more income and employment in the region. For this to happen, however, region A must be a low-cost producer. On the other hand, if region B happens to be the depressed area, then clearly its regional problems will worsen due to the loss or contraction of its market area. In the scenario where {CB-CA} > Mt, region B may be forced from the market altogether, driven out by the expansion of region A's market area. Taaffe and Gauthier (1973:36) corroborated this view when they wrote that "for trade to take place between any two points, *i* and *j*, the transport costs, *Cij* must be less than or equal to production cost or price differential between *i* and *j*, ie. $Cij \leq (Pi - Pj)$. If transport costs are less than price differentials between any two points, trade may take place and regional specialisation can begin". The model, however, assumes a single commodity market, which is hardly the case with comprehensive economies.

Regions prefer not to specialise in single commodities but rather in a range of commodities. With improvement in transportation, therefore, regions begin to specialise in several commodities in which they have competitive advantage rather than in just a single commodity. In this case, specialisation may be detrimental to some activities; it will nonetheless strengthen others. The overall effect of improved transport on the regional economy will thus, according to Button (1982:260), "depend upon relative production costs between the regions and the importance of transport vis-à-vis production costs in the overall cost functions for the various commodities". Rietveld and Nijkamp (1993) provide a diagrammatic presentation, showing the developmental effects of transport in a region in the scenario of multiple trade (Figure 1.6).

Figure 1.6

Effects of improvement of transport infrastructure



Source: Rietveld and Nijkamp (1993)

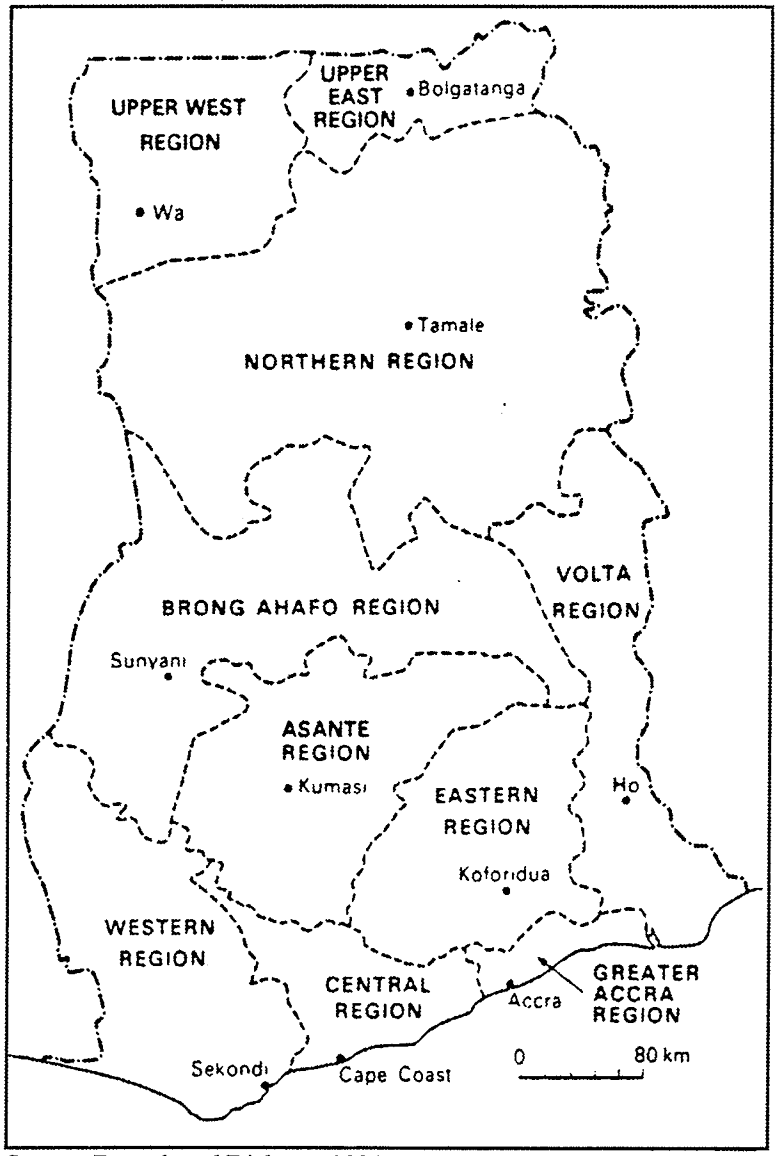
I now focus on the ports of Ghana.

1.5 Introducing Ghana

Ghana (Figure 1.7) is located on the West Coast of Africa, about 750 km north of the equator on the Gulf of Guinea, between the latitudes of 4-11.5°N. There are 10 administrative regions and 110 districts. The total land area is 238,305 km² and this stretches for 672 km north-south and 536 km east-west. Ghana is bounded on the north by Burkina Faso, by Ivory Coast (Côte d'lvoire) on the west, Togo on the east and the Gulf of Guinea on the south.

Figure 1.7

Administrative regions of Ghana



Source: Benneh and Dickson, 1984

Until its independence from British colonial rule on 6 March 1957, Ghana was called the Gold Coast, a name given it by early Portuguese explorers who first set foot on the shores of the country in the fifteenth century. The name aptly describes the country's wealth in gold and natural resources, which include to the present day:

- rich mineral resources such as gold, diamonds, manganese, bauxite, iron ore and various clay and salt deposits;

- extensive, rich forests with a wide range of fine tropical hardwoods;
- a wide variety of agricultural products and rich fishing resources;
- unique tourist attractions, including beautiful landscapes, inviting sunshine, golden beaches, wildlife parks, the country-side with its rich cultural heritage, and the proverbial warmth and hospitality of the people.

Ghana has a population of 18.3 million (1990 estimate) people. With an annual growth rate of 3.2 per cent, this figure is expected to increase to over 19 million by the year 2000. On average the population density is about 52 persons per square kilometre. Most of the population is concentrated in the southern part of the country, with the highest densities occurring in urban areas and cocoa-producing areas. The largest regions in terms of population are Ashanti (about 2 million), Eastern (about 1.7 million) and Greater Accra (about 1.5 million). The capital city is Accra. In terms of vegetation the country is divided into six regions; namely, moist-semi deciduous forest, Sudan savannah, Guinea savannah, the Rain forest, the Coastal scrub and grassland and the Strand and Mangrove zone (http://www.ghana-embassy.org/profile/).

1.6 The ports of Ghana[2]

1.6.1 Takoradi port

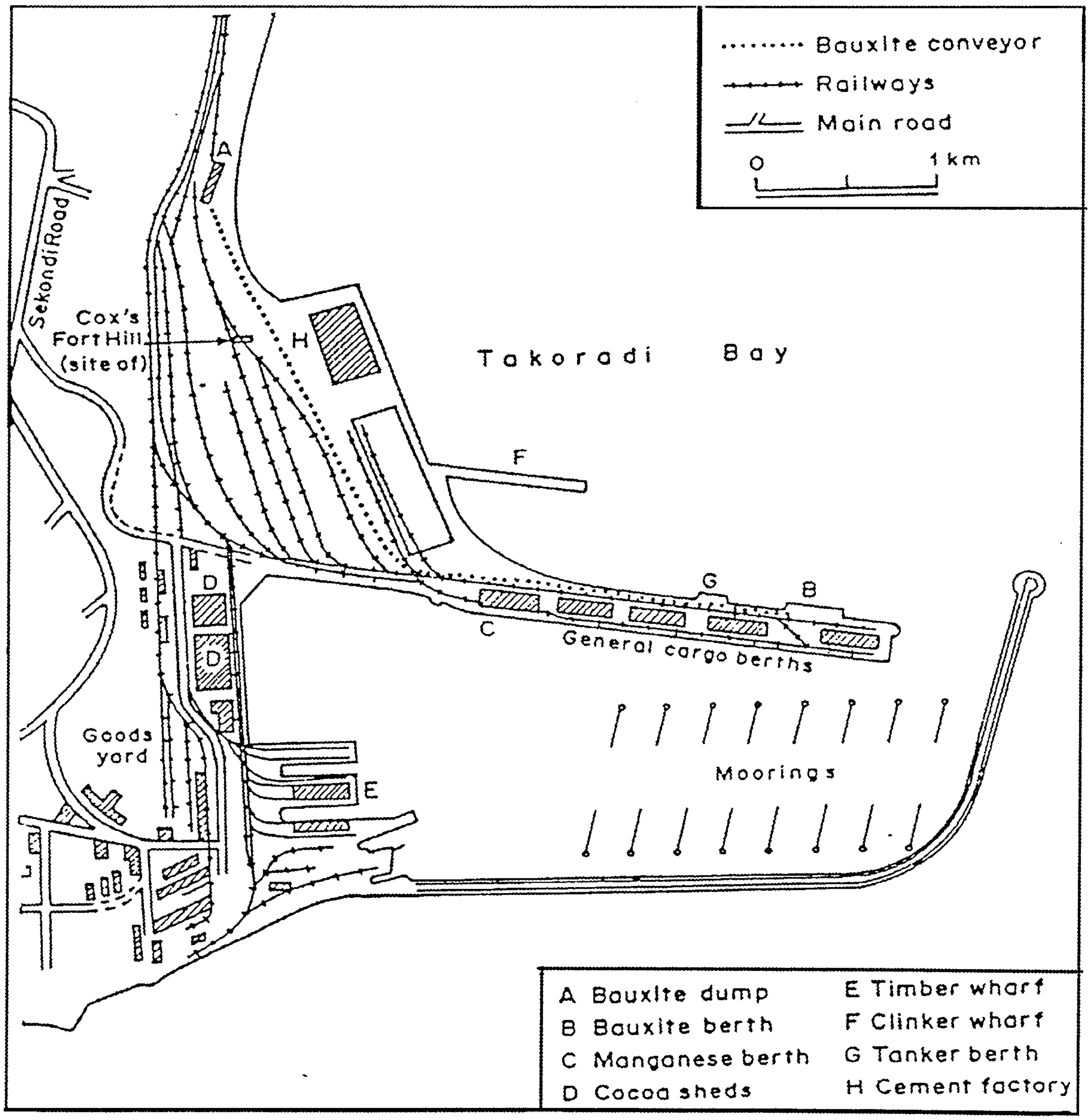
Takoradi port was constructed in 1928 by Sir Gordon Guggisberg, the then British Governor, in response to the difficulties encountered by the surf ports in handling the expanding external trade of the country, especially mineral shipments. There were problems with imports, too, as various kinds of goods stood out to sea for weeks on end. This congestion problem constitutes the basis of Takoradi's emergence. The construction of the port was central in the Ten-Year Development Plan of Guggisberg. Arguing before the Gold Coast Legislative Council, Guggisberg emphasised the importance of the port and its associated railway to the external trade of the country. He also noted the importance of an increased external trade on the recurrent cost of a better educational system that was to be implemented. Guggisberg's conviction of the significance of a modern port to the socio-economic development of the country was so strong that even

[2] Figure 1.14 shows the location of the ports.

the economic slump in the early 1920s could not restrain him. It is said, "He was convinced that the proper reaction to an economic slump was to build for the future, when prosperity should have revived, and not to sit supinely under adversity" (*see* Addo 1994:55). Construction work on the port (Figure 1.8) started after the First World War. Port operations started on 3 December 1928.

Figure 1.8

Port of Takoradi



Source: Addo, 1984

The port lies 228 km west of Accra. It has a water-enclosed area of 880,000m² and nine berths with a maximum draught of 9.5m. The berths of compose 5 multi-purpose berths, 1 manganese berth, 1 bauxite berth, 1 oil berth, and 1 clinker jetty. There are 7 buoy berths with a maximum draught of 10.97m. The total length of quay is 945m. There are two berths provided with facilities to handle container facilities and RoRo vessels. Also at the port is a small dry-dock used only for fishing vessels, barges, tug boats and a 300 tonnes-capacity slipway. The port has a covered storage area of 50,299m² and 257,079m². for open storage. Handling equipment include forklift trucks, mobile cranes, portal cranes, overhead cranes and RoRo tractor/trailers. Handling craft, include tugs, pilot launches, mooring launches, buoy barges, lighters and pontoons. A multi-channel VHF keeps 24-hour watch on channel 14 and 16. Pilotage is compulsory for all vessels in the port.

1.6.2 Urbanisation and industrialisation in Sekondi-Takoradi

The role of the port in the emergence of Takoradi as an urban centre cannot be over-emphasised. In 1931, just three years after the commissioning of the port, Takoradi's population reached 5,478, bestowing on it an urban status[3]. The population has since then increased significantly, from 17,327 people in 1948, 41,117 in 1960, 58,161 in 1970 to 61,484 in 1984 (Table 1.3). The rapid increases in the city's population have been attributed partly to jobs created within the port itself and to industries directly and indirectly related to the port. These activities attracted workers from different parts of Ghana as well as nationals from countries like Nigeria and Liberia. In 1994, Takoradi port had 1,200 employees in all categories.

[3] Five thousand (5,000) people is the minimum requirement for a township in Ghana.

Table 1.3
Population growth of Takoradi and Sekondi, 1931-1984

Year	Takoradi	Sekondi	Sekondi/Takoradi
1931	5,478	16,953	22,431
1948	17,327	26,417	43,743
1960	41,117	35,233	76,350
1970	58,161	33,713	91,874
1984	61,484	31,916	93,400

Source: Addo, 1994

Important in any discussion on Takoradi is its twin city, Sekondi, which is a little over 9 km from Takoradi. Until 1928, Sekondi was the main centre of port activity in the Western region of Ghana. The presence of the port and the railway connection it had to the key mining and cocoa-growing areas made its economy a vibrant one and a basis for its growth. Consequently it became the administrative capital of the Western region. After the Second World War, Sekondi lost its port functions and this affected its growth. As can be seen from Table 1.3, Sekondi's population, before 1960, was higher than that of Takoradi. The trend, however, changed from 1960 and since then Sekondi population has lagged behind Takoradi. In fact, Sekondi's population growth has been negative since 1970 while Takoradi's continued to increase, especially in 1984. This is interesting in the sense that in 1931 Sekondi's population was about three times that of Takoradi. Though Sekondi still holds its function as the administrative capital of the Western region it is more of a satellite town to the more prosperous Takoradi. Officially, the two towns are considered a twin-city. As a result, Addo (1994) suggests that any meaningful discussion is impossible without considering them in this light.

While the urbanisation process of the twin-city started before 1928 and particularly in the case of Sekondi serious urbanisation for both cities began with the construction of the Takoradi port. Housing development in both towns provides a clue to this assertion. The total housing stock for the two cities in 1948 was 3,223. This resulted in a ratio of 2.3 and 13.6 persons per house for Sekondi and Takoradi respectively. By 1970 the housing stock in Sekondi had declined from 1,894 in 1948 to 1,797. On the other hand, on account of its vibrant and growing economy Takoradi recorded an increase of 1,525 units (Table 1.4). The decline in the housing stock in Sekondi was associated with the city's loss of its port functions which served as a growth pole and the abandonment of old houses, as well as with the lack of desire to build new houses as a result of lack of demand. Together, however, the two cities had 4,651 housing units in 1970 against that year's population of 91,874. Thus, there were roughly about 20 persons per house. This compares with approximately 7 persons per house in 1948.

Table 1.4

Housing delivery at Sekondi-Takoradi, 1948-84

City	1948	1960	1970	1984
Sekondi	1,894	1,965	1,797	1,831
Takoradi	1,329	2,242	2,854	3,525
Sekondi/Takoradi	3,223	4,207	4,651	5,356

Source: Addo, 1994

This declining housing occupancy ratio marked the beginning of the problem of overcrowding which was a result of influx of migrants to Takoradi in search of jobs: jobs which were highly port-inspired. In 1984 the housing stock in Takoradi rose by 23.5 per cent as compared with only 1.9 per cent in Sekondi. For the twin-city in that year persons-per-house ratio was 17, implying improvement in the 1970 figure. The improvement, however, was attributed more to a low population growth rate than to any significant performance in housing delivery. From 1960 to 1984, for example, Sekondi recorded a negative population growth rate of 9.5 per cent.

With respect to industrialisation, two main industries have benefited significantly from the building of Takoradi port. These industries are those that deal in bulky raw materials and those that derive their raw materials from processed items. In the category of bulky raw materials are the mining companies and in the second category are the cocoa-processing factory, the numerous wood-processing factories, and units of the tobacco, leather, chemical and rubber and plastic industries. In 1984 the manufacturing sector in the twin-city employed about 12,903 people and this constituted 14 per cent of the total population of the twin-city. This figure represented an 850 per cent increase over the 1948 workforce in the manufacturing sector (Addo, 1994).

These achievements notwithstanding, Takoradi began to experience capacity problems during the post-war economic boom experienced by the country. Ghana's external trade increased dramatically immediately after the war due to the insatiable demand for tropical raw materials and the need to reconstruct and develop the country's infrastructure. There was, for example, a jump in the country's import from 7.6 million (British) pounds in 1938 to 45.4 million pounds in 1949. Food imports, for instance, increased in value from 1 million pounds to 6 million pounds while tobacco, drinks and textiles increased four, seven and ten times respectively. Cement imports doubled in the same period. After 1949 the ports' ability to handle the country's external trade became an issue of great concern, since its overall growth rate slackened even though world trade continued to boom. "Shipping was frequently delayed and there were cases of ships waiting for as long as 17 days before getting alongside to unload" (Hilling, 1970a: 112). Evidence of this can be seen from the ports' traffic in Table 1.5.

Table 1.5

Ghana's port traffic, 1938 and 1945-1967 (1,000 tons)

	TAKORADI		ACCRA		TEMA		OTHER		COUNTRY					
									Imports		Exports		Total	
Year	Imp	Exp	Imp	Exp	Imp	Exp	Imp	Exp	Tons	%Δ	Tons	%Δ	Tons	%Δ
1938	299	477	92	129	—	—	40	54	431	—	653	—	1084	—
1945	282	1135	62	99	—	—	—	—	344	-20.2	1234	88.9	1578	45.6
1946	320	1206	93	91	—	—	1	4	414	20.3	1301	5.4	1715	8.7
1947	355	986	156	58	—	—	7	15	518	25.1	1059	-18.6	1577	-8.4
1948	444	1179	184	56	—	—	18	14	646	24.7	1249	17.4	1895	20.2
1949	556	1319	273	65	—	—	35	25	864	18.9	1409	8.7	2273	20.10
1950	583	1280	245	66	—	—	51	27	881	1.9	1373	-2.6	2254	-0.84
1951	675	1378	320	61	—	—	53	25	1048	18.9	1464	6.6	2512	14.4
1952	711	1317	312	55	—	—	33	27	1056	0.76	1399	-4.4	2455	-2.3
1953	717	1403	390	69	—	—	51	31	1158	9.7	1503	7.4	2661	8.4
1954	719	1157	387	60	—	—	54	28	1160	0.17	1245	-17.2	2405	-9.6
1955	854	1272	512	69	—	—	60	30	1426	22.9	1371	10.1	2797	16.3
1956	799	1529	529	78	—	—	56	28	1384	-2.9	1635	19.3	3019	7.9
1957	874	1679	543	80	—	—	55	35	1472	6.4	1794	9.7	3266	8.2
1958	764	1525	583	65	—	—	50	27	1397	-5.1	1617	-9.9	3014	-7.7
1959	815	1720	675	81	—	—	55	29	1545	10.6	1830	13.2	3375	12.0
1960	1007	1895	791	89	—	—	45	51	1843	19.2	2035	11.2	3878	14.9
1961	1107	1558	877	155	172	35	57	38	2213	20.1	1786	-12.2	3999	3.1
1962	736	1562	206	—	622	206	17	7	1581	-28.6	1775	-0.6	3356	-16.1
1963	717	1504	—	—	1010	291	——		1727	9.2	1795	1.1	3522	4.9
1964	448	1513	—	—	1699	578	—	—	2147	24.3	2091	16.5	4238	20.3
1965	382	1643	—	—	1537	658	—	—	1919	-10.6	2301	10.0	4220	-0.4
1966	417	1597	—	—	1357	584	—	—	1774	-7.6	2185	-5.2	3955	-6.3
1967	242	1436	—	—	1510	558	—	—	1752	-1.2	1994	-8.7	3746	-5.2

Source: Hilling, 1970b
Imp = Import, Exp = Export, %Δ = % change

Despite fluctuations, the ports' traffic increased by 685,197 tons between 1938 and 1945, but by only 397,764 tons from 1949 to 1953. The 1950 figures were affected by a general strike, which disrupted port operations and accounted for the higher figures for the following year. This was especially the case at Takoradi, for the surf ports closed during the war had to be re-opened. The consequences of the limited port capacity were recurrent shortages of consumer goods and delays in delivery of important development materials. With this increase in personal consumption and the requirements of rapid development the country's physical capacity was stretched, causing inflation. Seers and Ross (in Hilling, 1970b) write, "to say which is the most serious of these strains would be hard, but a strong case can be made out for treating port capacity as the main bottleneck". These events ushered in plans for the construction of the port of Tema, to which I turn my attention in the following section.

1.7 Port of Tema

The development of Tema port occurred in association with an interlocking process of change initiated through the implementation of a major government policy. The other components of these processes of change include the establishment of the aluminium smelter and the construction of a dam across the Volta River at Akosombo. Discussions on the project to harness the Volta River for hydro-electric power to be used by the aluminium smelter started in 1949. One of the duties of the consulting firms employed was to report on the transport problems associated with the scheme and, most especially, on the provision of port facilities. The Committee's report (1951) concluded that "the provision of a new deep-water port is, in our view, essential to the future development of the colony, irrespective of whether the power scheme is carried out or not" (Hilling, 1970a:113). The choice of Tema as the site for the new port stems from two main considerations. The first was the requirements of the general economic development of the country while the second was the specific requirements of the Volta River Project. There were obvious advantages of siting the new port near the capital to serve the densely populated eastern part of the country and more especially as Accra was already linked by rail to the interior. What is more, the original idea of building the dam at Ajena with the smelter at Kpong (Figure 1.14) served equally to prove the locational advantage of having the port in the south-east of the country. The later decision to site the dam at Akosombo, a few kilometres downstream of Ajena, and ship bauxite from Kibi, about 75 km inland and close to the Accra-Kumasi railway, also confirmed a port location close to Accra.

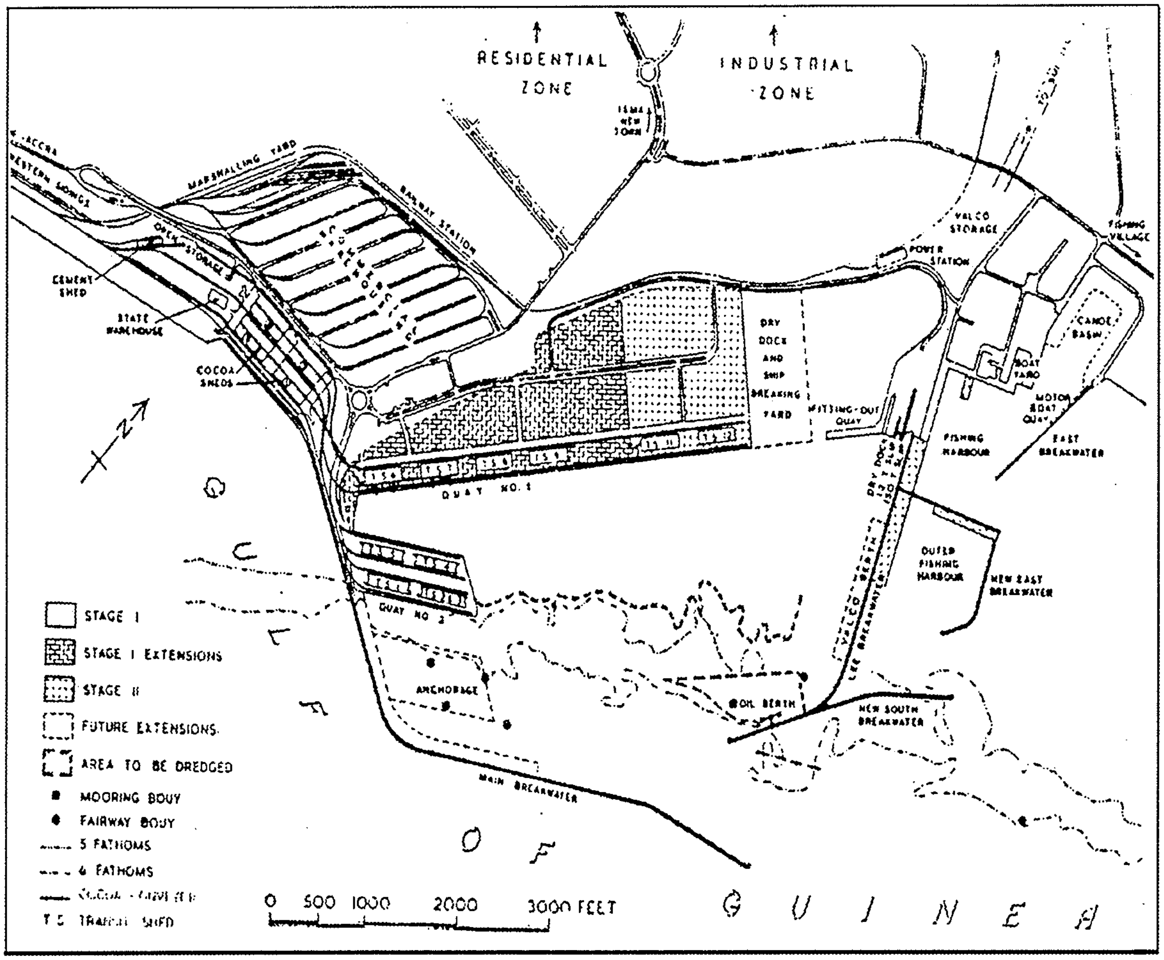
The original intention of the aluminium company was to have the port sited at Ada, at the mouth of the Volta River, as they planned to bring the bauxite ore from Aya-Yenahin, west of Kumasi, by way of the Volta Lake and River artery (Figure 1.14). The Ada area, however, is low-lying and badly drained. In addition, the cost of construction would have increased as a result of dredging and river control. Again Ada had no rail connections with Accra and was also not centrally located to serve the Eastern region. Locating the port at Accra itself was a non-issue as the coastline in the immediate neighbourhood is subject to silting and the already developed urban landscape adjacent to the existing port made further development of facilities at the capital impossible. From the outset, therefore, economic considerations supported the location of the port near Accra for linkage with the existing rail system and ease of access to the rest of the Eastern region and the proposed Volta River Project development schemes. With the coastline of Ghana deficient in natural port sites the ultimate decision to locate the port at Tema, a fishing village 18 km east of Accra was based on the following unusual physical characteristics of the site:

1. The existence of deep water close to the shore.
2. The existence of a rocky headland which provided a 'root' for the main breakwater.
3. The steep rocky sea bed which minimised the effect of littoral drift and considerably reduced dredging.
4. The existence of extensive areas of land in the neighbourhood for industrial and urban development.
5. The availability of suitable rock at the Shai Hills, 30 km north of Tema, for constructional purposes (Addo, 1994, 1995, Hilling, 1970a).

The port was started in June 1951 and completed in 1962 (Figure1.9).

Figure 1.9

Port of Tema



Source: Port of Tema

1.7.1 Facilities

Tema port is situated on the Greenwich meridian and 5'37° north of the Equator. It has a harbour entrance 240 metres wide, enclosed water area of 1,659,247m², a land area of 3,904,754m² and a total length of quays of 2,196m. There are 12 multi-purpose berths with average length of 183m, one oil berth (private) with length of 244m, and a berth owned by the Volta Aluminium Company (VALCO). This berth has a length of 175 metres. The maximum draught of the multi-purpose berths is 9.6metres. There is compulsory pilotage for all vessels of more than 10 net registered tonnage (NRT). A 24-

hour watch on VHF channels 14 and 16 is also in place. Equipment at the port includes multi-purpose and mobile cranes, portal and overhead cranes, forklift trucks, top lifters, RoRo tractors and cocoa conveyors. Harbour craft include tugboats, pilot launches and mooring launches. There is a RoRo marshalling area of 19,200m² to meet the increasing RoRo traffic. Two hundred and ninety (290) reefer points are available to serve containerised frozen cargo. The container stacking area is 200,000m², capable of accommodating 8,000 TEUs.

1.7.1.2 Organisation

Management of the ports is by the Ghana Ports and Harbours Authority (GPHA). The GPHA, established in 1986 as a statutory public corporation, is the sole planner, builder, developer, manager and controller of the ports in Ghana. The Authority is run by a 9-member Board of Directors who are responsible to the Minister of Transport. These include the Director-General of the GPHA and the directors of the two ports. Daily administration of the ports revolves round the Director-General who is assisted by the directors at Tema and Takoradi, the Chief of Personnel and Administration, and the departmental heads. Nine main departments constitute the Authority; namely, Management, Port operations, Marine engineering, Civil engineering, Electrical engineering, Mechanical engineering, Accounts, Stores and Internal audit.

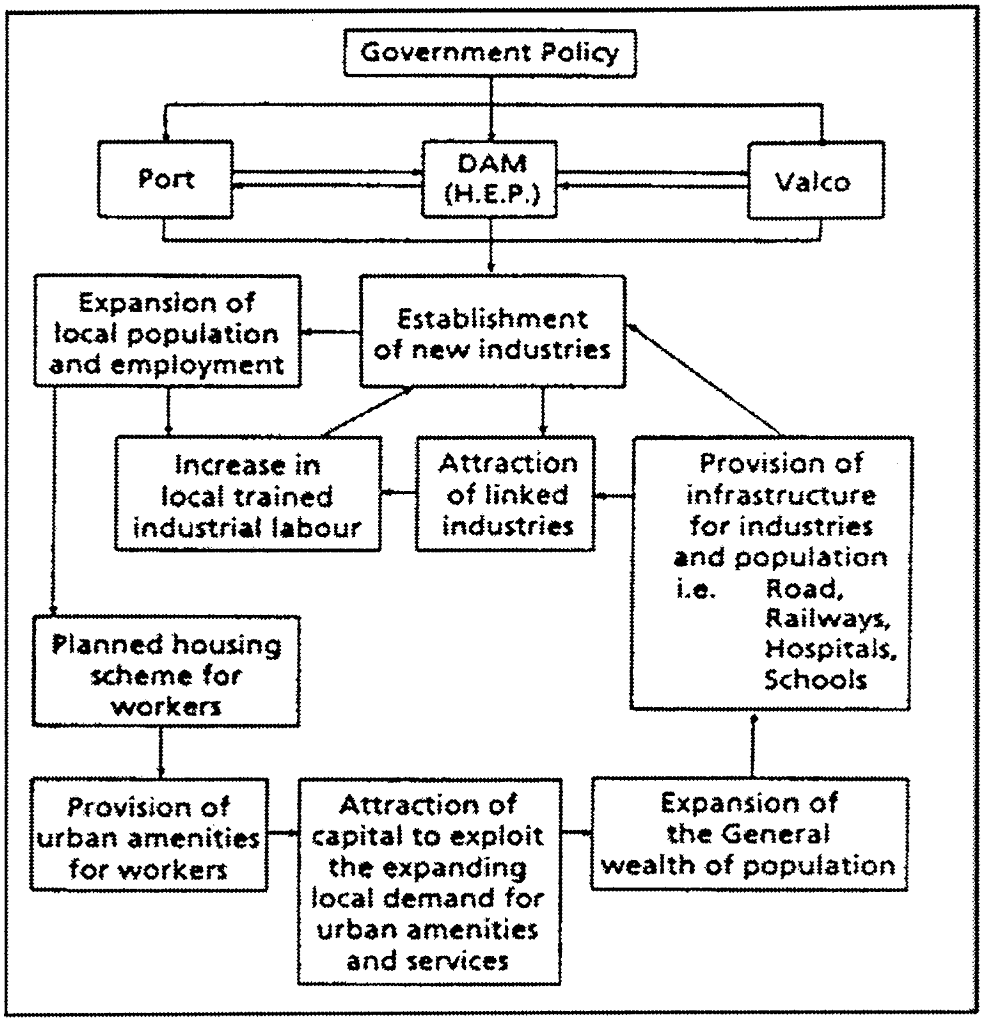
1.7.2 Industrial and urban development of Tema

As already remarked, construction of Tema port was part of an interlocking processes (Figure 1.10) of change initiated through government policy. The Volta River Project was to be power base, with the aluminium company (VALCO)[4] consuming about 50 per cent of the power to be generated. The agreement signed between the Ghana government and VALCO allowed the latter to use between 200,000 and 300,000 kw of electrical power from the dam over a thirty-year period. This agreement has since been revised. The combined effect of the activities of the three projects has given great impetus for urbanisation and industrialisation in the town. Tema is now home to most of the country's industries.

[4] VALCO is owned by the Kaiser Aluminium Corporation and Reynolds Metals Company.

Figure 1.10

Tema: cumulative process of growth



Source: Addo, 1994

Mention can be made of port-related industries like VALCO, the Tema steel company (TSC), the Tema oil refinery (TOR), the Ghana national petroleum company (GNPC), the Ghana cement works (GHACEM) and the Tema shipyard and dry-dock company (TSDC), to mention just a few. General port industries include cocoa processing (CPC), textile printing (GTP, TTL, GTMC), agro-food processing (GAFCO), the activities of the Pioneer aluminium company (PLC), Nyame metal works (NMW), Ghana aluminium works (ALUWORKS), and a host of others. Tertiary services include banks, insurance companies, hospitals, schools, and hotels among others. In 1987 about 20,000 people were employed in the manufacturing sector. In 1997 Tema had over 80 industrial establishments and an estimated work-force of about 50,000 people (Asafo-Adjei et. al, 1993). The effect of such vibrant industrial activity has been rapid urbanisation expressed in increased population growth and housing development. Thus from a small fishing village of 1,091 in 1931, Tema's population increased to 100,052 people in 1984 (Table 1.6). Presently the population is estimated to be about 200,000 people, residing in 21 communities.

Table 1.6

Population growth of Tema, 1931-1984

Year	Population
1931	1,091
1948	1,120
1960	14,937
1964	80,000
1970	60,767
1984	100,052

Source: Addo, 1994

Table 1.7 demonstrates the pace of housing development.

Table 1.7

Housing delivery in Tema, 1948-1984

Year	Housing units
1948	76
1960	3,216
1970	10,731
1984	12,300

Source: Addo, 1994

Over the years the Tema Development Corporation (TDC), established in 1952, has been the main supplier of housing in Tema. It has provided about 80 per cent of the total housing stock in the township. Institutions and private estate organisations have provided the remaining 20 per cent. Today, the TDC is no longer a housing provider; rather, it regards itself as a *facilitator*. Its main concern now is to provide the necessary physical infrastructure of the town. Housing provision is at the moment mainly the responsibility of private developers and the various employment institutions. The high cost of living in Tema – a plot of land [100x70m] cost between US$ 8,000 and 15,000 in 1995[5] – coupled with the increasing demand for housing and the inability of the TDC to meet the demand, led to the creation of a satellite town – Ashaiman – just 8 km north-west of Tema. Ashaiman is unofficially estimated to have a population of about one million people. Ashaiman has thus served as a cushion for Tema, saving it from the urban degeneration that has plagued many port cities and indeed its immediate counterpart, Takoradi.

Berko (1980 in Addo, 1995:330), writing on Tema made the following remarks; "There are serious implications for regional imbalance in the distribution of industrial establishments in developing countries, Ghana included. This situation leads to differential rates of overall development; whilst some regions develop, others stagnate. It is therefore necessary that government policy should aim at a fair distribution of industries among the various regions in a country. However, for individual industrial establishments, the pull of Tema due to urbanisation economies, such as port facility, abundant and ready supplies of power and water, a favourable labour market, proximity to government bodies and fairly well-developed transportation network makes the location the single most favourable in the country. Industrial activity will as a result continue to be pulled to the township".

Commenting on the implications of Berko's view, this is what Addo (1995:330) had to say; "Growth in industrial location and activity at Tema will exert tremendous pressure on the use of port facilities and other services. The indications are that a symbiotic relationship is emerging [and has indeed emerged] between the urban field and the port. Activities of the two systems complement each other". Such was the pressure of growth that the government offered incentives to industrialists to encourage them to establish

[5] US$ 1= ₵1,500 (1995), US$ 1= ₵2,330 (1998)

away from the zone! In this sense Tema has become a true industrial complex, an outcome inconceivable without the port (Hilling 1970a: 192-193).

This is the regional context within which the ports occur. Beyond this regional context is the wider national economic space, the context constituting the hinterland for both ports. Sharing a single economic space implies some form of competition between the ports. Which of these two ports occupies a greater portion of this economic space, and to what extent port performance contributes to this feat is the problem under investigation. Section 1.8 is an expanded form of this problem.

1.8 Research problem

Ports and hinterlands are closely linked in terms of their development, functions, and problems. Their fortunes, it is said, reflect the changing circumstances of their hinterlands and forelands. At the same time, the socio-economic and political systems exhibited by a hinterland also reflect and are reflected by the character of ports or port systems. This establishes an interdependent relationship between ports and their hinterlands. Thus, according to Hoyle and Charlier (1995:87) "the port function, wherever it has been developed, has normally been related to some aspects of inland growth, and economic development has in turn required port facilities ....". On the basis of this relationship the following working statement/hypothesis is proposed for the study.

> *A port's overall traffic is a function of its performance (port facilitlies) and hinterland (inland growth). However, for being the catchment area of the port, the hinterland, is considered fundamental to port growth and development, and thus, inaccessibility to them, by whatever reasons, can retard port (port system) growth and development.*

This working statement is in tandem with Hoyle and Charlier's (1995) observation of the important, dynamic and varied relationship that exists between ports and the regions they serve. They note further that the interface between a port and the regions, on various scales, within which it is located and those which it serves introduce different sets of relationships. These relationships are, however, less well-defined than in the case of the port/city interface, for example, although they may reflect a similar variety of contexts – environmental, economic, political, technological, etc – and a similar range of issues such as transport, employment and planning. There is, however, a significant difference "in terms of the spatial scales involved; for whereas the port/city interface is largely confined within the relatively discrete context of the built up area, the port/hinterland interfaces are not only far more extensive geographically, but also involve in other dimensions a variety of different concepts, scales and levels of interaction (Hoyle and Charlier, 1995:87-88). Among these dimensions inter-port competition is considered particularly significant.

There is evidence of such inter-port competition at the port-hinterland interface in Ghana, as hinted earlier. Actually, Hilling (1970a) has documented this. Using a geometrical locus of equal distance between Takoradi and Tema, Hilling identified four hinterland regions, which he believed corresponded to the areas which the ports served (Figure 1.14). The following are his demarcations.

Region 1. This is the uncontested hinterland of Takoradi, within which the present bauxite and manganese mines are found and from which much timber is obtained.

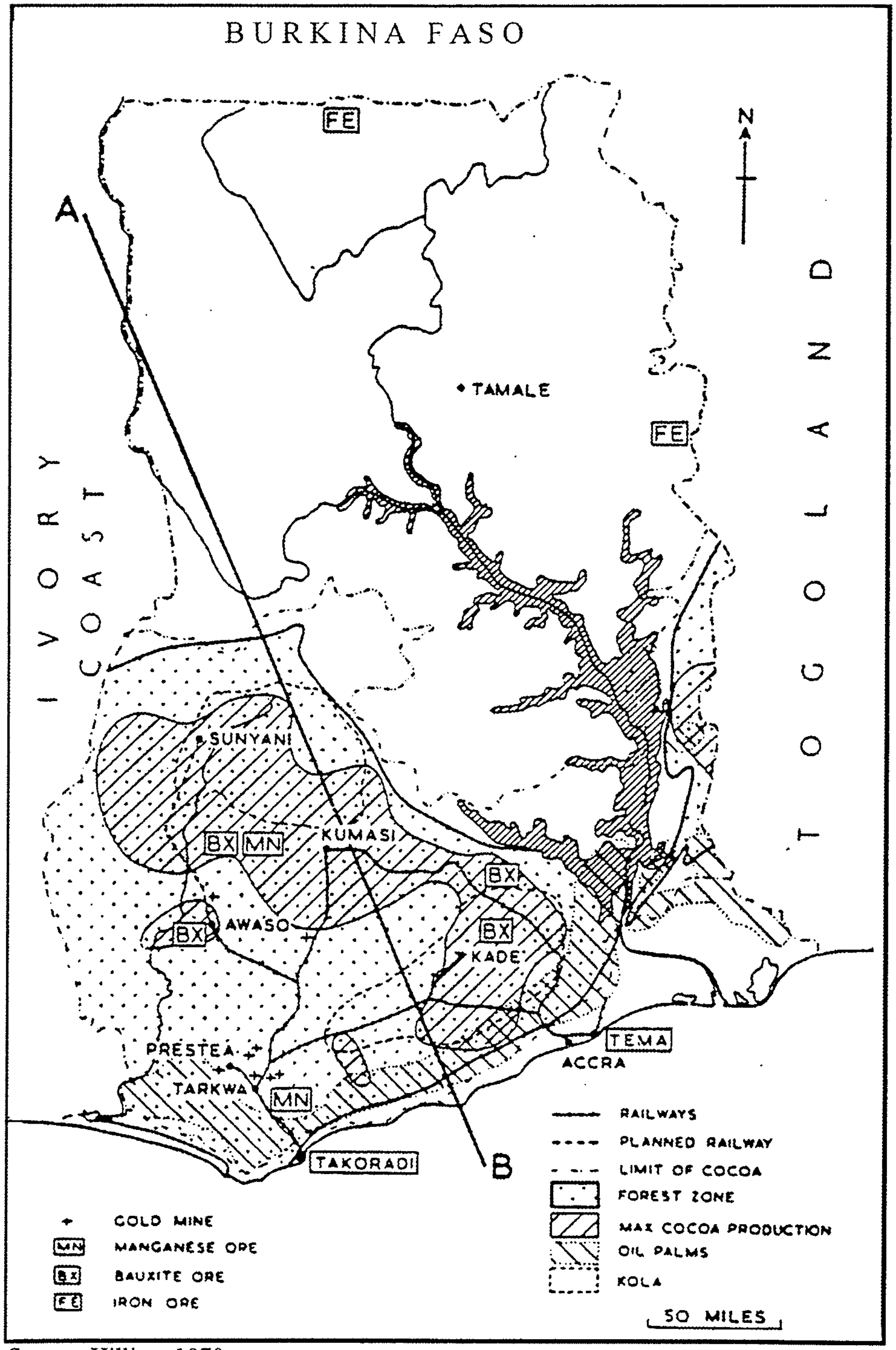
Region 2. Tema serves this area. The area is relatively poor in forest products and is the area most affected by cocoa-tree disease. The Kibi bauxite deposit, which is an important resource base for the Volta Aluminium Company in Tema, is found here.

Region 3. A region from which the trade is channelled through Kumasi which is nearer Takoradi by rail and Tema by road. The choice of port depends on the type of goods and the port traffic conditions. Thus, all timber goes to Takoradi but there is competition for cocoa and general imports. Here, Hilling asserts that the new straight road from Nsawam to Kumasi will favour Tema.

Region 4. Trade from this region passes through Kumasi and is comparable to Region 3. Hilling's predictions were that it will come under the hinterland of Tema upon the completion of the Volta Lake and more particularly as the rail link from Tema to the Shai Hills was to be extended (and electrified) to Akosombo and the lake was also to be provided with a series of ports.

Figure 1.11

Hypothetical hinterlands of the ports of Ghana



Source: Hilling, 1970a

Much development has taken place within the Ghanaian economy since Hilling's study was completed twenty-eight years ago. The Volta Lake has been constructed and the Nsawam-Kumasi road is also in place. The ports themselves, in 1986, underwent a rehabilitation exercise costing 100 million dollars. A programme, it is claimed, has brought the ports' facilities and equipment up to date, resulting in very high margins in their operational performance (Port News:undated). Thus, with *time* and *development* introducing a dynamic element, the hinterlands of the ports are expected to change, *ceteris paribus*, disproportionately. To help investigate this problem are the research objectives outlined below.

1.9 Research objectives

1. The initial objective is to study and compare the status of the two ports over time. The rationale of this objective is to provide a basis for assessing and interpreting the ports' performance (Rimmer, 1966a).
2. The second objective is to attempt a delimitation of the hinterlands of the two ports. The purpose for this objective is twofold. The first is to compare the new hinterlands with Hilling's to see the changes that might have occurred over the period and secondly, to comply with Rodgers' (1958) point that "the delimitation of a port's hinterland and an examination of its nature and extent are basic steps in an evaluation of the prospects for further development in that port".
3. Thirdly, the aim is to examine the transportation network linking the ports and their hinterlands. As Boerman (1951:348) remarks, "it is the hinterlands combined with the transport links, that gives the key to port growth".
4. Finally to bring the thesis to a close, policy recommendations would be offered for consideration by the port authorities and the Ghana government.

1.10 Summary

Three main themes have been discussed in this chapter. The first was concerned with justifying the sub-disciplines transport and port geography and thus the feasibility of conducting the study within the borders of geography. The second theme was about port infrastructure and development. Emphasis here was on the port infrastructure and African development with special emphasis on Ghana. The final theme was on the research problem and objectives. At the core of the research problem is the interdependent relationship between the port and the hinterland. What is more, there are the many dimensions of the port-hinterland interface. One significant dimension of this interface is inter-port competition. With port competition also comes port comparison, as competition requires assessment. But, on what basis and by what methodologies can ports' performance be assessed and compared? These are the issues I discuss in Chapters Two and Three. I begin with the hinterland concept in Chapter Two.

CHAPTER TWO

HINTERLAND:CLASSIFICATION AND FUNCTIONS

2.0 Introduction

In the concluding remarks in Chapter One, we noted the interdependent relationship between the port and the hinterland and the centrality of the two phenomena to the research problem. In this chapter I shall concentrate on the hinterland and tackle the methodology in Chapter Three. What follows is a review of the salient literature on the hinterland concept and its significance for port planning and development.

2.1 The hinterland concept

There is no agreed definition of the term hinterland by geographers. Van Cleef (1941) categorised hinterlands into two: the continuous hinterland and the discontinuous hinterland. The former he defined as the "the area adjacent to a trade centre - extending to and including its satellites - within which economic and some cultural activities are focused largely on the primary centre", while the latter "takes into consideration the fact that some regions are economically closely associated with a primary centre but that the intervening territory has no particular interest for the centre". A related concept, *umland*, he defined as "the area contiguous to a trade centre - extending to and including its suburbs or '*urblets*' - whose total economic and cultural activities are essentially one with those of the primary centre" (Van Cleef, 1941). This view of hinterland, informative as it is, does not capture the port-hinterland relationship. Naturally, the question arises as to the precise meaning of hinterland in the context of port studies. This is where the contribution of Weigend and other port geographers cannot be overlooked.

Weigend (1958:192-193) defines the hinterland as an "organised and developed space which is connected with a port by means of transport lines and which receives or ships goods through the port". To Hoyle (1967:76) the hinterland is "the land area behind the port which is served by it [the port]". Bird provides a more comprehensive definition. By his reckoning, (in Hayuth, 1982:13), the hinterland is "a tributary area the, 'backyard' of a port, and a functional region in which different internal points are linked to a port".

Morgan cautions against the temptation of considering the hinterland as a mere piece of land behind the port. He writes, "the concept of the hinterland of ports as a simple parceling out of the country behind them, with areas of overlap where ports compete, and with certain peculiar courses where a mountain range or a frontier affects the flow of trade, is hardly adequate" (Morgan 1967:76). The essence of his comment is appreciated in the foregoing.

2.2 Nature and extent of hinterlands

A hinterland may belong exclusively to a single port or several ports. Many ports in Africa, for example, have exclusive rights to their hinterlands on account of the fact that they have few or no competitors (Hoyle, 1967). On the other hand, ports on the Mediterranean and on the North Sea coasts have competed vigorously for hinterlands. Trieste, for instance, no longer enjoys the exclusive right to Vienna's traffic as a result of competition from ports on the North Sea of Germany, especially Hamburg. Despite being more than twice as far from Vienna as Trieste, Hamburg has been able to out-compete Trieste for Vienna's traffic. Traffic from Vienna took only six days to reach Hamburg compared with the five days it took to reach Trieste. In addition, Hamburg had better and more frequent maritime connections with all parts of the world and port fees were half those of Trieste. The German policy of preferential railway rates also helped to divert traffic away from Trieste and other Mediterranean ports. Furthermore, the decentralisation of industries in Austria brought about rapid urbanisation in western Austria as more industries moved there. With better transport connections northwards than to Trieste, more of Austria's overseas cargoes shifted towards the North Sea.

St. John, New Brunswick, presents a different dimension of the nature of hinterlands. During winter St. John competes with other Atlantic coast ports for the hinterland of most of the populated areas of Canada, from the Atlantic to the Pacific and certain areas of the United States north of the Ohio and Missouri rivers. In summer, however, St. John loses its interior hinterland to the St. Lawrence and Great Lakes ports and is thus left with the traffic of the Maritime Provinces, which is economically far less important.

The port of Lobito in Angola also presents a different story. Until 1956 Lobito could not attract the copper exports from Northern Rhodesia [Zambia], though the ocean route from Lobito to the main markets was 5,000 km shorter than that from Beira and Lourenco Marques (Maputo), Mozambiques's sea outlets on the east coast. Lobito's inaccessibility to the Copperbelt hinterland in Northern Rhodesia was due to the contract the copper companies signed with the then Rhodesia Railways. Under the terms of the agreement, the companies shipped all copper by way of Rhodesia Railways to the east coast and, in return, gained low freight rates for taking copper out and for bringing coal in (Weigend, 1958:194).

Thus far we see that the hinterland cannot be considered simply as some land behind the port. It is far more than that, as Morgan (1967) cautioned. A port's hinterland may lie outside its national boundaries. In addition, a port's hinterland may fluctuate with weather patterns, politics and policies of succeeding governments, and economic condition prevailing in a country. Hinterlands are therefore not static but rather dynamic and functional. Exceptions to this, of course, are the mineral ports like Nouadhibou in Mauritania where the ports have exclusive rights to their hinterlands. The nature and extent of Nouadhibou's hinterland, for example, has remained almost the same since its inception.

2.3 Ports, hinterlands and transport connections

As already established, hinterland analysis involves consideration of the transport network serving the port and the hinterland. The port of Rotterdam, for example, offers an efficient door-to-door service via a sophisticated combination of different modes of transport. Everywhere in Europe is readily accessible from Rotterdam. A choice can be made between transport by truck, train, barge, coaster and - for liquid bulk - pipeline. The ideal mode of transport is available in the port for every type and volume of cargo, required speed and price. The port also has rail links with all-important industrial centres plus two dedicated Rail Chemical Centres for the transportation of chemical products. A large part of Europe is accessible by train within 24-48 hours. The trains leave every hour of the day, including weekends. In addition, the port has a perfect link with the extensive road network of Europe. The truck services from the port offer tailor-made transport for every type of cargo. Every day in the port of Rotterdam, thousands of trucks travel to and from destinations in the heart of Europe.

Barge service is also available. The geographical location of the Rhine and Maas (Meuse) rivers gives Rotterdam an ideal starting point for European transport by water for every type and volume of cargo. Goods are carried into the heart of Europe by barge. For centuries inland shipping has formed the most important means of transporting all kinds of bulk cargo from Rotterdam, such as coal, iron ore and grain. Tankers and parcel ships also provide safe, environment-friendly transport of chemicals. Inland shipping now also plays a leading role in the transportation of containers. Approximately 22 per cent of containers handled in Rotterdam travel by inland waterways. Inland shipping shuttles operate liner services to inland terminals in Germany, Switzerland, France and Belgium. Just -in -time is also an important aspect of inland shipping. As a result of the opening of the Rhine-Main-Danube canal, inland shipping can now penetrate even deeper into Europe.

A large number of feeder and short-sea services leave Rotterdam every day. In addition to the UK, Ireland and Scandinavia, Rotterdam operates regular services to many countries, including Spain, Greece, Italy, the Baltic States and ports in North Africa. Short-sea and feeder services form an excellent alternative to - or addition to - transport overland deep into the heart of Europe and beyond. Feeder services link up with intercontinental container transport in large ships between Rotterdam and destinations in the USA, the Far East, South America and Africa. Short-sea shipping concentrates on European ports and ports in neighbouring continents. Both as liner service and charter, short-sea shipping offers numerous sailings daily from Rotterdam for every type of cargo. Also linking up with intercontinental transport, specialised ships guarantee customised transport. Ro-Ro ships offer an extra dimension for fast trailer transport. Within just a short space of time, Rotterdam has developed into Austria's second port because of the excellent transport network from the port.

Hungary and Romania are also opening up as part of the port's hinterland (http://www.port.rotterdam.nl/hinterland/GB/).

2.4 Hinterland classification and functions

Different types of hinterlands can be identified, depending upon the criteria adopted. For example, there is the export or import hinterland, bulk or break-of-bulk hinterland, commodity hinterland and primary or secondary hinterland, to mention a few. A further classification can also be made based on the type of inland transport used. A classic work on hinterland classification is that of Morgan (1951). Morgan classified hinterlands into three main categories based on three main factors viz.:

1. The nature of commodities - whether bulk cargo or general cargo is more important, or a combination of the two.
2. The mechanism of sea transport - types of ships, number of lines, frequency of calls, and nature of port equipment available.
3. The influence of policies such as those concerning the control and use of inland waterways, and the rate structures of inland waterways and railways.

From the interplay of these three factors Morgan identified three main categories of hinterlands:

1. Primitive hinterlands - These are exclusive hinterlands belonging to particular ports. Owing to the lack of other sea outlets or any transport connections to other sea outlets, they become incontestably the 'property' of a single port.
2. Raw material hinterlands - These hinterlands generally involve bulk cargo and frequently tramp shipping or specially designed ships such as ore carriers or tankers. Ports of these hinterlands are located so as to cut land transport of bulk commodities to minimum distances.
3. Liner port hinterlands - These are the largest in extent and most complicated in structure. They involve a combination of several cargoes - bulk and general – which requires diverse services. Two types of this hinterland can be identified: primary and secondary hinterlands. Primary hinterland refers to the area where the

port is well established; there is, however, competition between ports in the secondary hinterland.

Weigend (1956) has criticised the basis of Morgan's (1951) classifications as too limited to warrant any validity. According to Weigend, Morgan underestimates such other vital factors as inland transport, agricultural, industrial, and urban development in the interior or in overseas areas, though he acknowledges that Morgan gives prominence to these factors later in his discussion of each hinterland. In addition, the primitive hinterlands are larger than raw material hinterlands and as complex as liner port hinterlands, though Morgan presumes to have evolved a hierarchy of hinterlands by their structure and areal extent. He writes, "Morgan attempted to delimit the extent of the hinterland by imposing a limit for hinterland areas which received from and sent to the port in question a total of 50,000 tons of goods in each direction, but such a limitation is admittedly arbitrary; it is only likely to obscure the true traffic picture".

Mikolajski (1964:227) also adds that Morgan's classification lacks a "uniform criterion because the primitive hinterland is a spatial concept, a raw material hinterland .... is a concept referring to a commodity, having more in common with the organisation of maritime trade as a link with the foreland of ports". Mikolajski (1964:226) then went on to identify several types of hinterlands: natural, marginal, incontestable, contestable, basic, geographical, political with tariff walls, economic, kilometric, real, theoretical, empirical, regional, extra-regional, national concerning a communication area, interior, exterior, facultative, import, export, exclusive, provincial, local, within political frontiers, international, foreign, primary, secondary, primitive raw material, liner port, physical and static.

Bird (1971:125) has modified Morgan's classification. The following is his classification:

1. Immediate hinterland - This refers to the port area itself and the port city.
2. Primary hinterland or *umland* - This includes the immediate hinterland and the area where port and city assume a commanding role in the life of the area.

3. Secondary hinterland/Competitive hinterland - Secondary hinterland is difficult to distinguish from primary hinterland, but for working purposes it is taken as where less than 70 per cent of an area's traffic is forwarded or received from the port in question.

4. Advantage hinterland - An area which falls within the sphere of traffic influence of one port due to the non-linearity of inland tariffs from ports in competition.

5. Commodity hinterland - This is based on indicated direction of shipments of particular commodities or groups of commodities.

6. Hinterland functional overlap - This occurs when the hinterland of a large port overruns that of a smaller port for certain cargoes because of the greater range of port functions, perhaps due to greater number of sailings from the large port.

7. Hinterland areal overlap - This occurs where there is competition between ports of comparable size for cargo of the same type to and from the same area.

Rimmer (1964) also identifies what he calls the inferred hinterland. The concept is used to assess the extent to which a port satisfies the demand for imports imposed on it by the population in its hinterland. The concept relies on the assumption that there is a close relationship between imports handled by a port and the population residing in its hinterland. The methodology underlying the concept is this:

First, there is the presumption that each individual in a country has the same consuming power. Secondly, the actual and hypothetical (expected) import tonnages of a port are calculated and then the actual import tonnage is subtracted from the hypothetical import tonnage. The formula for the hypothetical value is:

$$\frac{\textit{Total country imports}}{\textit{Total country population}} \times \textit{hinterland population of a port}$$

The resultant value shows by how much a port exceeds or falls short of its expected tonnage.

The French have come up with their own classification. They identify two main types of hinterland, namely, regional and supra-regional. Regional hinterland is defined as the ‘natural’ hinterland and the area of functional development. By 'natural or physical' they refer to a 'geographic' region and is of necessity ‘static’; while the area of ‘functional’ or ‘dynamic’ development is the area won over from other ports. The stage of the supra-regional port is entered into when a port extends beyond the area of ‘natural’ hinterland. For supra-regional ports the maritime outlook is the pre-occupation. As Weigend (1956:3) puts it, ‘maritime determinism’ is advocated as opposed to ‘land determinism’.

This traditional view of hinterland described above has been challenged as a result of the introduction of new maritime technologies like intermodal and container transport. In the next section I discuss how these new technologies have affected the structuring of ports’ hinterlands, thereby giving the traditional hinterland a new meaning.

2.5 Intermodal transport and the hinterland concept

Hayuth (1982) claims that factors such as centralised governments’ control of port operations, government policy supporting one port against the other, natural hazards and exogenous economic factors affect particular ports and at certain times only and therefore do not have a worldwide effect or impact. On the other hand, technological change in ocean transport is capable of effecting worldwide change in the port-hinterland relationship. Containerisation and intermodal transport are two examples of this type of change that have profoundly altered the basic hinterland patterns established by the operations of conventional break-bulk cargo. The establishment of trade offices by ports such as Charleston, Seattle and New Orleans in Chicago, for instance, goes to prove the point about the changes taking place in ports’ hinterlands by containerisation and intermodalism. Now “large container ports compete in an expanded arena, in which their nearest neighbour may not be its most serious rival. The once rather well-defined tributary areas of a series of neighbouring ports have been heavily invaded by the major container ports, whose vast hinterlands can encompass entire countries or even continents” (Hayuth, 1982:13). At this point, I would like to explain the words containerisation and intermodalism.

2.5.1 Containerisation and intermodalism

Containerisation has been defined as a "method of cargo handling whereby small parcels can be unitised by use of standard containers, normally 20 or 40 feet (6 or 12 m) long, which can move from origin to destination through different modes of transportation and using sophisticated loading and unloading techniques" while intermodalism is "the arrangement for through transportation, from shipper to consignee, over the lines of two or more transportation modes - and under through-liability, through billing, and a single through-rate" (Hayuth 1982:14). The 'door-to-door', shipper-to-consignee cargo service which intermodal transport offers makes use of different transport modes like truck, ship, rail, barge and airline, thus taking advantage of a different mode on each segment of the trip. Containerisation facilitates and also makes the intermodal process more economical for both shipper and carrier as it avoids the need for breaking of bulk at the port, thus saving total transit time, reducing damage and pilferage, and cutting total transit costs. It also helps to reduce labour cost and, improve turnaround time of ships in port.

The intermodal-container is an integrated system whose activity depends on co-operation and co-ordination between transport modes, warehousing, and freight forwarding. Prior to the advent of the system the responsibility of the ocean carrier was restricted to cargo loading, vessel steaming, and cargo discharging. In the intermodal-container system, however, both the inland carrier and ocean carrier share the same corporate roof or in most cases work closely. More often than not, the ocean carrier takes on the inland transport task too, thus making the entire delivery the responsibility of a single carrier. Shippers are therefore relieved of the problem of storage and handling. The port in this case becomes a point, smoothly passed, on the way to a final destination. Despite jurisdictional and regulatory obstacles, such as the lack of agreement between the Interstate Commerce Commission and the Federal Maritime Commission in the United States on new definitions of jurisdiction over 'door-to-door' freight transport, thereby restricting the further development of the intermodal system, the "impact of intermodal movements of containerised cargo on inland distribution, nevertheless, has been significant" (Hayuth, 1982:14).

2.6 Traffic concentration and inland penetration

Container transport encourages traffic concentration and the establishment of 'load centres'. Sea Land Shipping Lines, for example, concentrated about 95 per cent of all its overland trade between the Far East and destinations west of the Rocky Mountains on the Port of Seattle. In 1977 New York/New Jersey, Los Angeles/Long Beach, Oakland, Seattle, Baltimore and Hampton Roads dominated container traffic in the United States. Together, these ports handled 70 per cent of the container traffic in that country. Concentration of containers in particular ports also helps carriers to take advantage of those ports with superior access to major inland transport networks in order to penetrate the interior as quickly as possible. The high expense and thus the uncompetitiveness of inland transport, for example, limited the effectiveness of the conventional hinterland. This forced ships to call at several small ports. With containerisation and significant improvements in land transport the competitive position of overland carriers has improved relative to ocean carriers. In the United States the development of the national highway system, the adaptation of long-distance truck haulage to the container system and all-container trainloads have combined to lower the unit costs of overland transport (Hayuth, 1982, Slack, 1990).

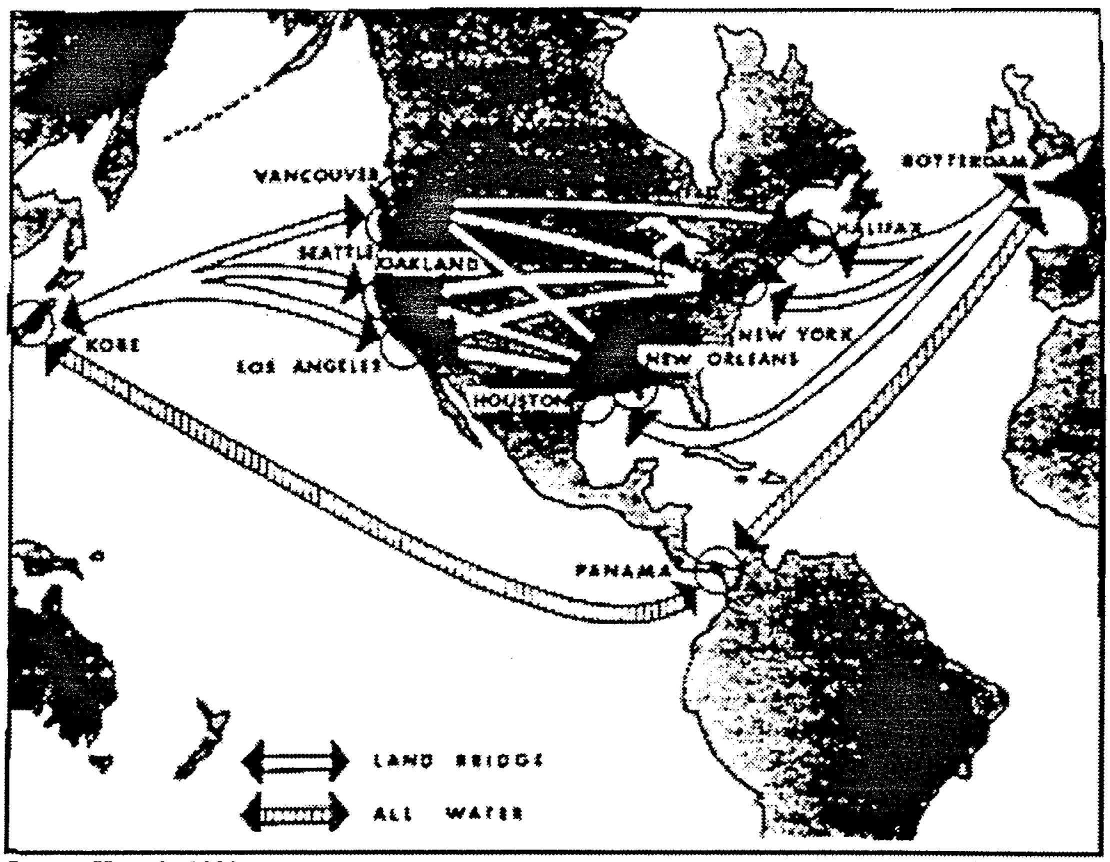
What is more, the capital costs of overland transport improvements are either borne by the government or have been comparatively small in other instances. On the other hand, the higher purchase costs of container vessels make their daily operating costs higher than conventional general cargo vessels. Together, these have served to encourage the development of inland distribution concepts in which overland movements of trucks and trains can compete successfully with the high daily operating cost vessels, on short as well as on long long-distance routes. The Land and Mini-land Bridge are two new concepts of inland distribution that developed from the intermodal-container system. Examples of this system include the so-called Trans-Siberian Land Bridge, the Negev Continental Bridge and the North American Land Bridge. Its essence is explained below, using the North American Land Bridge as illustration.

2.6.1 North American Land Bridge

In the North American Land Bridge concept overland transport complements an otherwise complete ocean voyage. Thus, traffic originating in Europe and destined for Japan moves first to the east coast of Canada or the United States by sea, then proceeds by land from there to the west coast before being moved again by sea to Japan (Figure 2.1). By this method, routing and selection of ports and indeed the entire journey are the responsibility of the shipping companies. The companies only pay the railways a flat rate for their services.

Figure 2.1

North American Land Bridge and Transport Routes

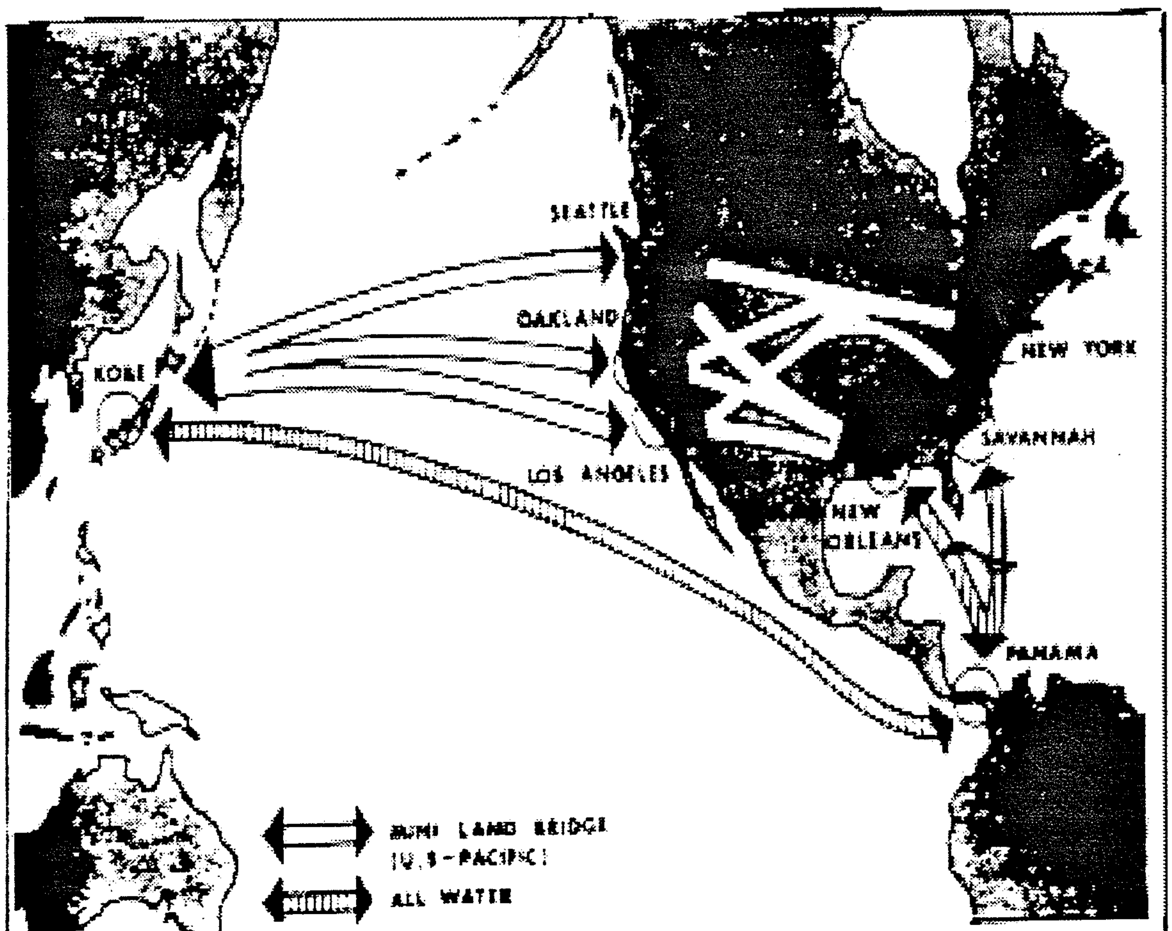


Source: Hayuth, 1982

With the Mini-Land Bridge or 'mini-land' (Figure 2.2) as it is popularly called, there is the "movement of containers under a single ocean bill of lading[6] from one country via a vessel to a port in another country, thence by rail mini bridge to a second port city terminating at the rail carrier's terminal" (Gibney in Hayuth, 1982:15). For example, a cargo from Japan will move by ship to a west Coast port in the United States and from there move overland to a final destination at the east coast port.

Figure 2.2

Mini-Land Bridge and all Water Transport Routes



Source: Hayuth, 1982

[6] Bill of lading - This is receipt for goods shipped on board a ship signed by the person (or his agent) who

The difference between the mini-land and the usual land bridge is that the mini-land does not involve sea-land-sea movement of cargo but only sea-land movement. In 1979 the Federal Maritime Commission estimated that about 50 per cent of the United States-Far East containerised trade was carried via the mini bridge route and the rest via the Panama Canal, emphasising the growing importance of the mini bridge concept now and in the future (*American Shipper* in Hayuth, 1982). The mini bridge has costs comparable to those of the Panama Canal route and the added advantage of saving time over the all-water Panama Canal route. For example, the distance from Yokohama to New York via Seattle and the mini-land bridge is 3331 km shorter than via the Panama Canal route. It must be stated, however, that time saving depends more on the carrier chosen than the mode.

Furthermore, more container trade is expected to divert to the land bridge system when the Panamanian government assumes control of the canal and enforces higher canal charges. Again there is the issue of increase in containership size above the length, beam and draft limitations of the Canal[7] as well as rising operating costs. In addition, the mini-land method also has the advantage of having tariffs which are generally applicable to all ports within one coastal range. For example, the freight rate from Japan to Houston is the same whether the inland movement transits Seattle or Los Angeles. This is not the case in the conventional system since the more distant port must absorb higher tariffs.

Also affected are traditional transport itineraries. Let us take the case of aluminium coils produced in Washington State as an example. Though the coils could easily be shipped to Europe through the port of Seattle and the Panama Canal, they are containerised and sent by rail to Houston from where they are then shipped to Rotterdam, reaching their destinations five days faster. Thus the mini bridge concept has the tendency and potential of shifting traffic from one coast/seaboard to another. The result of the mini bridge system has been the concentration of the trans-Atlantic and trans-Pacific traffic at few ports, which has enabled these ports to extend their hinterland penetration further inland,

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contracts to carry them, and stating the terms on which the goods are carried.

[7]Lock dimensions of 297-metres long, 32.3-metres wide and 12.2-metres draught limit the Panama Canal. Postpanamax vessels (6,000 TEU) have been in service since the mid 1990s.

creating large hinterlands for them. Port authorities, especially those on the East and Gulf Coasts, fearing loss of traffic due to the mini bridge method, insist that "each port has a vested right to all the traffic generated in its area; in their words, to 'naturally tributary' cargo" (Hayuth, 1982:18). Their claim is not supported by the facts, for, undoubtedly, the container system changes the dimensions of hinterlands and the traditional tributary areas of ports.

Clearly intermodalism, containerisation and the land bridge concept have considerably changed the conventional hinterland concept. Hayuth (1982:20) writes, "containerisation, port concentration and intermodalism, having reached a higher operational and technological stage, have brought a significant change in hinterland relations. The tributary areas of ports can be vastly extended to stretch over entire countries and continents. New concepts of inland distribution, such as the land bridges, have altered conventional patterns of cargo routing between trade areas. The complexity of the recent hinterland structure to a great extent makes meaningless the traditional hinterland boundaries both in spatial and dynamic terms". While Hayuth's conclusions, discussing the validity of the traditional hinterland, may ring true for containerised liner services, they do not apply to non-containerised cargoes, especially bulk commodities. Nevertheless, the hinterland, whether in the traditional sense or in the contemporary fashion, is critical to port development. As Rodgers (1958) notes, the delimitation of a port's hinterland and an examination of its nature and extent are basic steps in an evaluation of the prospects for further development in that port. It is therefore not surprising that port administrators continue to delimit their ports' catchment area. Rimmer's (1964) assertion that "the stature of an individual port reflects closely the nature, direction and rate of economic development in the area it serves" can thus be hardly challenged. The succeeding sections present case studies of port hinterlands, outlining their impact on port planning and development.

2.7 The Port of Genoa and its hinterland

The Port of Genoa in Italy presents a classic case of hinterland analysis and its importance to port development. During the 1950's Genoa was the leading port in Italy, challenging Marseilles as the most important port in the Mediterranean. This position it achieved as a result of its close location to the rich agricultural and industrial centres of the Po Valley from where it draws its traffic. However, from 1938 the port started to lose some of its traffic due to competition from other Italian ports. Nonetheless, it managed to record an over-all growth of 14 million tons in 1956 as compared with 7.2 million in 1938. Table 2.1 illustrates the trends and origins of the port's outbound traffic.

Table 2.1

Trends in the regional patterns of outbound movements

through the Port of Genoa, in per cent, 1953 to 1955

Origination	1953	1954	1955
Lombardia	17.3	20.7	19.1
Pietmonte	12.7	13.0	15.1
Liguria	53.0	47.6	49.1
Veneto	2.5	2.2	2.5
Emilia	2.9	4.6	3.5
Toscana	5.9	4.3	3.7
Southern and Central Italy	2.3	3.4	2.3
Foreign	3.4	4.2	4.7
Total	100	100	100

Source: Rodgers, 1958

2.7.1 Nature and extent of Genoa's hinterland

The main hinterland of Genoa is what Rodgers (1958) refers to as the *nodal hinterland*. This region is defined as the:

1. Provinces that absorbed at least 1 per cent of Genoa's inbound traffic in 1954.
2. Provinces that provided at least 1 per cent of Genoa's outbound traffic in 1954.
3. Provinces in which Genoa's share of the traffic was established to be predominant (50 per cent or more) in 1956.

The bulk of Genoa's traffic, about four-fifths, came from the nodal hinterland. Genoa's nodal hinterland is the most important economic area in Italy and thus provides the port with its primary source of traffic. Despite being one-eighth of Italy in terms of size the region contains one-fifth of the country's population, three of its large urban centres and over 44 per cent of Italy's manufacturing employment. In addition, the region more than any other region in Italy depends on trade with other countries for its economic survival. Within the nodal hinterland of Genoa is also the core hinterland. The core hinterland is that part of the hinterland that is most closely tied to the port. The extent of the core hinterland corresponds roughly to the Genoa industrial area. Two-fifths of Genoa's traffic comes from this sub-region, with nine-tenths moving through the port. Being one of the most industrialised areas of the country, it had a population of 700,000 people in 1957 and over 75,000 workers. The industrial development of the area is, to a large extent, considered a function of the movement of commodities through the port (Rodgers, 1958). The Milan province, whose overseas trade is predominantly tied to the port, also supplies one-fifth of Genoa's traffic.

The port's ties with the rest of the country are, however, weak. Even then the port attracts traffic from the central and southern regions of the country. Goods sent from these two regions to the port consist of high-value manufactured items of which transport cost forms an insignificant part of the total cost structure. Superior handling facilities (physical and commercial) and the existing corporate relationships between shipping firms and manufacturing companies have also gone a long way to attract goods from these parts of the country to the port.

The extent of Genoa's hinterland at the time was a reflection of the transport costs which prevailed between the region and competing ports. During the 1950's these costs were mainly a function of distance, though the relationship was not perfect. Another important factor were the connections between the hinterland and alternative ports. In this case rapidity of connections and ease played an important role in both road and rail transport. In the competition between Venice and Genoa for the eastern Mediterranean traffic, Genoa stood disadvantaged due to pressure imposed on its rail facilities by industrial traffic. In the case concerning Genoa and Turin, involving a distance which is longer than from Genoa to Savona, the bulk of Turin's traffic moved through the former port because of the relative ease and rapidity of rail connections. With respect to truck transport, Genoa's position on a superhighway over the Ligurian Appennines helped it attract more traffic.

Furthermore, Italian government policy of granting preferential rates to the port of Trieste and a number of ports in the south of Italy also affected the nature and extent of the hinterland pattern of Genoa, albeit in a very limited way. What is more, the inadequacy of facilities and frequency of services at Genoa, Italian tariff policy, French railway policy in relation to movements between Marseilles and Switzerland, and the impact of Rhine River movements on the direction of Switzerland's overseas flows also helped to shape the hinterland structure of Genoa. As mentioned, hinterland analysis is useful for port planning and development. This being so, the logical question we need to ask at this juncture is: what was the significance of hinterland analysis to the planning of the port?

2.7.2 Hinterland analysis and Genoa's development

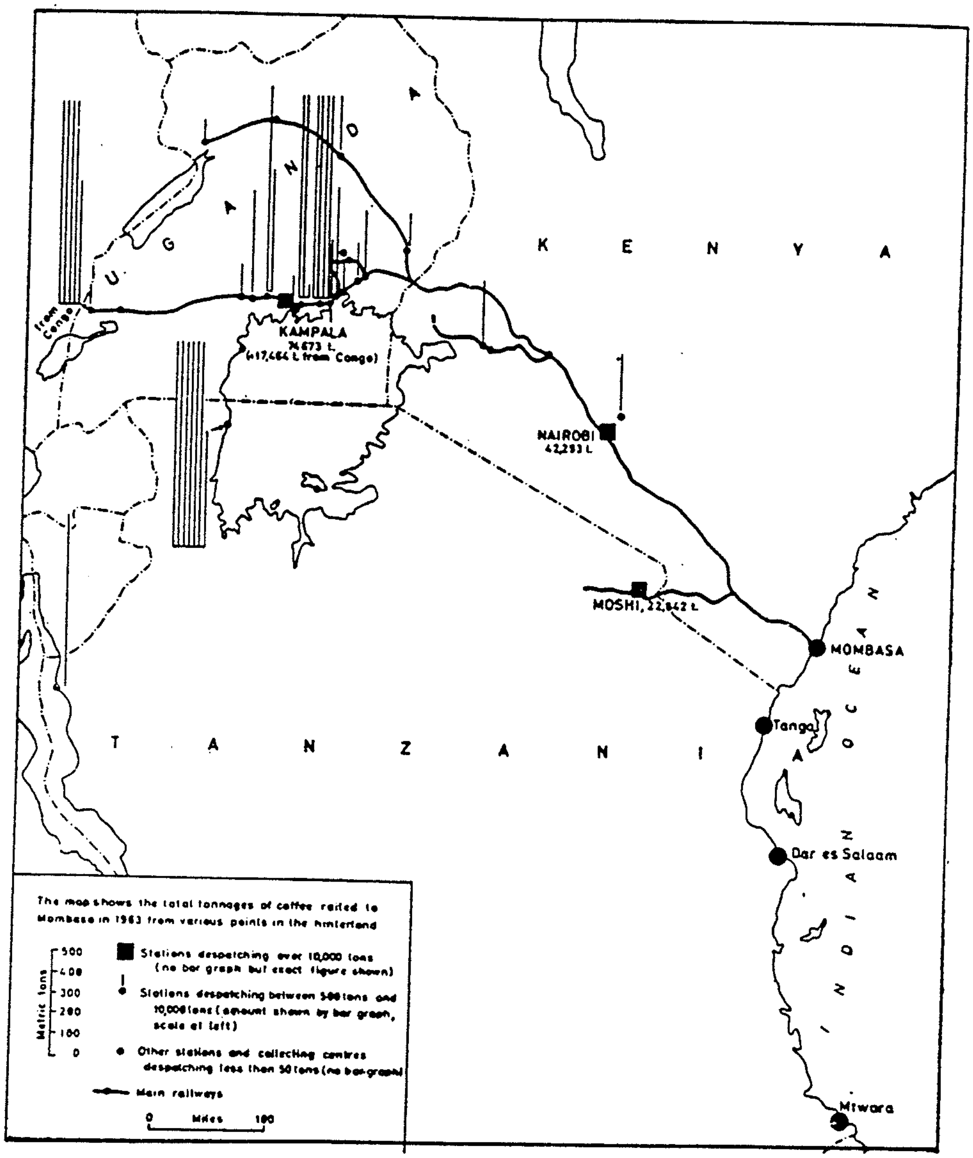
Genoa's import traffic after the war underwent a massive shift from coal to petroleum, leading to change in volume and direction of traffic flow. This affected the structure of the port's facilities, which had to be redesigned for discharging, storage, and transmission of petroleum. Consequently, an analysis and forecast of future trends in petroleum in the nodal hinterland became of great interest to the port authority. The construction of the Cornigliano steel mill also played a contributing factor to the growth in bulk traffic imports through the port. Unlike the petroleum traffic, the steel mill's traffic impact on the port's facilities, receipts, and labour-force requirements was relatively modest. The plant's export traffic was also not encouraging. Nonetheless, analysis of the plant's raw material requirements, its market structure, forecast of its future development and requirements was of vital importance to the port's traffic and facility planning. This required the port authority to keep abreast of developments of the plant in order not to be caught unprepared.

2.8 The Port of Mombasa and its hinterland

To corroborate the evidence from Genoa are the Kenyan cases of Mombasa and the proposed Manda Bay port. Like other African ports, the exports of Mombasa originate largely from specific areas that are to a large extent mutually exclusive, while a representative proportion of their imports is distributed to almost all their hinterlands, the proportion depending on the purchasing power and density of population in each region. The throughput of Mombasa comprises export commodities such as coffee, cotton, sisal, tea, soda ash, cement products and cashew nut, with oil and oil products like kerosene, gas and diesel oils constituting the major imports. Mombasa's coffee hinterland extends beyond the boundaries of Kenya to include northern Tanzania and Uganda. Figure 2.3 shows the coffee hinterland of Mombasa and the tonnages of coffee railed to Mombasa in 1963.

Figure 2.3

The Coffee Hinterland of Mombasa



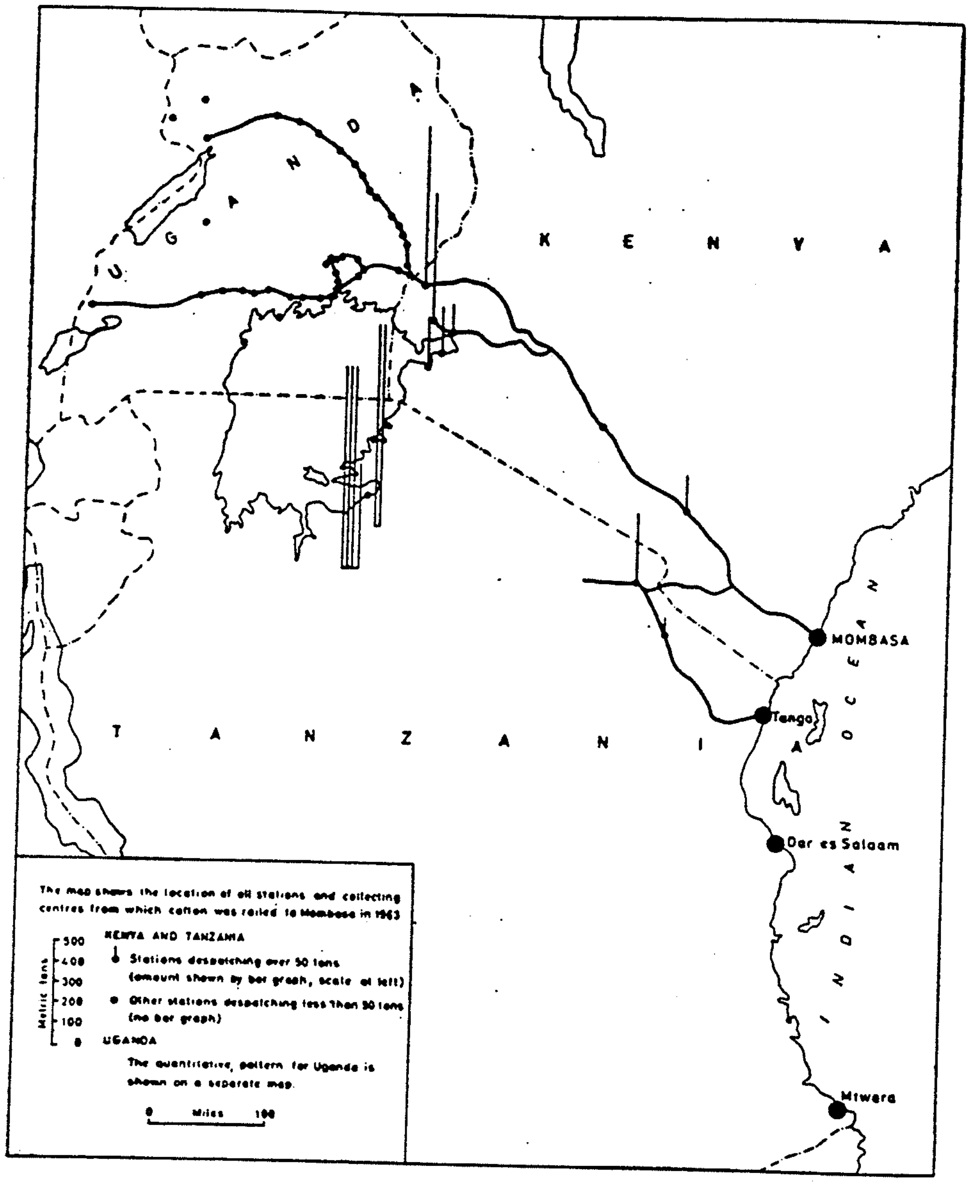
Source: Hoyle, 1967

By virtue of the volume of coffee shipped from its station, Kampala emerged as the most important single point in the hinterland of Mombasa. Kampala is the sole collecting centre for Uganda dry robusta coffee. The coffee is brought by road from a wide area in southern Uganda to the Coffee Marketing Board in Kampala. The Board also collects arabica coffee, which is grown in West Nile, Toro, Ankole and Kigezi. However, arabica coffee grown in the Bugisu District in eastern Uganda is collected independently by the Bugisu Co-operative Union. Mombasa also received significant amounts of coffee from the Congo via Kampala by both road and rail. This traffic has now ceased though. Some coffee is also despatched coast-wards from stations in Uganda without passing through Kampala. Overall Kampala accounts for one-third of the total coffee exported from Mombasa.

In Kenya, Nairobi acts as the collecting centre. Road transport is the main means of transporting coffee from the growing areas to Nairobi. In Tanzania, Bukoba and Moshi act as the collecting centres, with Moshi being the major centre for the coffee-growing areas in northern Tanzania. The capture of the Moshi and Bukoba coffee hinterland by Mombasa from the Tanzania ports is due to the convenient transport connection between these centres and Mombasa. In the case of Bukoba, for example, Lake Victoria and the Mombasa railway provides a more convenient route to Mombasa port than the alternative of going through Mwanza to Dar es Salaam.

The cotton hinterland of Mombasa port has also contributed significantly to its growth and development. Like its coffee hinterland, Mombasa's cotton hinterland covers the three East African mainland countries, albeit in a more widespread fashion (Figure 2.4). Uganda (Figure 2.5) is presented separately because of the degree of concentration of production there. As can be seen from Figure 2.4, unlike coffee, the marketing and despatch of cotton is less centralised, though the Lint and Seed Marketing Board carefully controls its activities. The cotton production in Uganda is concentrated in the eastern part of the country with major growing zones in Buganda and the eastern and northern regions. Some cotton is also grown in the northern region too. Cotton grown in northern Uganda was given a significant boost by the opening of the northern railway line beyond Soroti to Lira in 1962 and Gulu in 1963. Coffee is now railed from here to Mombasa instead of using the earlier lake steamer services. Cotton production in Kenya is centred in the western region of the country and in the dry areas near Kibwezi.

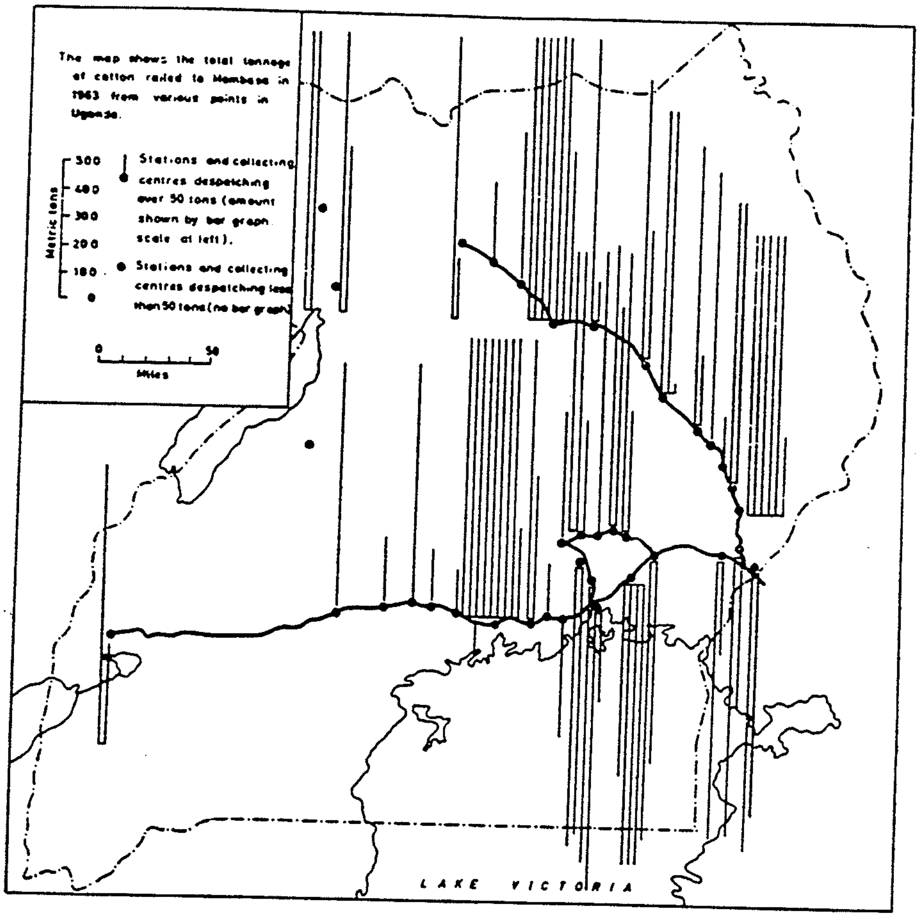
Figure 2.4
<u>The Cotton Hinterland of Mombasa</u>



Source: Hoyle, 1967

Figure 2.5

The Ugandan Cotton Hinterland of Mombasa



Source: Hoyle, 1967

In Tanzania the despatch is from the Moshi area and the southeastern shores of Lake Victoria. Mombasa also enjoys large sisal traffic, which is indeed one of the principal cash-crop exports through the port. Unlike coffee and cotton, sisal production is more significant in Kenya than in Uganda. Production centres are found in several parts of the country, especially the drier parts of Nyanza Province and the Thika area north of Nairobi. Limited amounts also originate in the Moshi-Arusha area in Tanzania. The other major export crop channeled through Mombasa is tea. The Kericho area in western Kenya is the most important single source within the tea hinterland of Mombasa. Tea in the Kericho area is produced on an estate basis and this has been aided extensively by the highly favourable conditions of altitude, temperature and rainfall. Production in other parts of western Kenya is far less significant. In Uganda the tea hinterland of Mombasa covers southern Buganda between Mityana and Jinja, and production in the Fort Portal area of western region is also important. The whole of the western region in Uganda is gradually coming under the tea hinterland of Mombasa, as suitable conditions there continue to encourage tea production. Kigezi and Ankole are two new tea centres. In the past, some tea was sent from Congo to Mombasa by rail via Kasese or Kampala. As major sources of foreign exchange for these countries, production of these crops has received both political and technical support from succeeding governments. This is in addition to the suitable climatic conditions, which exist in the growing areas. Also important is the relatively efficient transport network connecting the port to these areas.

As mentioned, Mombasa was able to capture the coffee-producing area in northwestern Tanzania due to the ease of transporting coffee exports through the port of Bukoba. From Bukoba the coffee is exported across the lake via Kisumu and then to Mombasa rather than through Mwanza to Dar es Salaam. This overlap with Tanzanian ports may now, however, disappear partly as a result of the building of the Mnyusi-Ruvu rail link and partly for political reasons. Moreover, the Moshi-Arusha area of northeastern Tanzania is in many ways orientated economically more strongly towards Kenya than towards central Tanzania and exports the bulk of its coffee crops through Mombasa rather than through Tanga in Tanzania. Mombasa has also attracted Tanzanian traffic as a result of the port's superior facilities and the concentration there of the control of the coffee trade. It is these vibrant economic hinterlands coupled with a relatively efficient transport network which have combined to serve and sustain Mombasa's port and thus its growth and development which far outrank the Tanzanian ports.

It is interesting to compare Mombasa with the proposed Manda Bay port. The latter, if constructed, is envisaged to be the second deepwater port on the coast of Kenya. The main purpose for its construction is for it to serve as a new urban and industrial growth point for Kenya. The decision to construct the port was made during the third and fourth national development plans of the Kenya Government (1974/78-1979/83). According to the Government Report, Manda Bay was chosen over Kilifi Creek and Malindi due to its favourable conditions of land and water, the likely impact on the development of the hinterland, and the relationships with local and national transport systems.

Included in the plan was the idea of linking Manda Bay with rail and road routes through Galole, Kitui and Machakos to Nairobi (510km). Road links with Somalia and Ethiopia were also envisaged. The immediate task of the port authority would be to improve the communication link between the Bay and the Tana River valley to bring the lower Tana valley within the hinterland of the port, for the Tana river valley possesses the economic potential to generate traffic for the port. Existing road communications are poor, and there is no railway. Thus, right from the outset Manda Bay's hinterland was expected to go beyond the local hinterland boundary to interior Kenya and beyond the boundaries of Kenya.

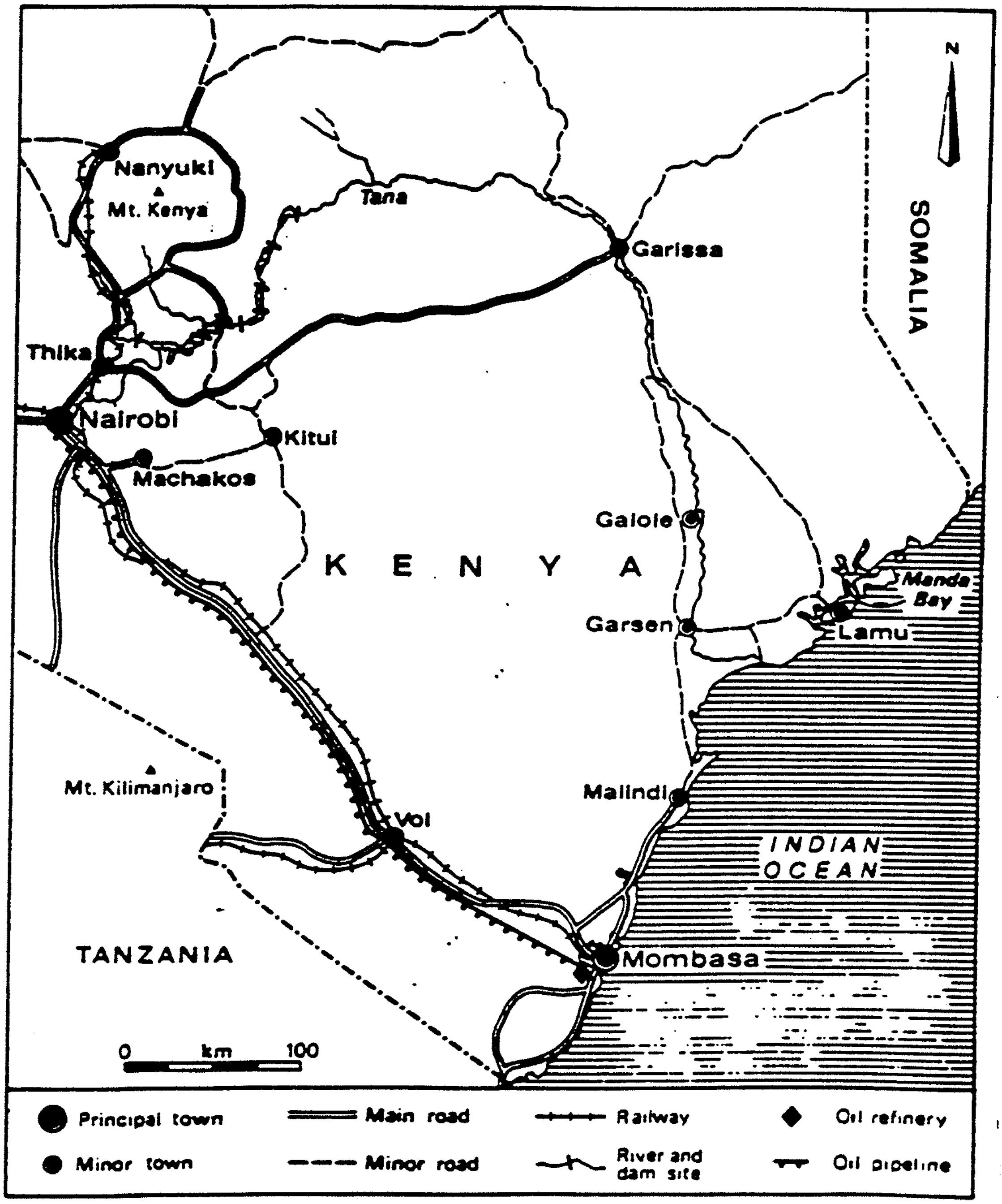
The agricultural and livestock potential in the area is considerable. Cotton production and the cultivation of mangoes and citrus fruits are also well established and could be expanded considerably for export. The Tana River Development Authority has established numerous irrigation schemes, but there is water scarcity and the demands of irrigation and hydroelectric power production would need careful planning. A fishing industry, livestock ranching and industrial projects like meat canning and fertiliser production all present possibilities yet to be tapped. Export throughput is envisaged to consist of cotton, livestock products and fruit, with imports comprising mainly construction materials, fertilisers and machinery. Though there are plans of extending Manda Bay's hinterland to include the Kenyan economic core zone centred upon Nairobi, the high cost involved in such a long-distance communication does not make the project feasible in the immediate future. The improvement of the road links between Garsen and Nairobi (via Galole, Garissa and Kangodi, [Figure 2.6]) was included in the 1974-78 development plan, but this route is much longer than that between Nairobi and Mombasa.

The proposed road from Kitui to Garsen would link Nairobi with Manda Bay by a route slightly longer than the Nairobi-Mombasa axis, but such a road would pass through areas with little economic potential. Kenya Railways also investigated a direct rail link from Thika to Lamu and reported that the link would be justified only if Manda Bay were to develop as a major national seaport. Extending its hinterland beyond the local boundaries is crucial to the growth and development of the port, since its immediate hinterland, the north-eastern coastal zone, is economically undeveloped and thus incapable of generating traffic for the port, at least in the short run.

What is more, Manda Bay unlike Tema (Ghana), Saldanha Bay (South Africa), Nouadhibou (Mauritania), Free Port of Monrovia (Liberia), San Pedro (Ivory Coast) and Lome (Togo) has no major mineral deposits or industrial base within its immediate hinterland, neither has the search for oil yielded any results. Thus, as the evidence presents itself the possibility of Manda Bay developing as an industrial growth pole in the reasonably near future does not seem likely. Its immediate hinterland, by comparison with the Mombasa-Nairobi-Kisumu axis or the southern coastal area between Mombasa and Malindi, is considered poor. As Hoyle (1980:301) remarks, "the arguments in favour of Manda Bay therefore rest largely on the socio-economic and strategic desirability of developing a neglected corner of the national territory, an area of considerable long-term potential but limited resource endowment, and also reflect the need to provide solutions to the problems associated with cityport congestion at Mombasa".

Figure 2.6

The pattern of surface transport facilities in south-eastern Kenya



Source: Hoyle. 1981

2.9 The Port of Beira and its hinterland

Like Mombasa, the Port of Beira in Mozambique presents a similar case of the importance of a vibrant economic hinterland to port growth and development. Beira's hinterland stretches beyond the borders of the country containing it. Its extra-national hinterland covers the Rhodesias, Nyasaland, and the Upper Katanga region in the Belgian Congo[8].

The national hinterland consists of the reorganised Manica and Sofala, and Tete districts, covering about three-tenths of Mozambique. Figure 2.7 shows the approximate boundaries of Beira's national hinterland. Major products found in Beira's national hinterland are maize, oilseeds and oil cake, fruit, potato, beans, sisal, and some quantities of rice and wheat. There is also cotton from the Gorongoza and Chimoio areas for shipment to Portuguese textile industries. Timber from the sawmills along the Beira rail line has also been an important source of traffic for Beira. Beira's import traffic to the interior region includes petroleum products, cement, and sugar. Unfortunately, manufactured imports bound for the interior are limited due to the low purchasing power of the farmers living there. Though mining had the ability of providing a better livelihood, its activities were restricted to only small diggings of gold, copper, tin, and mica. There were no major cities in Beira's national hinterland during the 1950's. The only two relatively big cities in addition to Beira are Dondo and Vila Pery. Dondo had the potential of developing into an industrial satellite due to its favourable location for assembly of raw materials and distribution of manufacturing products. It was also a rail junction. In addition, it had a cement factory, a milling industry and a fibrous cement plant, which used local cement and asbestos from Southern Rhodesia. Vila Pery, a small agricultural processing centre, could boast of only the first textile plant in the province.

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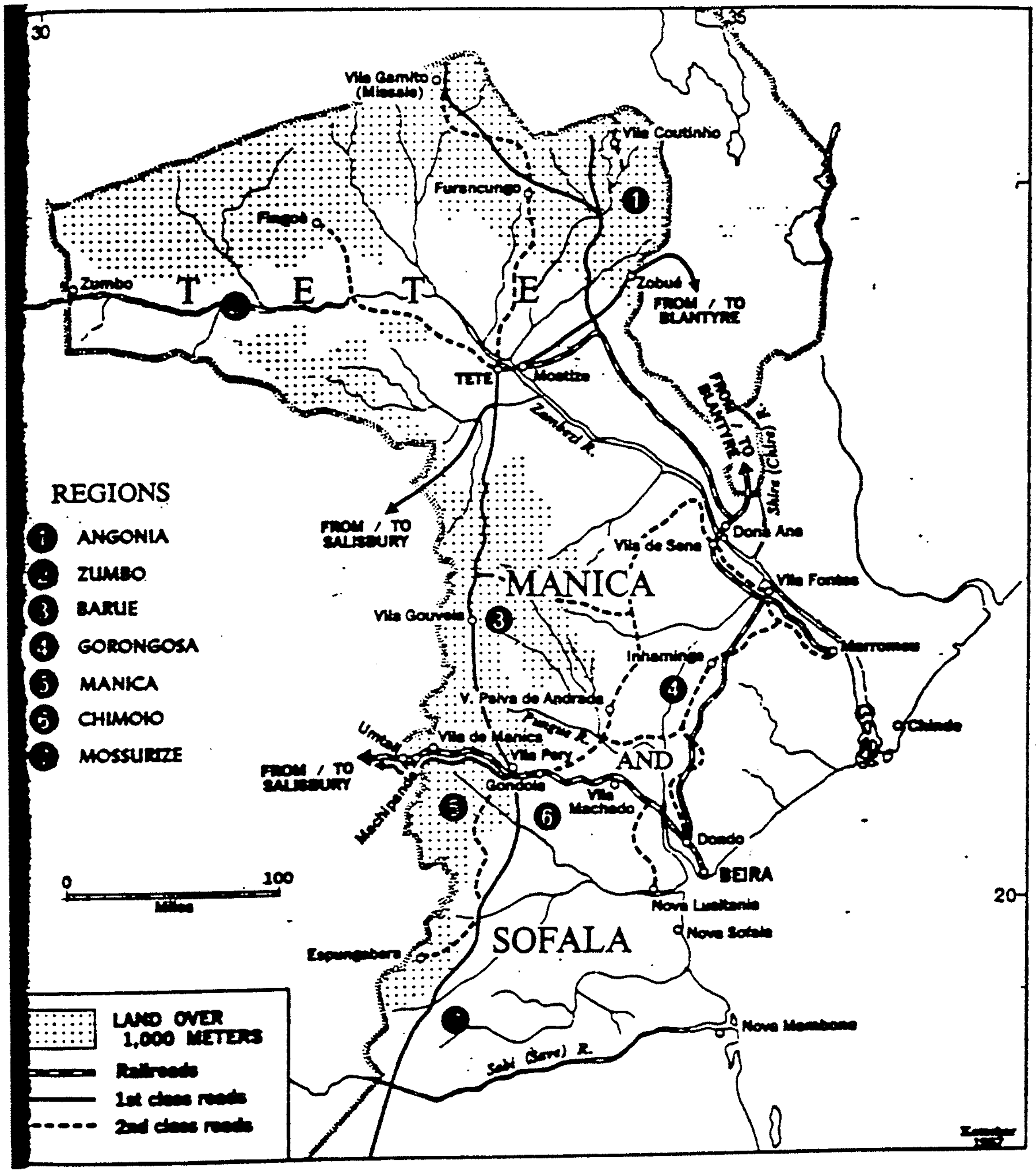
[8] The Rhodesias were divided into Northern and Southern. Northern Rhodesia is present Zambia. Southern Rhodesia is now Zimbabwe. Nyasaland is now Malawi while Belgian Congo is now the Democratic Republic of Congo, formerly Zaire.

Figure 2.7

Beira's National Tributary Area



Source: Hance and Van Dongen. 1957

The second part of Beira's national hinterland was the Tete region in the northwest of Mozambique, which was still undeveloped in the 1950's. Coal constituted the largest traffic, 97 per cent, (109,646 tons in 1954) from the Moatize field. From Beira a trickle of petroleum products and general cargo (573 tons) was moved to the Tete district. Cotton, groundnuts, and surpluses of food staples (82,241 tons in 1953) raised in the Zambesi valley by African farmers were sent by the waterway to the sea either by canoe or by barge. Between Vila de Sena and Dondo junction, 80 per cent of the local traffic offered north of Beira was timber and timber products from the sawmills north and south of Inhaminga. The railway carried the greatest part of these products. About one-quarter was exported by sea, and the rest moved inland by rail to Southern Rhodesia.

Apart from the underdeveloped state of resources in Beira's national hinterland, there was also the problem of the sparse nature of the population relative to Lourenco Marques[9] which served as the national capital. The population density for Beira was 11.7 persons per square kilometre as compared with 30.3 for Lourenco Marques. These differences largely explained the lower value of Beira's domestic traffic compared with that of Lourenco Marques. For example, in 1954, Lourenco Marques recorded 482,629 tons of shipment as compared with Beira's 306,965. In value terms this amounted to 1,993,244 contos (US$ 55,833.17) for Lourenco Marques and 783,888 contos (US$ 21,957.65) for Beira.

It is evident that Beira's national hinterland has provided little support for the port's activities. Conditions were not expected to improve, as the government-sponsored agricultural export programmes were concentrated on other areas of Mozambique like the Limpopo Valley and the northern highlands of Lake Nyasaland[10]. The few farmers in the highlands west of Beira were on their own without any support from the government, and this affected their productivity. Timber exploitation was, however, expected to expand. Eucalyptus plants were being planted for tannin and plywood and a veneer factory was to be built. It was hoped that the coal that was discovered in the Moatize fields in the Tete

[9] Now known as Maputo
[10] Now known as Lake Malawi

district would prove to be substantial enough to generate a considerable export by sea. Attempts to build an iron and steel mill to utilise the large-scale hematite and magnetite deposits did not succeed for various reasons, among which was the remoteness of the area. Unlike its national hinterland, the extra-national hinterland of Beira was economically vibrant. The Rhodesias[11], as shown in Table 2.2, dominated this trade.

Table 2.2

Origin and destination of extra-national traffic flow through Beira port, by country, 1948 and 1954. (volumes in '000 metric tons; values in '000 contos = $35.7 as of 1957)

Year		Rhodesias		Nyasaland		Belgian Congo	
		From	To	From	To	From	To
1948	Volume	521.9	401.9	22.7	33.7	76.4	6.3
	Value	2,430.5	2,027.8	370.7	330.7	220.5	26.9
1954	Volume	904.9	683.2	56.9	60.7	95.0	6.6
	Value	3,942.7	3,428.0	510.2	474.4	344.7	83.6

Source: Hance and Van Dongen, 1957

Beira's hinterland in the Rhodesias covered an area of approximately 705,330 km². The traffic from this zone consisted mainly of minerals and this made the outward traffic heavier than the inward traffic. During the mid 1950's the mineral exports from these countries through Beira totalled 1-1.1 million short tons as compared with some 100,000 tons of all other exports. This also explained why Beira handled 127 times more of the exports from the Rhodesias in terms of value than the Union ports[12], but only twice the value of imports. Copper from the four mines of the Copperbelt was the most important commodity shipped from this zone through Beira. Beira's attraction of the copper from the Copperbelt was one of contract. According to Hance and Van Dongen (1957), a long-standing agreement between the copper producers and the Rhodesian Railways, involving special rates on copper metal and on coal and timber moving to the mines, served to compel the movement of copper to Beira even during periods of severe congestion; a point which was noted earlier. Thus, the rise of the Copperbelt to the second largest

[11] Now Zambia and Zimbabwe

world producer of copper concentrates and metal after World War II has been of considerable importance to Beira. Production of blister copper, for example, reached 230,000 short tons, of electrolytic copper 194,000 tons, and of cobalt 1,800 tons in 1954. After 1952 all cobalt metal from the Copperbelt was moved to Beira.

Following copper in importance is chrome ore from the mines in the Lomagundi and Selukwe areas of the Southern Rhodesia High Veld. The construction of the 36.87km Selukwe-Gwelo branch and the 38.47km Umvukwes sub-branch were purposely meant to bring local chrome ore to the main line. A major problem, which faced chrome producers, was the shortage of freight cars. This resulted in large stockpiles in the mining areas, the inability to meet export requirements and the cancellation of orders. Other bulk minerals exported through Beira from Southern Rhodesia were asbestos and petalite (a source of lithium). At a production rate of 10,000 tons per month, petalite became the most rapidly growing mineral export to come from Southern Rhodesia. The asbestos was mined at Shabani and Mashaba. Gold, lead, zinc, and vanadium were also sent from these areas to Beira. Agricultural products included manufactured tobacco leaf, maize, vegetable oil and oilseeds, and timber. It is apparent that Beira's export hinterland outside its national boundaries was economically more prosperous than its national hinterland. Growth in the export traffic was envisaged to continue into the future. Even agriculture, which did not have strong foundation in these areas, was expected to improve, especially for tobacco, tea, citrus fruit and animal products.

Imports from Beira to its extra-national hinterlands consisted of petroleum products, construction materials, softwood lumber, grain (mainly wheat), and fertilisers, salt and paper. Gasoline comprised 62.5 per cent of the petroleum products. These shipments to Beira's extra-national hinterland were expected to increase as the standard of living of the population increased. The character of the import traffic, however, was expected to change as local industries diversified.

[12] The Union is the present South Africa.

However, the ability of the port to offer this extensive service depended on the efficiency of the port's equipment and the transport service between the port and the hinterlands. The Rhodesia rail network, for example, witnessed severe congestion during the post-war economic boom in Central Africa as owners of the network were not prepared for the sudden boom and had no concrete plans for its expansion. The network was later nationalised and its capacity raised, though this was still inadequate in relation to the amount of traffic being hauled. In 1954 the total tonnage hauled increased to 8.6 million from 5.1 million in 1949, while net ton-kilometres increased in the same period from 2,300 to 3,400 million.

The importance and function of the extra-national hinterland to Beira cannot be overstated, either in terms of supplying the port with traffic or in determining the nature of port planning. This explained the attempts that were made to improve and maintain the infrastructure, which served the port and its extra-national hinterland. Various parties interested in Beira's extra-national hinterland traffic committed large investments in order to alleviate some of the transport difficulties occurring between the port and the hinterland. In 1949, for example, the ECA supplied road-making equipment. A further ECA loan of $950,000 and 4,250,000 Dutch florins in counterpart funds financed the bulk mineral wharf at Beira. In 1951 another ECA loan of $14 million to the Rhodesia Railways was made available for general improvements. Some $289,000 was given to cover the reconstruction of the Great North Road from Broken Hill to Tunduma in Northern Rhodesia.

It was obvious that Beira's extra-national hinterland would continue to send as well as receive traffic to and from the port. Current figures throw more light on the functions of Beira's extra-national hinterlands. The total volume of cargo through Beira in 1996 rose by 5 per cent over 1995 to 2.6 million tonnes, according to the Beira Corridor Group. Excluding petroleum products, the total was 1.5 million tonnes, an 11 per cent increase over the previous year. Transit cargo of 1.24 million tonnes accounted for almost all of the traffic, with Zimbabwe (Southern Rhodesia) accounting for 964,000 tonnes, an increase of 29 per cent. Most of the increased traffic to and from Zimbabwe consisted of agricultural commodities such as maize, fertiliser and wheat. Exports from Malawi (Nyasaland) and Zambia (Northern Rhodesia) also picked up, showing a considerable increase for the first half of 1996 in comparison with 1995. Zambia's increase, however, came mainly from bulk exports of copper. Copper exports from Zambia totalled 24,700 tons for the first six months compared with 12,700 tons for the first half of 1995. Announcing their half-year figures, Mozambique Railways (CFM) said that the increase from Malawi was mostly with containerised cargoes of tobacco, tea and cotton. Comparative figures for the first six months (in TEUs) are shown in Table 2.3.

Table 2.3

Malawi's tobacco and tea traffic through Beira,

1995-96 (TEU)

Item	1995	1996	Increase (%)
Tobacco	463	1620	250
Tea	753	1017	35
Total	1,216	2,637	285

Source: Prepared from the internet sites:

(http://rapidttp.com/cargo/ftw/97/97fe14g.html,) - 1998

(http://cargoinfo.co.za/ftw/96oc04q.html) - 1998

Comparing Table 2.3 with Table 2.2 we see a sharp increase in Beira's traffic from its extra-national hinterland. For example, while traffic volumes in the 1950's were in thousands the comparable values for the 1990's traffic are in millions. In 1954 exports from the Rhodesias (Zimbabwe and Zambia) combined totalled 905,000 tonnes; exports from Zimbabwe alone totalled 964,000 tonnes in 1996. In the case of Malawi tea and tobacco exports alone totalled 2,637 tonnes in 1996 compared with 1954 total exports of about 57 tonnes.

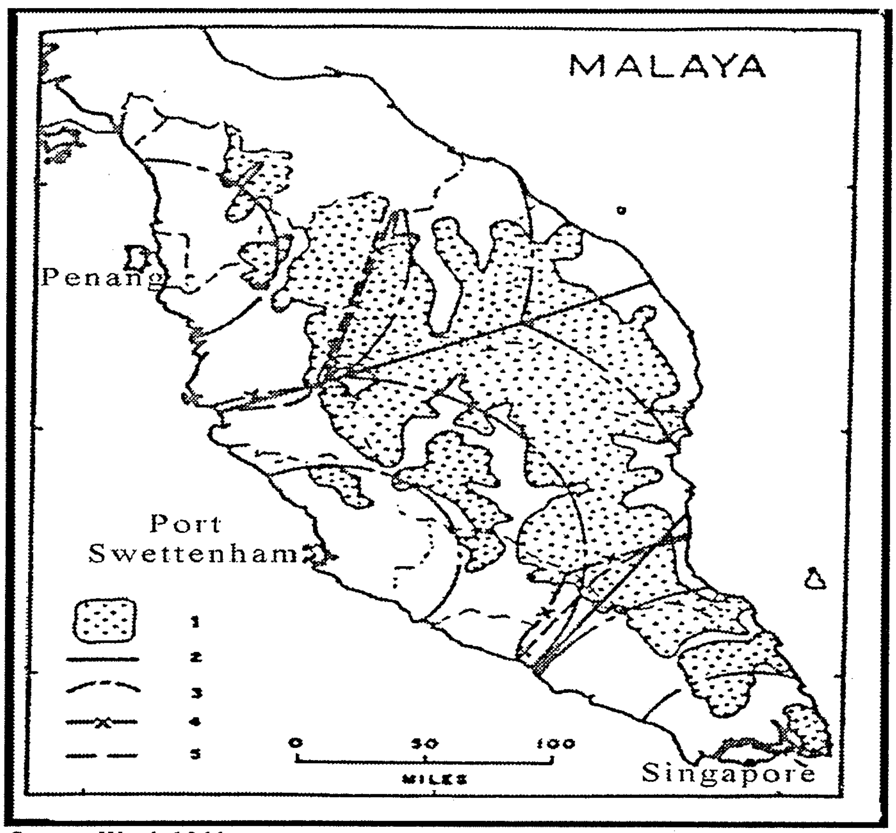
As a result of the increase in traffic, a R 40 million-grain silo project for Beira has been proposed, to be owned by the National Railways of Zimbabwe, CFM of Mozambique and other private investors. The silo is expected to greatly improve handling and efficiency at the port, largely using mechanical equipment instead of manual labour. Among the private investors will be the two farmers' unions in Zimbabwe, Seaboard of Britain and Nectar of the United States (http://rapidttp.com/cargo/ftw/97/97fe14g.html, http://cargoinfo.co.za/ftw/96oc04q.html).

2.10 Malaya ports and their hinterlands

A slightly different hinterland structure from the preceeding cases is that revealed in the commodity hinterlands of Malaya (now Malaysia) ports. Three major ports (Figure 2.8) serve peninsular Malaya, Penang, Port Swettenham[13] and Singapore. Penang and Singapore were founded as British trading stations in 1786 and 1819 respectively, while Swettenham emerged as a railway port serving Central Malaya after 1901.

Figure 2.8

Major Ports of Malaya and their hypothetical hinterlands, 1966



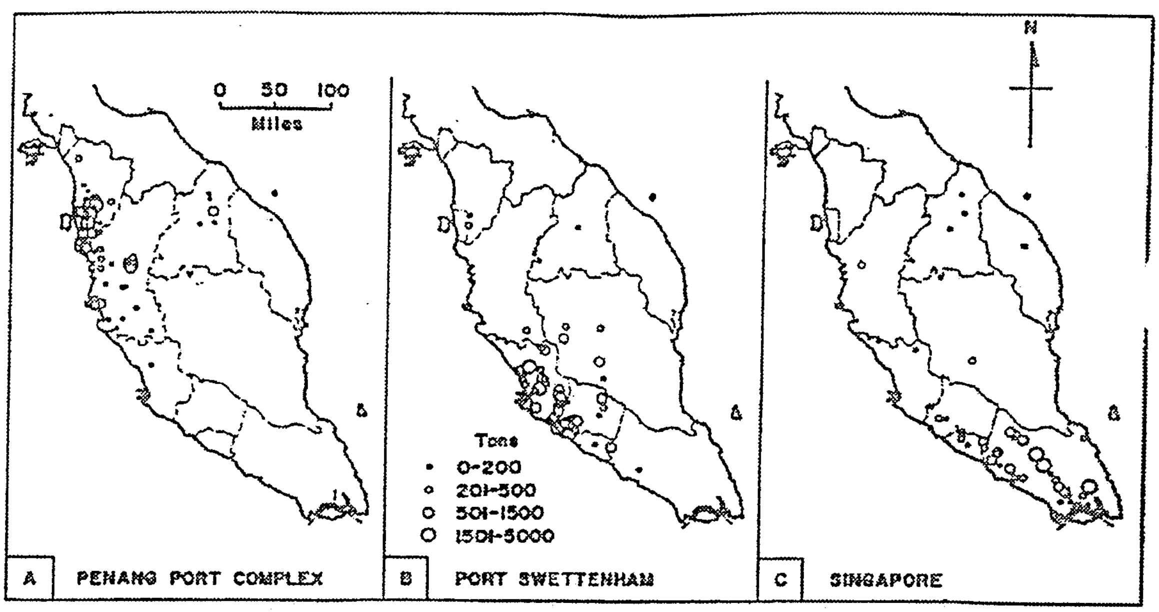
Source: Ward, 1966

[13] Now known as Port Klang

Figures 2.9A, B and C show movement of rubber through Penang, Swettenham and Singapore for the year 1957. The direction of movement reveals very interesting information on the hinterlands of the ports for rubber. From the Figures we see that each port has a core or exclusive hinterland zone from where rubber was shipped to the port; however, some ports received rubber from outside their core zone - shortest distance - hinterlands. There was, for example, movement of rubber from southern Perak to Penang, and from Malacca, western Negri Sembilan and west Pahang towards Singapore and also the movement from southern Kedah to Swettenham. These deviations are explained by the exigencies of the rubber trade in which it was at times preferable to use 'unnatural ports of exit' in order to get a bill of lading dated for a particular month or to complete an assignment. The wider range of shipping services available there and the presence of a vibrant rubber market also explained the 'exceptional' movements of rubber to Singapore.

Figure 2.9

Movement of Rubber to Ports, 1957

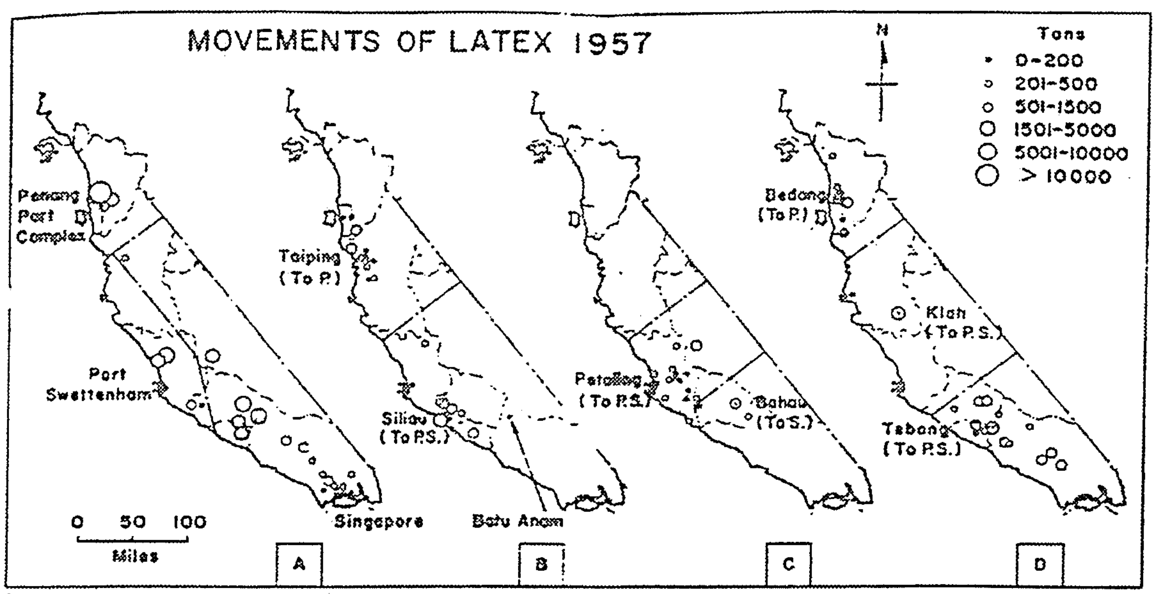


Source: Ward, 1966

The next major export is latex. Liquid latex export from Malaya is considered a mid-1950's phenomenon. The latex factories form the organisational point of the latex export business. From these factories, freshly gathered latex was prepared for shipment in bulk or drums to overseas destinations. In order to prevent coagulation the latex was treated with ammonia immediately after extraction from the tree. Consequently, the factories tended to be located in the centre of large areas of estate rubber, and usually belonged to large estate groups. Each factory served areas within a radius of 32 kilometres. Figure 2.10 shows movement of latex to some of the collecting centres, including the three major ports. The port of export is indicated for the output of inland centres. The total quantities mapped in Figure 2.10 represent approximately all the liquid latex shipped in 1957 through Penang, about 64 per cent of that shipped through Swettenham, and about 55 per cent of that shipped through Singapore.

Figure 2.10

Movements of Latex, 1957



Source: Ward, 1966

The latex hinterland of Penang was thus largely restricted to southern Kedah and western Perak and was controlled by supplies from a factory at Bedong, Kedah (Figure 2.10A and D). From Bedong, the liquid latex was loaded into lighters from where it was shipped to Penang. At Penang it was blown directly into ships' tanks. Swettenham's latex hinterland extended from southern Perak into southern Johore, and served as the export port for several important collecting centres (Figure 2.10). The southward extension of Swettenham's latex hinterland was due to the traffic it received from the collecting centre in Tebong. Though Tebong is nearer to Swettenham than Singapore it drew its latex from areas lying in Singapore's hypothetical hinterland. Latex from Bentong was also moved by road to Swettenham for export.

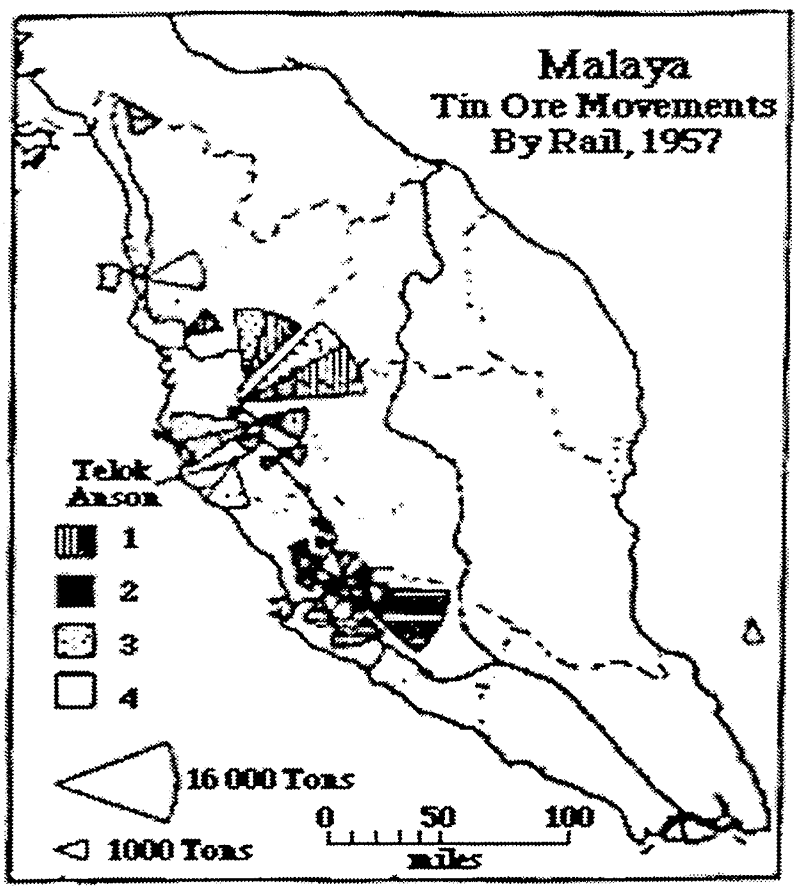
The use of the railway for inland hauling of latex to the port is reflected in Singapore's latex hinterland (Figure 2.10A and C). There were additional shipments from collecting centres in Rengam, Ulu Tiram, Muar, Johore Labis and Klang, all in central and south Johore. Latex also moved from centres in Negri Sembiam, Malacca and western Pahang, although these centres are closer to Swettenham than Singapore. The interlocking of the hinterlands of Singapore and Swettenham was manifested through the large collecting centre at Batu Anam (Figure 2.10B) which is almost equidistant from both ports and, accordingly, it shipped to both ports. Batu Anam's supply came mostly from southern Negri Sembilan and along the northwest Johore border, north of the lines of equal distance between Swettenham and Singapore. However, Singapore received latex shipped by lighter from Malacca and collected mainly in Malacca and southern Negri Sembilan for transhipment.

The next most important Malayan export after rubber and latex is tin. There were three tin ore smelters in Malaya in 1957, one on Pulau Brani in Singapore Harbour and the others at Penang (at Butterworth), and Province Wellesley. In 1957 about 25,740 and 50,000 tons of tin ore were exported from the Malayan Federation to Singapore and other foreign destinations, respectively. The data on tin ore for 1957 reveal a very complex movement with some ore moving from Kinta valley in Perak in the north to Singapore while other ore moved from Selangor and Johore fields in the south to

Penang/Butterworth in the north. The ore from the east coast, mainly from the Sungei Lembing lode mine, was shipped to Singapore in coastal steamer via Kuantan. Figure 2.11 shows a more detailed picture of the amount and destination of tin ore moved by rail in 1957. As the Figure reveals, ore moved by rail from the Kinta valley, most of the northern mines (e.g. Kaki Bukit, Perlis, and Lahat-Taiping, Perak) and from some of the Selangor mining areas like Batu Village to the Penang/Butterworth/Prai area. Some ore was sent to Swettenham from the Selangor fields for shipment to Penang/Butterworth and Singapore. Telok Anson, a minor port in southern Perak, shipped quite substantial amounts of tin ore from the Kinta valley and southern Perak to either Penang/Butterworth or to Singapore.

Figure 2.11

Tin Ore Movements by Rail, 1957

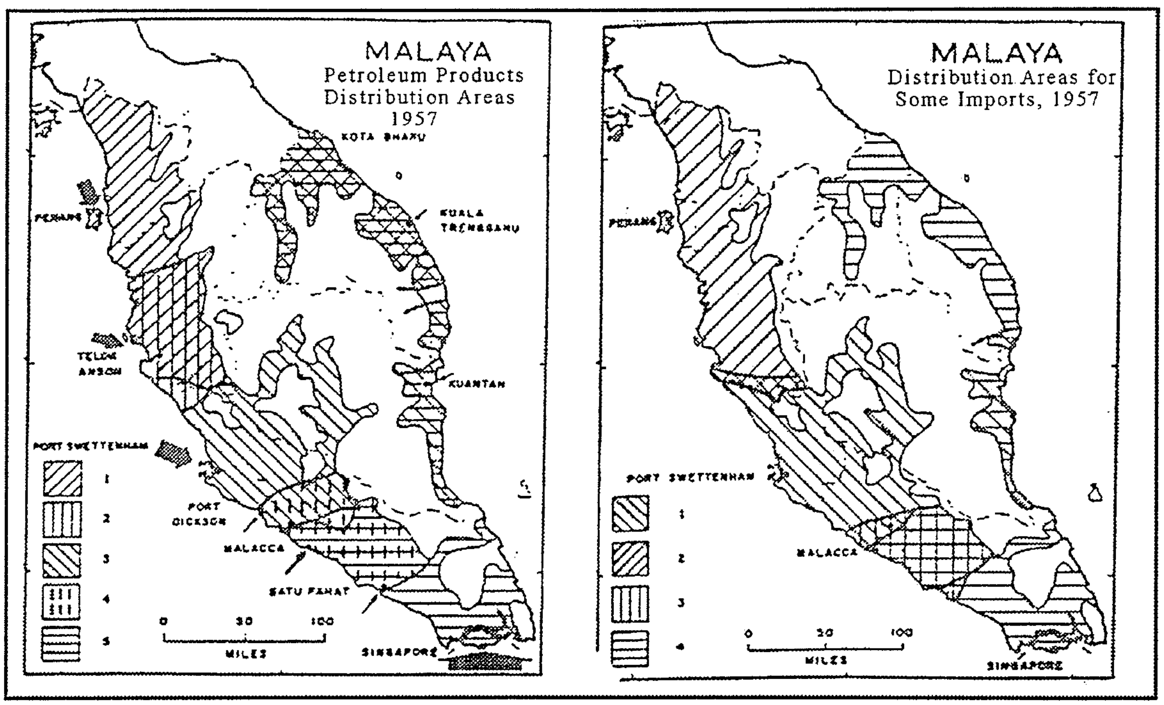


Source: Ward, 1966

With respect to imports their analysis is considered more tenuous due to dearth of data. Figures 2.12a-b present the distribution of petroleum and three other important imports. Imports amounting to about $Mal.400, 000,000 ($US 133,000,000) were brought into the Malayan Federation and Singapore in 1957. The arrows depict the relative importance of the major and minor ports of entry in 1957. The distribution areas are confined to only the three major ports and two other minor import ports. A relatively high use was made of the minor ports, because of the cost advantages associated with water transport of bulk shipment of petroleum products.

Figures 2.12a-b

<u>Petroleum Products Distribution Areas and Import Distribution Areas, 1957</u>



Source: Ward, 1966

The minor ports received their supply from barges or coastal steamer either from Singapore (to Batu Pahat, Kuantan and Kuala Trenggan) or Swettenham (to Port Dickson), directly from Sumatran refineries by barge (e.g Telok Anson, Malacca), or from ocean-going tankers (e.g Penang, Swettenham and Singapore). Consequently, the hinterlands of Telok Anson and Malacca overlap greater parts of the petroleum products' hinterlands of the major ports in western Malaya. Apart from Kelantan, the east coast was supplied from Singapore by sea, with the minor ports of Kuantan and Kuala Trengganu as second-order distribution centres.

In the case of toothpaste about 44 per cent of the total supply came through Singapore. Of this figure, 95 per cent was distributed in Singapore itself. Distribution areas centred on Penang and Kuala Lumpur accounted for about 19 per cent and 18 per cent of sales respectively, while Ipoh accounted for 14 per cent of the sales. Malacca, Kuala Trengganu, Muar and Kota Bahru accounted for the remaining 5 per cent. The concentration of toothpaste distribution in the major cities and towns was attributed to a number of urban factors such as higher incomes, better-developed selling facilities and greater European element in the urban population.

2.11 Summary

Port hinterland, *the port's collecting and distributing area* [P.C.D.A], is an important facet of geographical analysis of ports. Hinterlands can be classified variously, depending on the criteria adopted; for example, import or export hinterlands, commodity hinterlands or national or extra-national hinterlands. Classic classifications of hinterlands are found in the works of Morgan (1951) and Bird (1971). Morgan identified what he called the primitive, raw material and liner hinterlands. Bird's classification is grouped into immediate, primary, secondary, advantage, commodity, and functional and overlap hinterlands. Hayuth (1982), on the other hand, demonstrates that this view of hinterland, popularly referred to as the traditional hinterland concept, is made complex by the introduction of new maritime technologies like the intermodal-container system. With the intermodal-container and the land bridge systems, large container ports have been able to penetrate far beyond their immediate hinterlands to capture vast hinterlands in other nations and indeed continents. Hinterland analysis, it was noted, also requires a consideration of the transport network between the port and the hinterland. Relevant to both cases is the example of Rotterdam. Having explained the hinterland concept I now proceed to describe the methodology for assessing and comparing ports.

CHAPTER THREE

PORT COMPARISONS:THE INDICES AND METHODOLOGY

3.0 Introduction

As mentioned in Chapter One, inter-port competition is an important facet of the port-hinterland interface. A corollary of port competition is port comparison. Port comparisons, however, have generated some reservations about appropriateness of various indices and methodologies. Yet, before the question of suitable tools for analysis can be settled, satisfactory resolution of a more basic issue must first be achieved. That issue concerns the data themselves, the format and validity of the numerical information compiled as port statistics. Bird (1963), for example, argues that great care must be exercised in the handling of port statistics if they are to give meaningful comparisons of the status of ports or size of their activities. Port statistics are numerous, not to say frequently confusing. Svendsen (1951) groups them into three main categories:

1. Statistics concerning the structure of the harbour – These statistics comprise the technical equipment of the harbour; for example, length of the quays, number of cranes and area of the sheds.
2. Statistics concerning traffic – These comprise the entrances and clearances of vessels with cargo or in ballast, number of ships and tonnages, nationality of ships and trading areas.
3. Transport statistics – These furnish information on goods loaded and unloaded, gross weight volume and value, commodity groups and direction of the traffic.

Any of these statistics can be used as benchmark indicators in a comparative study of ports. The purpose of this chapter is to describe how some of these statistics have been used in port comparison studies, and the methodological issues which arise as a result. The upshot of the chapter provides the grounds for preferring some over others; that is to say, it justifies my selection of indicators for this study.

3.1 The indices

Port statistics are diversed. There is therefore no consensus on standard indices for comparing ports, especially in terms of measuring port performance. Nonetheless, some of the indices seem to predominate in studies of port comparisons. Among the more popular of these indices are aggregate figures of net registered tonnage of shipping (nrt), cargo tonnage/overall traffic, number of ships calling at a port, and number of different commodities handled by a port. Physical indices like maximum draught, and size and number of berths are also very popular. Performance indicators such as ship productivity, ship turnround time and cargo handling/labour productivity are also not uncommon. Last but not least are financial indicators like ship control calculations and contribution figures and profits generated[14]. Underlying the use of these different indices is the implicit assumption that some of the indices are more useful than others. Morgan (1958:17), for example, claims that net registered tonnage is "the most comprehensive index for evaluating ports as places concerned with the arrival and departure of ships".

The basis of Morgan's argument is the extensive applicability of this measurement to all ports with the exception of naval bases. Net registered tonnage also applies to all ships and cargo types: the cargo liner, the tanker, the passenger-cargo liner, the passenger liner, the collier and the Ro-Ro or Ro-pax ferry. There are, however, drawbacks associated with using net registered tonnage alone over a considerable period of time. Naval architects – the designers of ships –, for example, are noted for keeping net registered tonnage figures as low as possible because of the positive correlation between net registered tonnage and wharf dues. Consequently, there is a deliberate effort by naval architects to reduce the ratio of the net registered tonnage to the carrying capacity of ships, making any growth in

[14] Ship control calculations are very necessary when accepting new types of vessels. They show the contribution figure per ton or per unit for the specific ship. In addition, there is the need to determine the absolute overall contribution figure for the whole vessel. Wilking (1990) maintains that besides these sporadic checks, it is absolutely necessary to have a cost accounting system which gives each month accurate information about the costs per ton/unit of commodity/commodity group discharged/loaded. This will enable management to allocate resources optimally.
The Contribution figures metric is defined as revenue less itemised costs – direct costs. This gives the amount of revenue to cover overheads. An effective cost/revenue control requires the regular calculation and comparison of contribution figures per ton/unit for each commodity/commodity group.

net registered tonnage to be disproportionately lower than the actual growth in the capacity of shipping[15].

Realising the deficiencies associated with the use of net registered tonnage, Alexandersson and Norström (1963: 118), Weigend (1958: 192-193), and Ullman (in Rimmer, 1966b: 83) proposed cargo tonnage — manifested, practically, through deadweight tonnage (see footnote [15]) — as the best alternative. Cargo tonnage, too, has its problems. Its leading flaw for port comparisons is its bias in favour of ports specialising in bulk cargoes. On the basis of cargo tonnage, then, the leading ports in the world are those that handle coal and oil cargo. Thus, in the United States Hampton Roads overtakes New York and Los Angeles/Long Beach as the leading importing port by virtue of its large oil intake and coal export. Moreover, by Rimmer's (1966b) reckoning, sole reliance on cargo tonnage also undervalues most general cargo ports in the world because they are characterised by large net registered tonnages going hand in hand with modest deadweight tonnages.

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[15] A ship's capacity in terms of carrying weight and volume can be divided into two; which are, the cubic capacity and weight capacity. The former describes how much space is available for cargo and is expressed in cubic feet or cubic metres. Depending on how this space is measured, there can be *grain* or *bale* cubic capacities. Weight capacity, on the other hand, is measured in metric tons. Two types of weight capacity can be identified when dealing with tonnage measurements in shipping. These are weight and space tonnages, with the former referring to cargo-carrying characteristics. The initial weight measurement is the *light displacement* tonnage, which is the weight of the ship unloaded. The other is the *loaded displacement,* which is the weight of the ship when it is loaded to the designed draught with crew, provisions and bunkers. The difference between the two displacements is the weight carrying capacity or deadweight tonnage (dwt) of the ship. When the weight of non-earning loads such as bunkers, stores, and water are deducted we get *cargo deadweight tonnage* (cdwt).
Space tonnage is measured in *register ton* of 2.83 cubic metres – 100 cubic feet. There are two types of space tonnage, which are gross register tonnage and net register tonnage. Gross register tonnage is the measurement of the entire internal cubic space of the ship with the exception of areas that are integral parts of the ship's construction. Thus, the measurement excludes only those spaces that, because of the construction of the ship, must at all times be used for the running of the ship. These spaces include the bridge, anchor box, and steering gear , - that is, spaces that cannot be used for cargo. Net register tonnage is the gross register tonnage less non-earning areas such as galley, crew quarters, stores, and engine room – that is, spaces that need not necessarily, and for the life of the ship, be used for the same purposes.
The register tonnages are used to determine manning scales and fees for registration, ports, pilots and canal transits. The registered tonnages are important to the shipowner because they affect the fees and charges paid on a particular trip. In the same vein, they are important to port authorities whose revenues depend on these fees. The shipper, on the other hand, is more interested in the carrying capacities measured in dwt and *grain* and *cubic* capacities (Abrahamsson, 1980).

The use of indices such as number of ships, value of cargo, maximum draught, numbers and size of berths alone has also been rejected. Currency fluctuations and exchange rate problems, for example, make the use of value of cargo problematic. The varying size of ships also makes the use of number of ships alone unappealing. Using berth size has also been criticised. Within the Port of Otago, New Zealand, for example, Port Chalmers is placed ahead of Dunedin, although Dunedin receives and dispatches more shipping and cargo than the former (Rimmer, 1966b). In a nutshell, the use of a single measurement for comparing ports' performances is inappropriate, for a single criterion is subject to so many anomalies. Fortunately, attempts to remedy this problem have been forthcoming. The section that follows discusses some of these attempts.

Bird (1963), a prominent writer on the subject, combined two criteria – net registered tonnage and value of cargo – to compare and classify the major seaports of the United Kingdom (UK). Usually, high-valued cargoes like jewellery, bullion and *objets d'art* occupy little space and thus ports specialising in these type of cargo stand disadvantaged when net registered tonnage of shipping is used. On the other hand, bulk cargoes with their high net registered tonnage have very low value. Thus, the disadvantage of having ships not fully loaded and therefore having a low net registered tonnage is countered by adding the value of cargoes and vice versa. Taken separately, this compounding effect would be lost. Consequently, Bird argued for, and adopted the use of these two criteria as the best indices for inter-port comparisons. His recommendation, however, overlooked other useful aspects of port statistics.

Carter (1962), by contrast, argued for a multi-criteria approach as the best way to compare ports. Much more ambitious than Bird, he combined six different criteria; namely, gross cargo tonnage, major commodity types, type of traffic, balance of traffic flow and variety of commerce. Variety of commerce is distinguishable into two components: variety of cargo and value of foreign commodity. Table 2.1 is a summary of Carter's traffic characteristics as they applied to American ports in the 1960's.

Table 3.1

Major traffic characteristics for sixty US ports, 1962

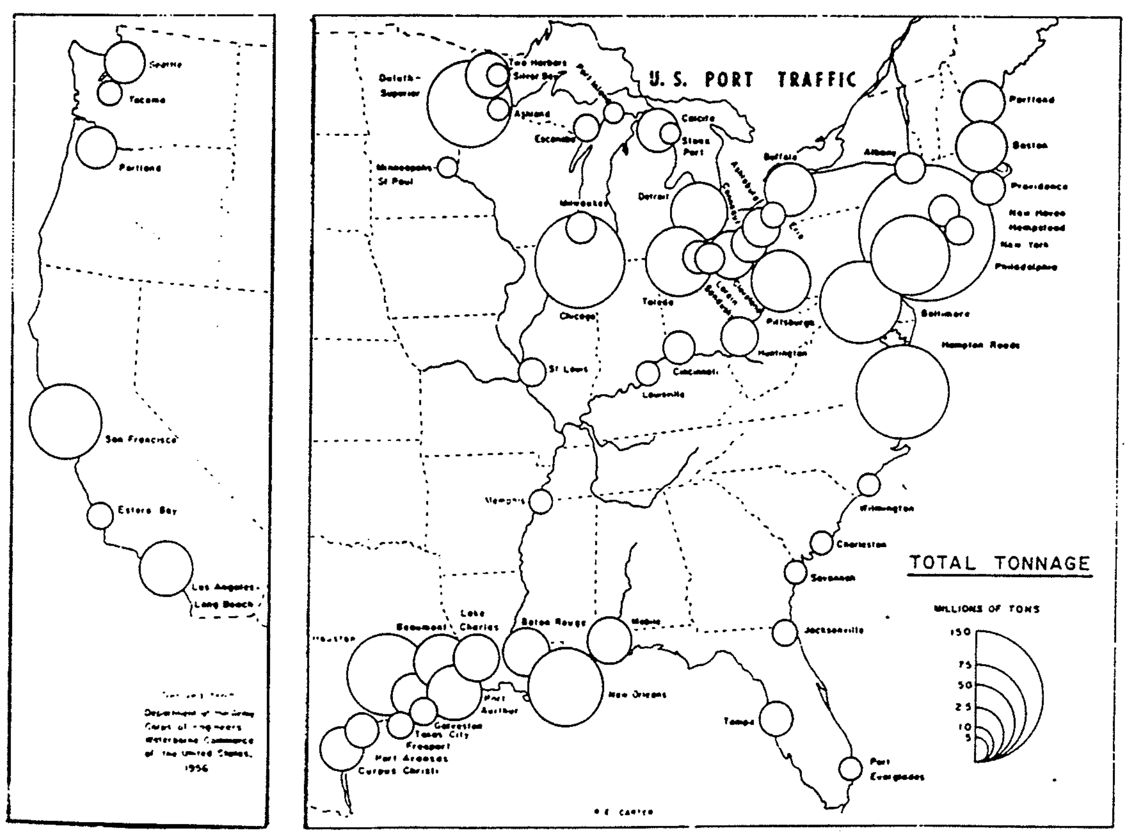
Port	*Tonnage*[a] (000,000)	*Value of foreign commerce rank*[b]	*Variety of commerce*[a]	*Leading commodity*[a]	*Leading type of traffic*[a]	*Balance of flow*[a]
New York	154.7	1	Very High	Petroleum Prod.	Coastwise	Imports 60–80%
Chicago	72.6	17	Above Average	Iron Ore	Lakewise	Imports 60–80%
Hampton Roads	71.6	4	Very High	Coal	Foreign	Exports Over 80%
Duluth Superior	59.4	–	Below Average	Iron Ore	Lakewise	Exports Over 80%
Philadelphia	55.7	5	Very High	Crude Petroleum	Foreign	Imports 60–80%
Houston	52.2	6	Very High	Petroleum Prod.	Coastwise	Exports Over 80%
Baltimore	51.5	3	Very High	Iron Ore	Foreign	Imports 60–80%
New Orleans	50.7	2	Very High	Crude Petroleum	Internal	Balanced
San Francisco	36.9	7	Very High	Petroleum Prod.	Coastwise	Balanced
Toledo	35.9	–	Above Average	Coal	Lakewise	Exports Over 80%
Pittsburgh	30.7	..	Below Average	Coal	Internal	Imports Over 80%
Detroit	27.1	–	Above Average	Coal	Lakewise	Imports Over 80%
Los Angeles L.B.	26.6	8	Very High	Petroleum Prod.	Coastwise	Balanced
Beaumont	25.7	–	Above Average	Petroleum Prod.	Coastwise	Exports Over 80%
Port Aurthur	24.8	–	Below Average	Petroleum Prod.	Coastwise	Exports Over 80%
Buffalo	22.1	–	Above Average	Iron Ore	Lakewise	Imports Over 80%
Boston	20.9	9	Very High	Petroleum Prod.	Coastwise	Imports Over 80%
Baton Rouge	18.9	20	Above Average	Petroleum Prod.	Internal	Exports 60–80%
Cleveland	17.6	–	Above Average	Iron Ore	Lakewise	Imports Over 80%
Mobile	17.5	11	Very High	Aluminum Ore	Foreign	Imports 60–80%
Lake Charles	17.0	..	Above Average	Petroleum Prod.	Coastwise	Exports 60–80%
Two Harbors	16.0	..	Very Low	Iron Ore	Lakewise	Exports Over 80%
Calcite	15.9	..	Very Low	Limestone	Lakewise	Exports Over 80%
Portland, M.	15.8	–	Below Average	Crude Petroleum	Foreign	Imports Over 80%
Corpus Christi	15.5	18	Above Average	Petroleum Prod.	Coastwise	Exports Over 80%
Texas City	14.7	..	Above Average	Petroleum Prod.	Coastwise	Exports Over 80%
Portland, O.	13.7	13	Very High	Petroleum Prod.	Coastwise	Imports 60–80%
Seattle	13.6	16	Very High	Petroleum Prod.	Coastwise	Imports 60–80%
Ashtabula	13.1	–	Below Average	Iron Ore	Lakewise	Imports Over 80%
Huntington	12.4	..	Very Low	Coal	Internal	Exports Over 80%
Tampa	11.9	–	Above Average	Petroleum Prod.	Coastwise	Balanced
Conneaut	11.0	..	Very Low	Iron Ore	Lakewise	Imports Over 80%
Port Aransas	9.0	..	Very Low	Crude Petroleum	Coastwise	Exports Over 80%
Milwaukee	8.6	–	Below Average	Coal	Lakewise	Imports Over 80%
Sandusky	8.4	–	Very Low	Coal	Lakewise	Exports Over 80%
Cincinnati	8.3	..	Below Average	Coal	Internal	Imports Over 80%
New Haven	8.2	–	Above Average	Petroleum Prod.	Coastwise	Imports Over 80%
Providence	8.2	–	Below Average	Petroleum Prod.	Coastwise	Imports Over 80%
Lorain	7.7	–	Very Low	Iron Ore	Lakewise	Imports 60–80%
Albany	7.6	–	Below Average	Petroleum Prod.	Coastwise	Imports 60–80%
St. Louis	7.4	..	Below Average	Petroleum Prod.	Internal	Balanced
Galveston	6.9	10	Above Average	Sulphur	Foreign	Exports Over 80%
Hempstead	6.8	..	Very Low	Sand & Gravel	Coastwise	Exports 60–80%
Jacksonville	6.5	19	Above Average	Petroleum Prod.	Coastwise	Imports Over 80%
Erie	6.4	–	Very Low	Coal	Lakewise	Balanced
Estero Bay	6.1	..	Very Low	Crude Petroleum	Coastwise	Exports Over 80%
Escanaba	5.7	–	Very Low	Iron Ore	Lakewise	Exports Over 80%
Freeport	5.7	–	Below Average	Petroleum Prod.	Internal	Exports 60–80%
Tacoma	5.4	12	Above Average	Wood & Prod.	Internal	Balanced
Port Everglades	5.1	–	Below Average	Petroleum Prod.	Coastwise	Imports 60–80%
Memphis	5.0	..	Below Average	Petroleum Prod.	Internal	Balanced
Louisville	5.0	..	Below Average	Petroleum Prod.	Internal	Imports Over 80%
Stone Port	4.9	..	Very Low	Limestone	Lakewise	Exports Over 80%
Silver Bay	4.3	..	Very Low	Iron Ore	Lakewise	Exports Over 80%
Ashland	4.3	..	Very Low	Iron Ore	Lakewise	Exports Over 80%
Port Inland	4.1	..	Very Low	Limestone	Lakewise	Exports Over 80%
Savannah	4.1	15	Above Average	Petroleum Prod.	Coastwise	Imports 60–80%
Charleston	4.1	14	Above Average	Petroleum Prod.	Coastwise	Imports 60–80%
Wilmington	3.8	–	Below Average	Petroleum Prod.	Coastwise	Imports Over 80%
Minneapolis-St. Paul	3.6	..	Below Average	Petroleum Prod.	Internal	Imports Over 80%

Source: Carter, 1962

Further expatiation on Table 3.1 is provided in the succeeding maps. The first map (Figure 3.1) represents gross cargo tonnage distribution of the various ports, with the area of each circle directly proportional to the total tonnage of the port it represents. As can be seen from the map, ports along the coasts, with the exception of Southern Atlantic and Northern Pacific coasts, had extremely large tonnages. The top ten and twenty ports together handled over one-third and one-half of the gross tonnage respectively.

Figure 3.1

<u>Gross tonnage of United States ports, 1962</u>

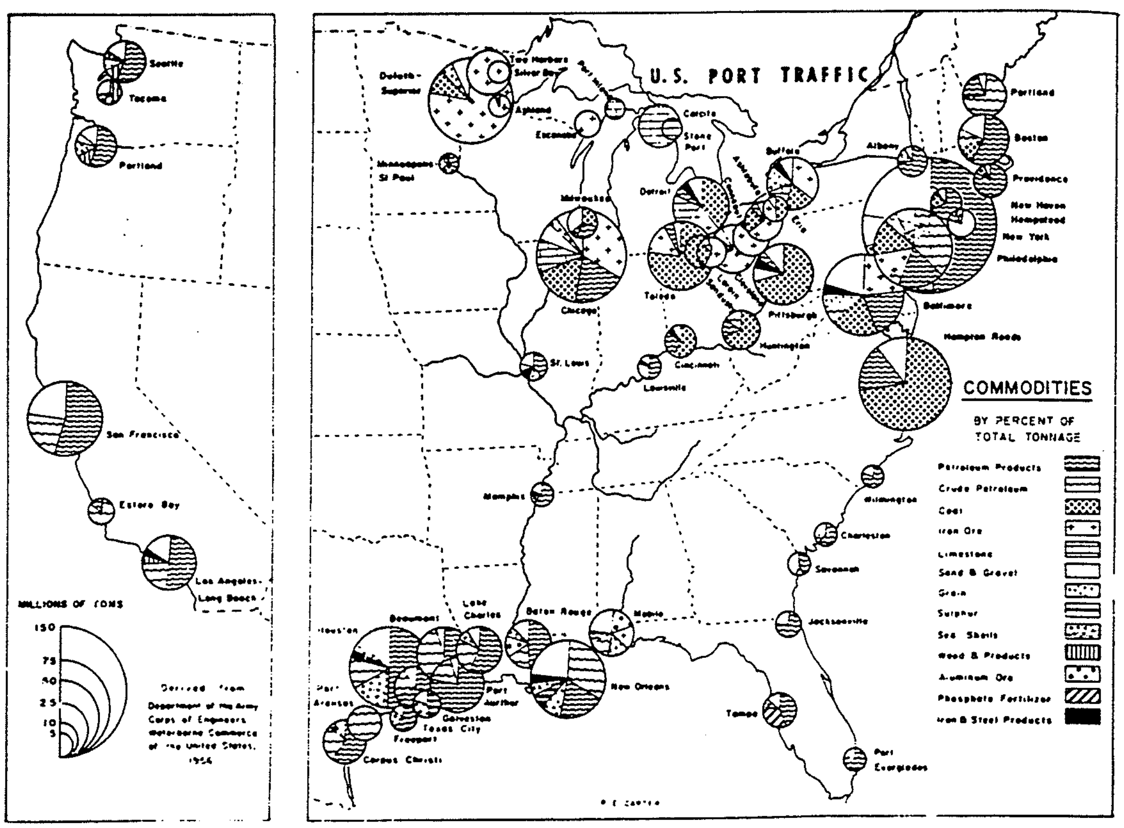


Source: Carter, 1962

In drawing conclusions on ports based on gross tonnage alone caution must be exercised because of the measure's potential to lead to wrong interpretations about ports' status. For instance, base on Figure 3.1 one is tempted to conclude that Calcite, Michigan, was as significant as Mobile, and more important than Seattle, or Portland, Oregon, which was not the case. To get a broader view on the status of the ports requires breaking the gross tonnage into their component parts. The following maps exhibit the breakdown.

Figure 3.2

<u>Commodity structure of United States ports, 1962</u>



Source: Carter, 1962

Figure 3.2 (above), for example, evinces the commodity structure or groups of each port, with each commodity group shown as the percentage of the gross tonnage. The limitation with this map is that not all commodities can be shown in certain situations. For example, while it was possible to make distinctions as fine as 5 per cent for the larger ports, 10 per cent was the minimum for the smaller ports. As a result of this cartographic limitation, some important commodities could not be shown. In effect, perusal of a commodity structure map permits analysis of only the distribution of major commodity throughputs.

The next component is the type of traffic[16]. Figure 3.3 shows that although all the coastal ports engaged in foreign traffic, the traffic was dominated by some few ports, especially Hampton Roads, New York, Baltimore, New Orleans and Philadelphia. The Great Lakes ports also had some foreign traffic, notably traffic from Canada. Coastwise traffic was also significant. The most typical type of this traffic was that of the large tankers which brought petroleum from the Gulf Coast to the Northern Atlantic coastal cities. The lakewise traffic usually consisted of movement from ports of the Northern Great Lakes to a consuming centre or transfer point on the southern shores of Lake Michigan or Lake Erie. With regards to internal traffic New Orleans was the dominant port according to tonnage. Pittsburgh and Chicago came second and third respectively. Most of the coastal ports also engaged in this traffic. The intra-port and local traffic were also significant for some of the ports. They accounted for about 47.2 million tons of New York's total tonnage. Baltimore, Mobile, New Orleans, and Houston also had large amounts of intra-port and local traffic.

[16] Type of traffic refers to whether the traffic is foreign or domestic. Foreign traffic applies to traffic between countries. In other words, traffic across national boundaries. Domestic traffic involves traffic within a country. Five types of domestic traffic can be identified; namely, coastwise, lakewise, internal, intraport and local.

a. Coastwise traffic refers to traffic transported over the ocean between two or more ports of a country. In the United States, for example, this may involve traffic between ports on the Atlantic coast and those on the Gulf of Mexico (Houston and New York) or between ports on the same coastline (Hampton Roads and Boston). Again, in the United States, traffic between the continent and the insular possessions is considered coastwise. Traffic between the Great Lakes and the sea-coast ports, when transported over the ocean is also considered coastwise.

b. Lakewise traffic refers to traffic transported along lakes within a country. In the United States this refers to ports on the Great Lakes.

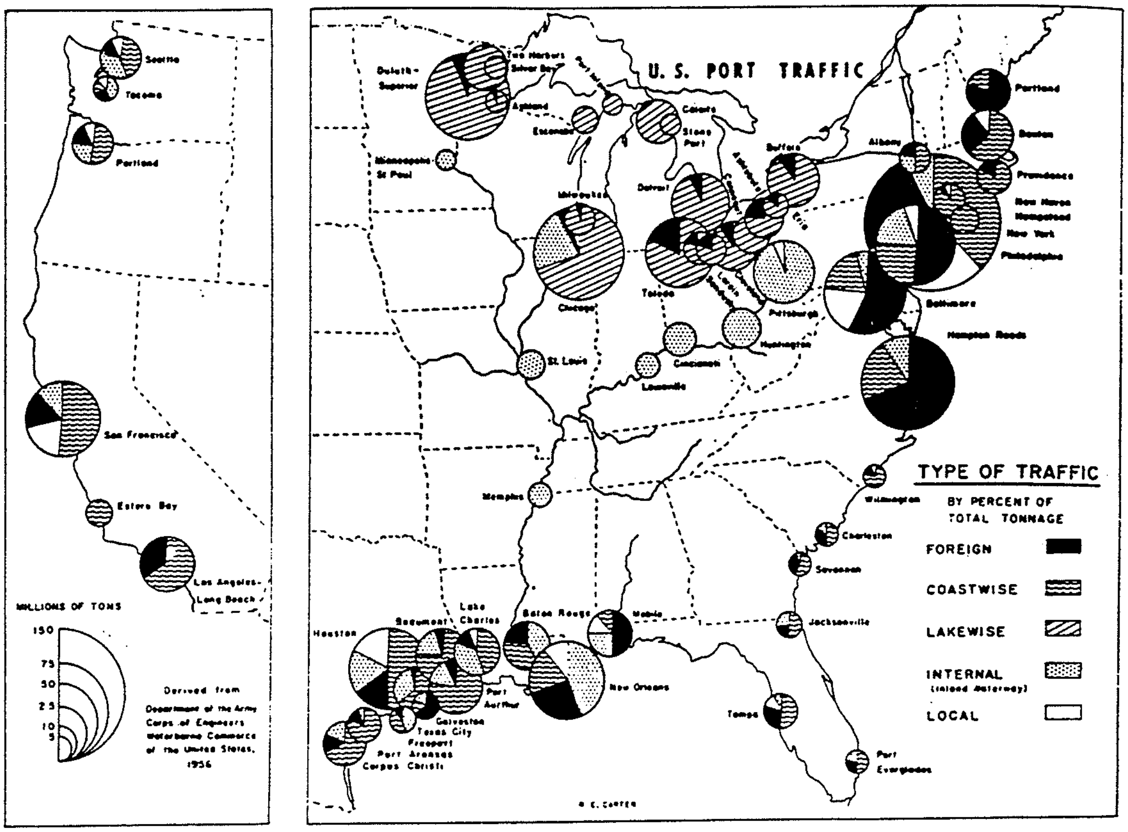
c. Internal traffic applies to traffic moved over protected inland waterways, bays or sounds. Most of this traffic is handled in barges. An example of this is the traffic between Philadelphia and a locality on the Delaware River.

d. Intraport traffic concerns traffic between the several arms or channels of a port, as at New York, for each of which a separate report is made.

e. Local traffic refers to movements within the confine of a port with the exception of car ferry, general ferry, and cargoes in transit (see Svendsen, 1951).

Figure 3.3

Type of traffic of United States ports, 1962

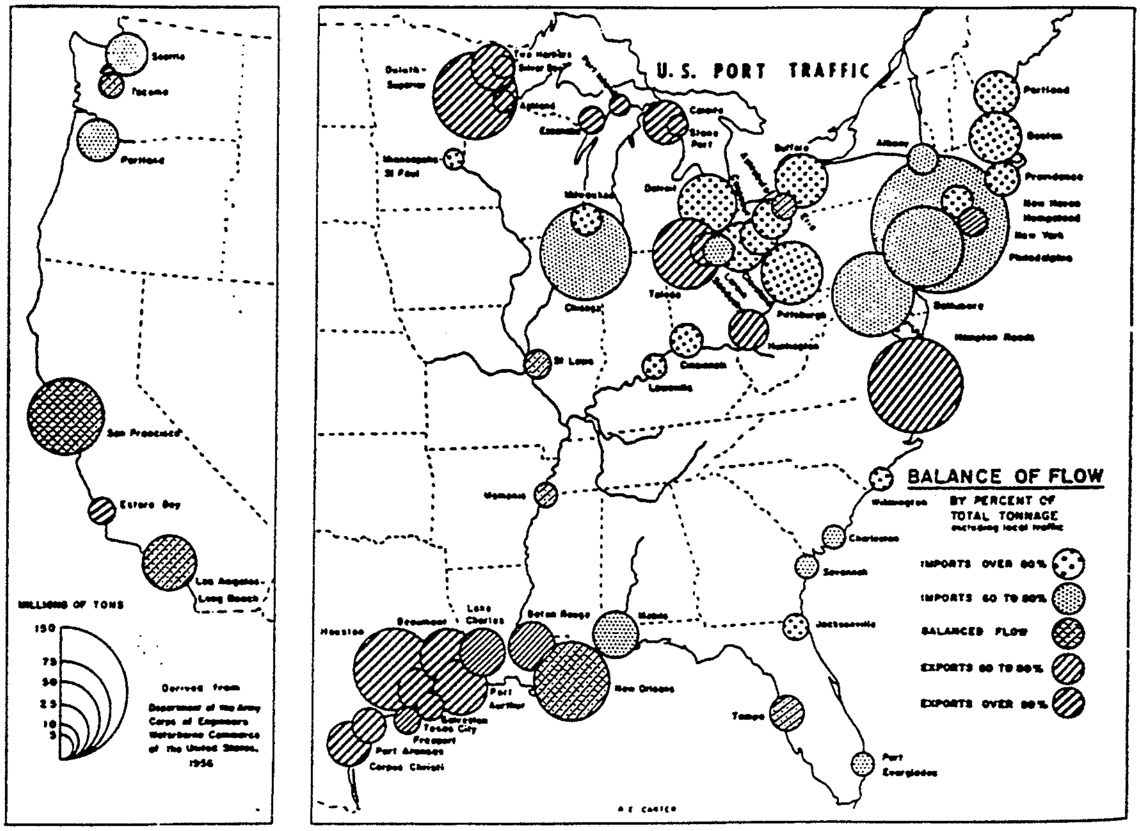


Source: Carter, 1962

Another component of gross tonnage is the balance of traffic flow. This index relates to traffic coming into a port and that moving out of the port. Desirably, a relative balance is expected between a port's inbound and outbound traffic so that judicious use would be made of the port's facilities. However, this has not been the case at most ports. Figure 3.4 shows that about 35 of the 60 ports had over 80 per cent of their traffic moving in one direction. Of these 35 ports, 20 were imports dominated and 15 exports dominated. Only 8 had a relatively balanced traffic. Ports along the major raw material resource areas, notably those of the Upper Great Lakes and the Texas Gulf Coast, are export-oriented as against the import-oriented ports of the heavily manufacturing consuming centres of the Lower Great Lakes and the Atlantic Coast.

Figure 3.4

Balance of traffic flow of United States ports, 1962

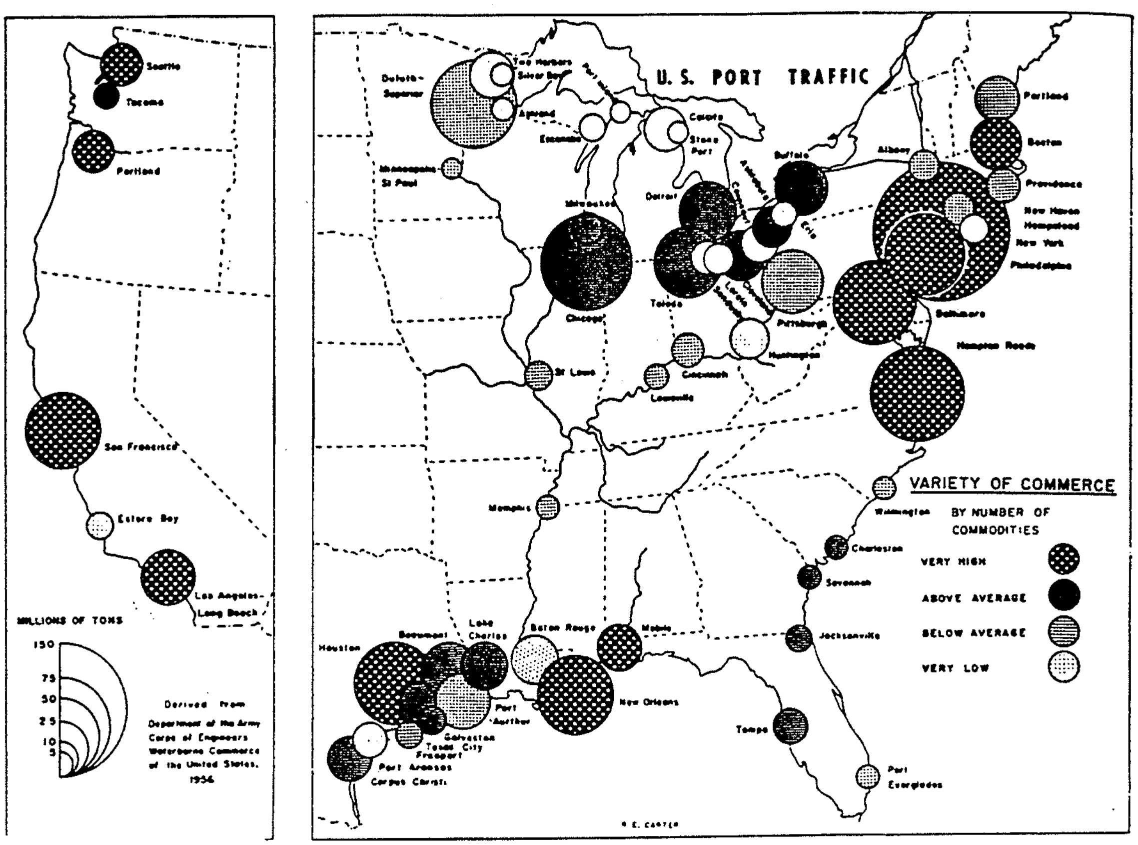


Source: Carter, 1962

The cargo tonnage components discussed so far are traffic characteristics which reflect bulk commodities. The next two components to be discussed, on the other hand, focused on general cargo. Because general cargo cannot be compared fairly with bulk cargo in terms of weight, two types of measures were used for this traffic in an attempt to counteract the bias associated with using weight; namely, the variety of commerce and value of foreign commerce. In Figure 3.5, the ports have been divided into four commodity classes or categories ranging from "very low" (less than 25), "below average" (25 to 100), "above average" (101 to 175) to "very high" (over 175) according to their standard deviation from the mean. As the distribution shows, only the coastal ports fall

Figure 3.5

Variety of commerce of United States ports, 1962

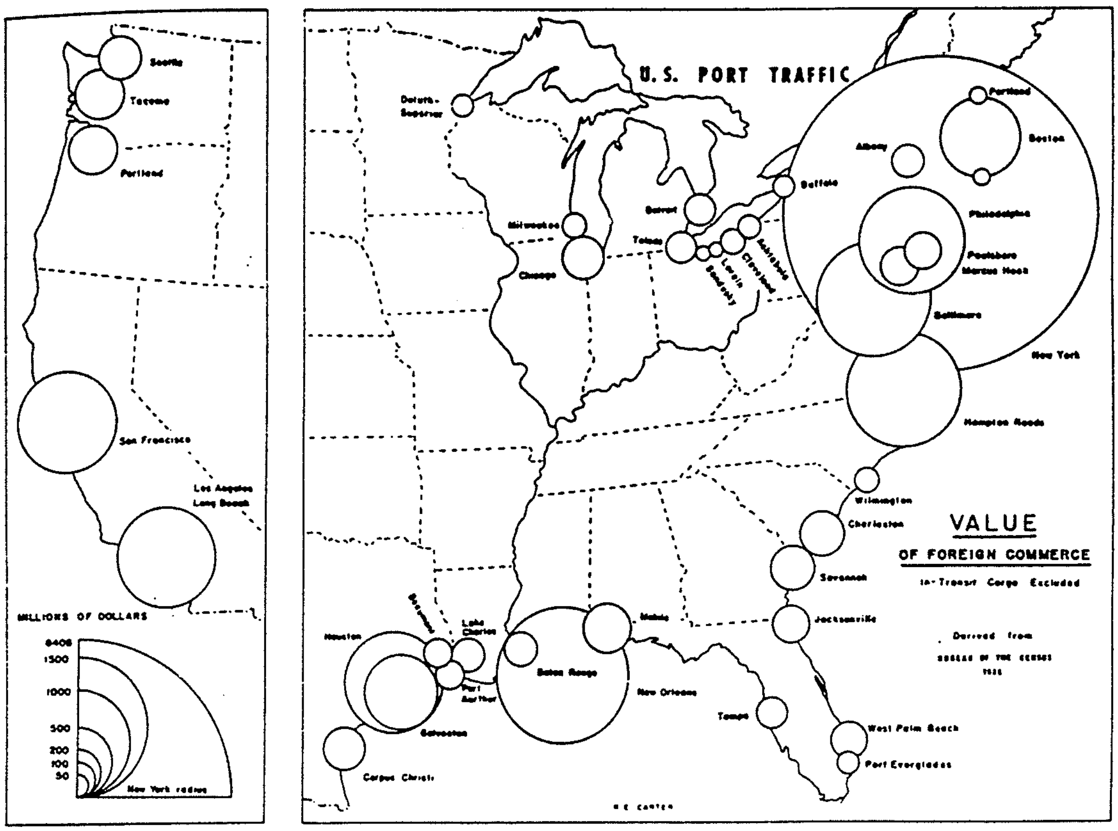


Source: Carter, 1962

into the highest category, that is, they handled over 175 cargo varieties. All the international ports; New York, Philadelphia, Baltimore, New Orleans, and San Francisco, handled the full range of the commodity classes. However, ports of the Inland Waterway System and the Great Lakes excepting Buffalo, Cleveland, Toledo, Detroit, and Chicago, were marked by low cargo variety. This was basically the result of the limited amount of general cargo carried on the waterways. The value of foreign traffic (Figure 3.6), in the opinion of Carter (1962), is the best measure for determining the relative status of international ports. As pointed out earlier, Hampton Roads overtook New York in terms of gross tonnage. In terms of value, however, New York was about eight times greater than Hampton Roads.

Figure 3.6

Value of foreign commerce of United States ports, 1962



Source: Carter, 1962

Having pointed out some of the vital port comparison indices we are now faced with the question of selecting the index judged to be most expressive of hinterland productivity. This question can be linked with Rimmer's (1966b) attempt to statistically establish the superiority of the indices. In order to establish such superiority, Rimmer combined Carter's multi-criteria approach[17] into a formula and then used the Pearson product moment correlation technique to find the extent of relationship among the indices. The exercise was conducted on New Zealand ports for the years 1926, 1936, 1950 and 1961 (Table 3.2). The following indices were used:

Table 3.2

Port comparison indices

Gross[18]	Overseas	Coastwise
Net registered tonnage	Net registered tonnage	Net registered tonnage
Weight of cargo	Weight of cargo	Weight of cargo
Different commodities	Different commodities	Different commodities
Number of ships	Number of ships	Number of ships
Maximum draught	Maximum draught	Maximum draught
	Value of cargo	

Source: Rimmer, 1966b

Although relatively high positive bivariate correlations occurred between all the measurements, at the .01 level of significance, there was a closer relationship between weight of cargo (cargo tonnage), net registered tonnage and the number of ships. — over .90 in all four years. All in all, cargo tonnage emerged as the best measurement for the ports in aggregate, followed by net registered tonnage, number of ships, number of commodities and, lastly, maximum draught. The results for the coastal ports were not substantially different, although the association between the criteria were not as high as in the cases of gross (aggregate) and overseas ports.

However, results took a different turn for the overseas ports. Apart from the higher associations – higher than for the gross and coastal – that generally existed among the six criteria, for three of the years – 1926, 1936, 1950 – net registered tonnage was the measurement most closely associated with the others. In 1961, the number of ships emerged as the measurement most closely associated with the others. Based on their high correlations – all over .90 – Rimmer suggests that any of the four measurements –net registered tonnage, cargo tonnage, number of ships and value could be used in assessing the status of an overseas port. The number of commodities was not quite as valuable

[17] Carter's (1962) approach, as already described, combined six different criteria to assess the relative status of United States ports in 1962. See section 2.1, paragraph 4.

[18] The ports were broken down into these components – gross, overseas and coastwise – because of their differential performance spatially and temporarily.

(coefficient ranged between .80 – .90), while maximum draught was the least valuable (coefficients ranged between .65 – .85). From the literature, however, it is evident that cargo tonnage has been the most widely used index despite its deficiencies (see Rimmer, 1966a, Hoyle and Charlier, 1994). In the present study, for example, cargo tonnage has the drawback of exaggerating Takoradi, which specialises in bulky cargoes. But as Rimmer (1966a) points out, "tonnage is most expressive of the primary function of a port, which is to transfer cargo between ships and the land, and vice versa". In conformity with the weight of established practice, cargo tonnage is adopted as the most expressive measure of hinterland in this study. Referring to Carter's (1962) approach, however, we know that cargo (overall) tonnage can be broken down into different components, which include the following:

a. Overall traffic
b. Variety of traffic
c. Container traffic
d. Balance of traffic
e. Leading commodity

Other indices to be analysed are the following port performance indicators:

a. Net registered tonnage of shipping (NT)
b. Ship calls - number of ships visiting each port (NS)
c. Ship turnround time (ST)
d. Labour productivity/Cargo handling productivity (LP)
e. Berth occupancy ratio (BO)
f. Gang hours (GH)
g. Ship productivity (SP)

In effect, I adopt the multi-criteria approach suggested by Carter and Rimmer in this study.

3.2 Method of analysis I

Analysis of these indices would be performed with the help of tables, graphs, maps (cartographic techniques) and ordinary least square (OLS) regression. From these tables, maps, and the regression analysis comparisons and relations between and among the different variables would be made[19]. Further comment is needed on the regression technique.

3.2.1 Regression analysis

The OLS regression is specified as:

$$OT_t = \alpha_o + \alpha_1 ST_t + \alpha_2 LP_t + \alpha_3 BO_t + \alpha_4 NS_t + \alpha_5 NT_t + \alpha_6 SP_t + \alpha_7 GH_t + u_t$$

where,

OT_t = Overall tonnage

ST_t = Ship turnround

LP_t = Labour productivity

BO_t = Berth occupancy

NS_t = Number of ship calls

NT_t = Net registered tonnage

SP_t = Ship productivity

GH_t = Average gang hours

α_o = Constant

α_1 - α_7 = Parameters or coefficients

u_t = Error/disturbance term

t = 1................T (number of years)

[19] This first part of the analysis is restricted to the two ports of Tema and Takoradi because of the absence of required data on other African ports.

Before the regression is run, we will check for stationarity of the data because of the time-series nature of the data. Removing trends or seasonality from the series can be done using parametric or non-parametric techniques. In using the non-parametric technique the first step involved is to perform a time plot; that is to say, plotting the observations against time. This will often show up the most important properties of the series. If any features such as trend, seasonality, or discontinuities, are present, the series would have to be *differenced* to remove these features.

Regarding the parametric technique the Phillips-Peron test (PP-test) (see Enders, 1995) is used. The test is specified briefly as:

$$y_t = a_0^{*} + a_1^{*} y_{t-1} + u_t$$

and

$$y_t = \tilde{a}_0 + \tilde{a}_1 y_{t-1} + \tilde{a}_2\left(t - T/2\right) + u_t$$

where,

T = number of observations and the disturbance term u_t is such that

$Eu_t = 0$, but there is no requirement that the disturbance term is serially uncorrelated or homogeneous. The PP-test allows the disturbances to be weakly dependent and homogeneously distributed.

The PP-test proceeds to characterise the distributions and derive test statistics that can be used to test hypotheses about the coefficients a_i and a_i under the null hypothesis that the data are generated by

$$y_t = y_{t-1} + u_t$$

Various statistical time-series software packages are available for deriving PP-test statistics, and the SHAZAM version has been made use of in this thesis. The effectiveness of the resultant regression analysis will be inferred from the following:

a. Residual tests for autocorrelation, heteroscedasticity and normality.

b. Multicollinearity test

c. Specification bias test

d. Hypothesis/inference testing using *t-test*, and *F-test*.

3.3 Definition of terms

3.3.1 Berth occupancy[20]

Berth occupancy refers to the time period during which a vessel actually occupies a berth. This period starts from actual arrival of a vessel at the berth to its actual departure from the berth. The indicator reflects the utilisation of the berth capacity and therefore is useful for governing decisions taken about investments in new berths, which, along with dredging, is considered the highest financial burden for any port authority. To some writers, "the output of the port is the output of its several berths" (Oram and Baker, 1971:16) The berth occupancy ratio is calculated as follows:

$$\frac{\text{Number of hours of occupancy x 100}}{\text{24 hours x number of berths}}$$

Illustration:

1. The case of conventional general cargo vessel:

Number of hours = 140 hours

Number of berths = 10 berths

Berth occupancy would be:

$$\frac{140 \text{ x } 100}{24 \text{ x } 10} = 58\%$$

[20] Todd (1993:3) has described the primary function of a seaport as ensuring "the smooth transfer of cargoes from and to the sea (export and outgoing coastal trades) or vice versa.........". "The berth is the point at which this transfer takes place" (Oram and Baker, 1971).
Another variant of the berth indicator is berth throughput. This indicator is concerned with the actual tonnage loaded and discharged for a berth, expressed per metre of available berthage and unit of time. The berth throughput can be measured in terms of length of quay in metres or berth area (m²). Like berth occupancy, additional information like commodities discharged and loaded is needed in order to arrive at the correct interpretation of this index. With respect to container terminals the berth throughput is measured in twenty-foot equivalent units (TEU) per metre and time.

2. The case of cellular container ship[21]:

Number of hours of occupancy = 8

Number of berths = 4

Berth occupancy would be:

$$\frac{8 \times 100}{24 \times 4} = 8\, {}^{1}\!/_{3}\, \%$$

The interpretation of berth occupancy figures requires some caution. One limitation with the berth occupancy ratio is that it cannot be defined for a port as a whole. Secondly, berth occupancy figures are affected by a wide range of factors such as special berths and related handling facilities and different kinds of commodities (bulk, break-bulk, containers etc). What is more, average occupancy ratio for a whole period, say a week, masks peak and low times of occupancy within the period. Attention should also be given to whether the right vessel is served at the right berth, as a high rate of occupancy reduces considerably this flexibility. The berth occupancy ratio described above, therefore, refers to the gross rate. A break-down of the gross rate into the different components gives the net berth occupancy rate. This is the real time of operation of a ship at the berth.

3.3.2 Ship turnround time

The ship turnround time consists of three components:

1. Net working time of a ship: This is the actual time the ship is in operation.
2. Waiting time of a ship in a port: This time includes periods of non-operation on a ship as a result of equipment breakdown, non-availability of cargo and/or labour, shift-breaks, opening and closing of hatches, storms and rains, to mention a few.
3. Manoeuvring and clearance time: These are periods prior to and after operation, such as towage, mooring, customs clearance and immigration.

Distinguishing and calculating these different components is very important during negotiations between port operators and port users when discussing port performance.

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[21] Typically, a port revolving round a container terminal boasts a smaller number of berths than a port catering largely to break-bulk cargoes.

3.3.3 Cargo-handling or labour productivity

Cargo-handling productivity is defined as tonnage handled – loaded/discharged – per man/hour. When defined in terms of gang/hour, this indicator could be useful for a port's operations department, especially in determining labour and equipment requirements for incoming vessels. Cargo-handling productivity could also be calculated separately for commodities and the different operational units.

3.4 Port performance, costs and traffic volume[22]

There is a close relationship between all the four indicators described above, the upshot of problems associated with berthing capacity. The problem of berthing capacity emerges as a result of the irregularities connected with the arrival and departure times of ships. Three scenarios can be proposed as a solution to this problem. The first is ensuring a hundred per cent berth occupancy at the expense of continuous and very long queuing of ships. The second would be to guarantee ships no more queues to get onto a berth, but this would be achieved at the expense of very low berth occupancy rates. The third option is to strike a balance between the first two options as the best way of reducing port costs.

There are two components of port cost; namely, fixed and variable cost. The fixed component consists of capital costs incident to the installing and upkeep of quays, sheds and cranes. This cost is independent of tonnage throughput. The variable cost, on the other hand, is dependent on tonnage throughput and comprises costs such as labour and staff, fuel, and maintenance. Fixed costs, when expressed as a cost per ton, have an inverse relation with tonnage increase. That is to say, fixed costs per ton decrease with increase in tonnage throughput. On the other hand, variable costs, when expressed as cost per ton, normally remain fairly stable until the berth comes under intense pressure to accept high tonnage throughputs, at which point the variable cost per ton begins to rise as a result of working overtime and the introduction of more costly handling equipment and methods (Figure 3.7a). As Figure 3.7a shows, the port cost curve (PC) – sum of fixed and

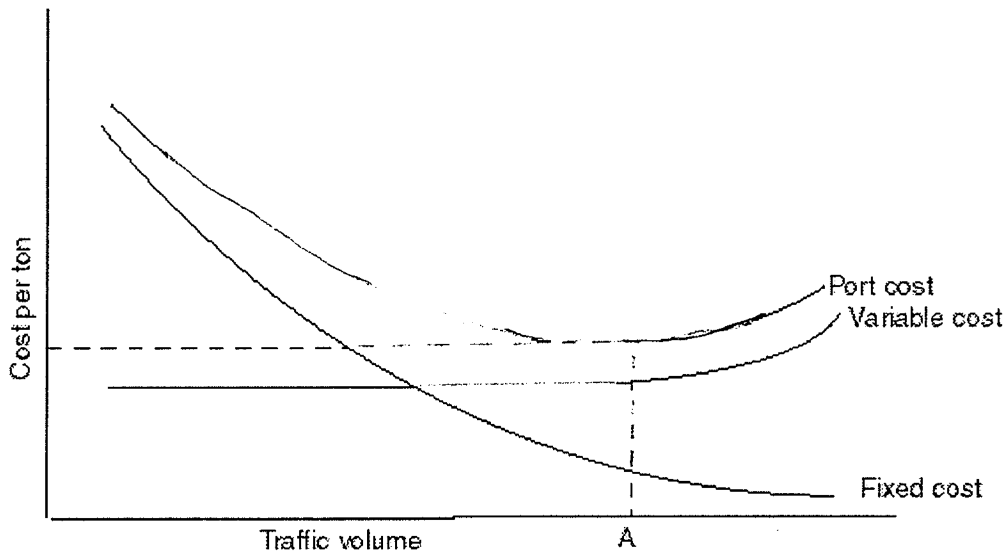
[22] The emphasis on these indicators derives from their impact on port performance and thus ultimately on a port's hinterland. These indicators, if not managed optimally, will increase port costs which are ultimately transferred to port users. However, increased port charges have the tendency of driving away port users, leading to loss of hinterland.

variable costs – reaches a minimum value when the rate of reduction in the fixed cost per ton equals the rate of increase in the variable cost per ton, point A.

Next in consideration is cost of ship's time in port. Two aspects of this time is considered; viz., the time the ship spends at the berth – including time needed to proceed to and leave the berth – and the time the ship spends waiting for a berth to become vacant. When traffic through the port increases and port authorities come under pressure to increase the berth's throughput, two options become available. The first is either to reduce the ship's turnround time by improving cargo-handling rate by working overtime or improving handling equipment and methods. This, of course, as noted, would be achieved at the expense of ship waiting time for berth (Figure 3.7b).

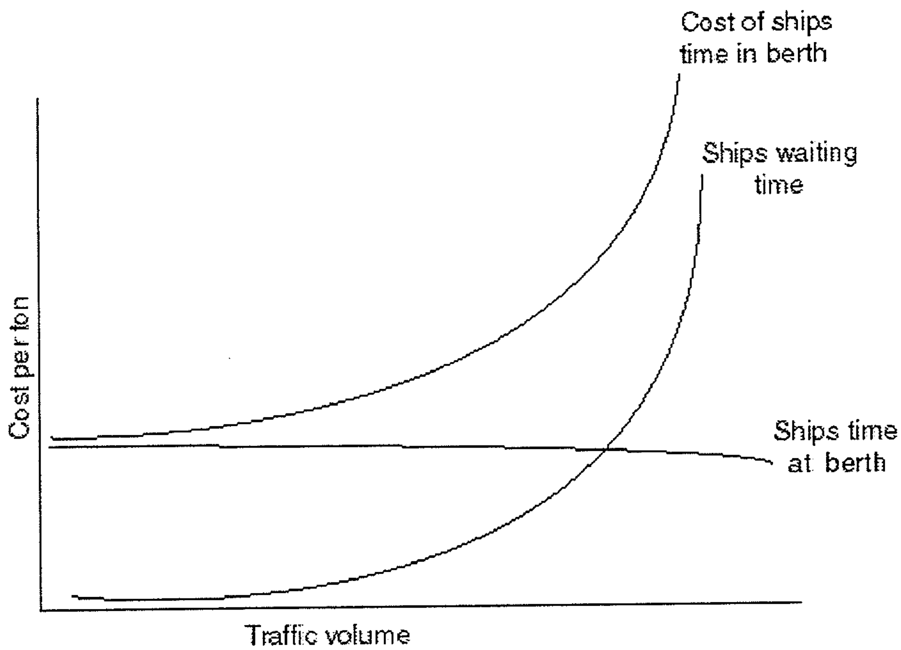
Figure 3.7a

Variation of port cost with increasing traffic



The typical variable cost (VC) is u-shaped. Ceteris paribus, the VC of plants will decline, remain stable for a while and then rise with increase in output as a result of economies of scale. In the present situation, there is no decreasing returns to scale hence the deviation of the VC from the normal.

Figure 3.7b
Variation of port cost with increasing traffic



The second is to substitute smaller ships with larger ones so that there will be fewer berthings. A juxtaposition of the two diagrams (Figures 3.7a-b) provide a better appreciation of the relationship between berth capacity and total cost (Figure 3.8).

Figure 3.8

Variation of total cost in port with increasing traffic

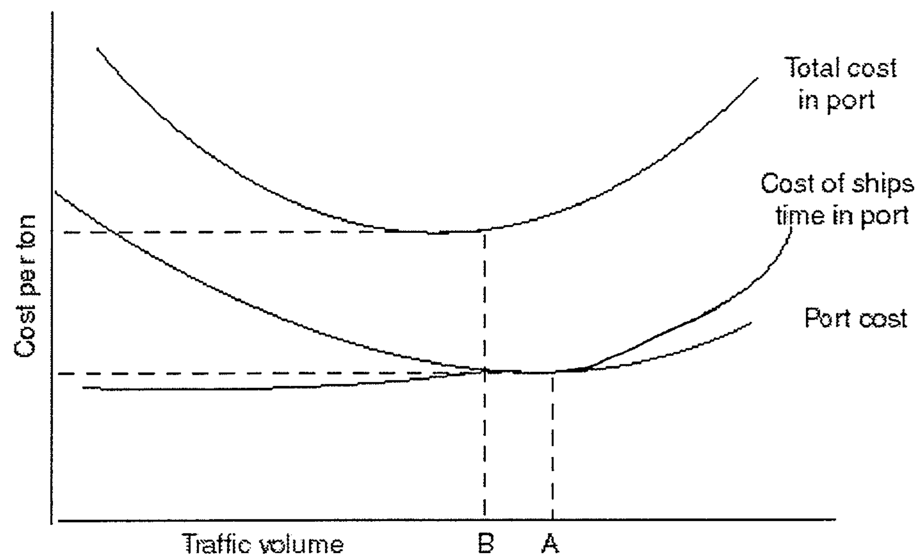


Figure 3.8 reveals that total cost per ton in port has a minimum point at B. However, this minimum point – including the cost of ship's time – is achieved at a much lower throughput than that leading to the minimum port cost (A). Thus in the attempt to reduce port costs at the expense of shipowners, port authorities may risk increasing ship queues and this outcome has the possibility of increasing port surcharge which is detrimental both to the port and the wider national economy (Norwegian Shipping News, 1974).

3.5 Method of analysis II[23]

The second part of the analysis concerns the relative growth in the ports' traffic from 1983 to 1993[24]. The methodology to be used here is the shift-and-share technique.

3.5.1 The shift-and-share technique

In analysing the relative growth in the hinterlands of the ports using cargo tonnage as a proxy the shift-and-share analysis lends itself to use as the most appropriate methodology. The shift-and-share procedure is a technique for assessing differential growth rates between two or more phenomena within a country or any reference area. Employment has been the most widely used variable for monitoring change. Formally, shift-and-share has been defined as "a technique for assessing the relative importance of different components in regional employment growth or decline" (Hepple, 1990:554). Two main components constitute the model; the regional 'share' and the total 'shift'.

The regional share is defined as the amount by which total employment in a region would have grown or declined during the period under study if the region had grown or declined at the same rate as the national rate. Algebraically, the regional share is written as;

$$RSj = \{\sum_{i} Eij^{1} (\sum\sum_{ij} Eij^{2} / \sum\sum_{ij} Eij^{1})\} - \sum_{i} Eij^{1} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where,

RSj = share of region j (j = 1, 2 ....n);

$\sum_{i} Eij^{1}$ = employment in all industries in region *j* in period 1 (initial time period);

$\sum\sum_{ij} Eij^{1}$ = employment in all industries in all regions in period 1;

---

[23] The application of the shift-and-share technique to the present study does not resort to all the variations of the methodology; hence only the fundamentals of the 'mainstream' methodology are explained.

[24] This section of the analysis will include other major ports in Africa. Emphasis is on the period 1983-1993 because this is the period for which data are available for all the ports.

$$\sum_{i}\sum_{j} Eij^2$$ = employment in all industries in all regions in period 2 (terminal time period).

The total shift is the difference between actual regional employment growth and that which would have occurred if the region had grown at the overall national rate (i.e., the difference between 'real' regional growth and the 'abstract' growth encapsulated in the regional share). It is defined mathematically as:

$$TSj = \sum_{i} Eij^2 - \{\sum_{i} Eij^1 (\sum_{ij}\sum Eij^2/\sum_{ij}\sum Eij^1)\} \ldots\ldots\ldots\ldots\ldots(2)$$

where,

TSj = total shift of region j;

$\sum Eij^2$ = employment in all industries in region j in period 2.

The total shift is often divided into proportionality shift (PS) or 'composition effect' and differential shift (DS). The PS measures change due to regional concentration in slow-growing or fast-growing sectors, and is calculated by applying to each industry a growth factor that is the difference between the actual industrial growth rate and the overall national rate. Proportionality shift will be positive if region *j* contains a sizeable fractional fast-growing industry *i* whose growth rate is higher than that of the national average. Proportionality shift, however, will be negative if region *j* contains a high proportion of industry *i* whose growth rate is lower than that of the national average. On the other hand, PS will be zero if growth rate of industry *i* and the national growth rate are the same. Mathematically, proportionality shift is written as:

$$PS = \sum_{i} Eij^1 \{(\sum_{j} Eij^2/\sum_{j} Eij^1)\} - (\sum_{ij}\sum Eij^2/\sum_{ij}\sum Eij^1)\} \ldots\ldots\ldots\ldots\ldots(3)$$

where,

$\sum_{j} Eij^1$ = employment in the *ith* industry in all regions in period 1 (i = 1, 2, ...m)

$\sum_{j} Eij^2$ = employment in the *ith* industry in all regions in period 2.

The differential shift is the amount by which employment in region *j* would vary if its industries grew at a different rate from the performance exhibited by their peers at the national level. The formula for DS is written as follows;

$$DSj = \sum_{i} Eij^1 \{(\sum_{i} Eij^2/\sum_{i} Eij^1)\} - (\sum_{j} Eij^2/\sum_{j} Eij^1)\} \ldots\ldots (4)$$

This can also be written as,

$$\sum_{i} Eij^2 - \sum_{i} Eij^1 (\sum_{j} Eij^2/\sum_{j} Eij^1) \ldots\ldots (5)$$

where,

DSj = differential shift of region j.

The DS, like the proportionality shift, can also be positive, negative or zero. The differential shift will be positive if the growth rate of industry *i* in region *j* grows faster than the national rate of industry *i.* On the other hand, if industry *i* in region *j* grows slower than the national rate of industry *i,* then the DS will be negative. The shift will be zero when the growth rates of industry *i* are the same (Subramanian, 1986, Wang, 1997).

The shift-and-share methodology has been extended to port studies (Rimmer, 1966a, Todd, 1993). The point of departure of the approach in port studies has been to measure the relative positions of ports, P_1 and P_2, for two or more different time periods, T_1 and T_2. To provide a basis for interpreting the changes in the ports' performance, the ports are initially ranked according to their percentage of the gross tonnage in the initial and terminal years. Implicit in the rankings is change in concentration. Thus, port P_1, with 4.8 per cent of the gross tonnage in T_1 and 6.2 per cent in T_2, is considered to have experienced an increase in concentration of 2.1 per cent. To make these changes in concentration explicit, they are translated into absolute terms by calculating the difference between the actual tonnage of port P_1 in time T_1 and the hypothetical figures showing what the tonnage would have been if the port had grown at the national rate between T_1 and T_2. Ports which grew more than the national rate are said to have 'gained', while ports which grew less are said to have 'lost'. However, since this 'gain' or 'loss' is measured against the national average it conceals the absolute gains or losses made by ports. In other words, it is possible for a port to record a comparative gain when compared with the national average and yet lose in absolute terms and vice versa. The difference between the actual and hypothetical tonnage is calculated as follows:

[1] $H_p = X_p \; Y_N \div X_N$

or,

[2] $H_p = X_p \, (T_{t1} / T)$

[3] $Y_p - H_p$ = Comparative gain or loss

where,

H_p = Hypothetical tonnage of port

X_p = Tonnage of port in initial year

Y_p = Tonnage of port in terminal year

X_N = Tonnage of national ports in initial year

Y_N = Tonnage of national ports in terminal year

T_{t1} = Tonnage of national ports in terminal year

T = Tonnage of national ports in initial year

3.6 Data collection

A majority of the data for the thesis was collected from what Singleton et. al (1993) refer to as public documents and official records. These sources comprised the Ghana Ports and Harbour Authority, the University of Ghana, the Ghana Shippers Council, Ministry of Transport and the Ghana Haulage Truck Drviers Association. With the use of partially structured questionnaires, primary data were collected through face-to-face interviews with the port authorities, some shipping companies and the Ghana Haulage Truck Drivers Association (GHTDA).

3.7 Summary

The subject of port comparison is a topic of great interest to both port authorities and researchers. Consequently, indices and methodologies have been devised to enable port researchers achieve this aim. Among the indices often used in this exercise are overall cargo tonnage, types of traffic, equipment, number of ships visiting a port and size and depth of quays, value of traffic, to mention a few. Despite the numerous variables available to choose from in comparing ports, there has been the tendency of some researchers to emphasise the use of a single index, however, others, including Carter (1962) and Rimmer (1966b) have cautioned against this practice. They advocate for a multi-criteria approach, which is the strategy I adopt in this study.

The analysis is in two parts. The first part is to analyse the throughput statistics and performance indicators using various graphical techniques and regression analysis. The second part involves using the shift-and share methodology to analyse the relative growth in the Ghanaian ports and their East African counterparts over the 1983-1993 period. As noted, performance indicators have significant impact on total port cost, which has the tendency of making the port uncompetitive. An uncompetitive port, however, risks losing its users and by extension its hinterland. I now apply these methodologies to the case studies; namely, the ports.

CHAPTER FOUR

ANALYSIS OF PORT PERFORMANCE AND THROUGHPUT

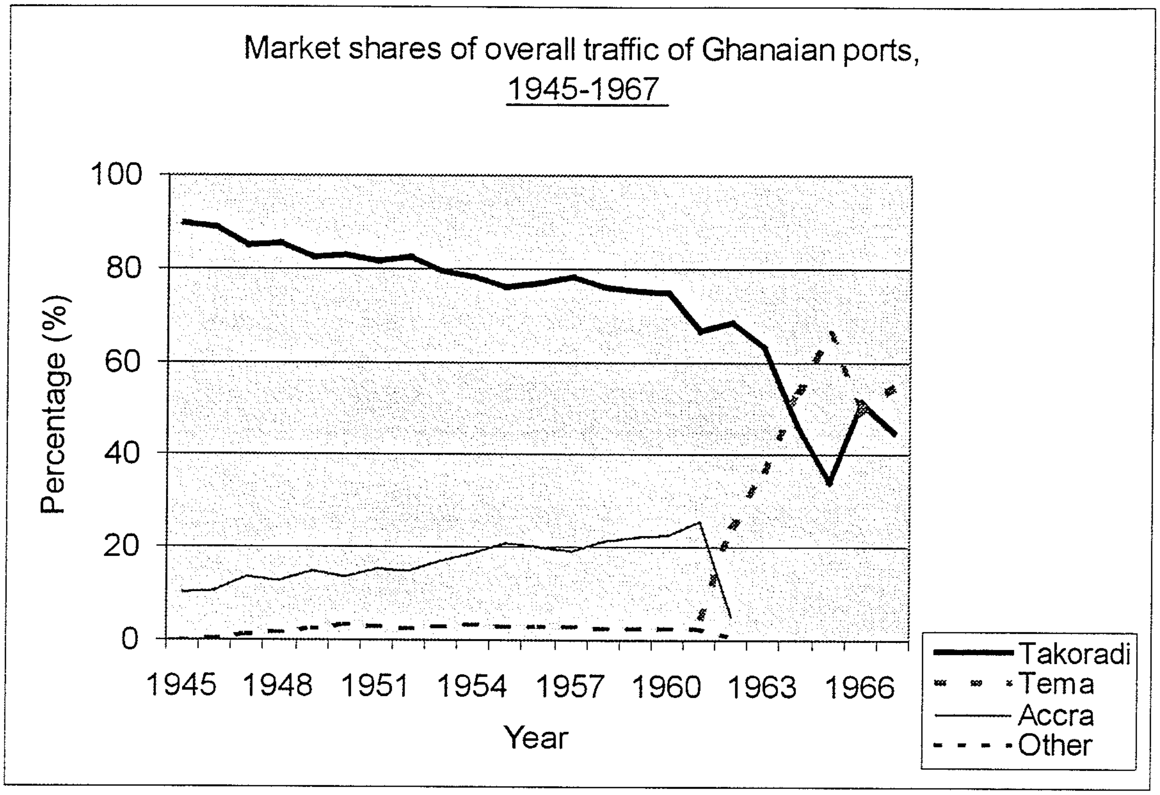
4.0 Introduction

Port comparison analysis, as was noted in Chapter Three, can involve different indices and methodologies. There has been the tendency for some writers to compare ports on the basis of a single index. The shortcomings of this approach were also discussed. Carter (1962) and Rimmer (1966a and b), it will be recalled, argued for a multi-criteria approach, which involved a combination of two or more indices. Among the methodologies discussed were the linear regression technique and the shift-and-share technique. In this chapter, I employ the multi-criteria approach and its attendant methodologies in order to assess the Ghanaian and East African ports. The analysis is in three parts. The first part is a description of the ports' throughput statistics and performance indicators. This is done within the framework of Carter's (1962) multi-criteria approach. The second part is a synthesis of the throughput statistics and performance indicators. The rationale is to determine the relative contribution or role of the performance indicators on total tonnage. This is approached using the linear regression model. To place the performance of the Ghanaian ports in a much wider perspective, I compare their performance with the two major East African ports, Mombasa and Dar es Salaam. The analytical tool here is the shift-and-share technique.

4.1 Throughput analysis

Up until 1963 Takoradi was the leading port of Ghana. In 1945, for example, it had about 89.9 per cent market share of the overall national traffic (Appendix I, Figure 4.1). The dominant position of Takoradi at the time was quite understandable given that it was the only deep-water and best-equipped port at the time. Accra and the other ports were surf ports (Hilling, 1975).

Figure 4.1



Source: Prepared from Hilling, 1970b

A closer examination of the statistics (Appendix I and Figure 4.1) reveals that Takoradi's share of the market dwindled through the years, though it continued to have the largest market share until 1964. Takoradi's lost portion seemed to have gone to Accra, which increased its market share from 10.2 per cent in 1945 to 22.7 in 1960. The other ports also increased their market shares but their gains were not as significant as Accra's, making Accra the overall winner within the period of 1945-1960. The biggest blow to Takoradi's operation occurred with the emergence of Tema. The other dramatic impact Tema had on the Ghanaian port system was that it eliminated Accra and the other surf ports, leaving the Ghanaian port system to consist of the two deep-water ports – Takoradi and Tema (see Hilling, 1977). Beginning in 1964, just two years after coming into operation, Tema took over the overall traffic lead from Takoradi. In 1965, for example, Takoradi had only 34.3 per cent market share of the overall traffic as against Tema's 65.7 per cent (Appendix I).

Let us now examine what Hilling (1977) has referred to as the *consolidation period*, that is, the period within which Takoradi and Tema consolidated their positions and became the only two ports of the country. Though the *consolidation period* dates back to 1963 our analysis focuses on the 1980-1997 period, as this is the period for which data is available for both ports. Table 4.1 shows Tema's overwhelming market share of the overall traffic from 1980-1997. In 1982 Tema had as much as 82 per cent of the market share while Takoradi had only 18 per cent. Tema's lowest share was 63.9 per cent and this was in 1994. Tema's leading position notwithstanding, its market share continued to dwindle vis-à-vis that of Takoradi, especially during the 1983-1994 period. Figure 4.2 provides a quick appreciation of Table 4.1

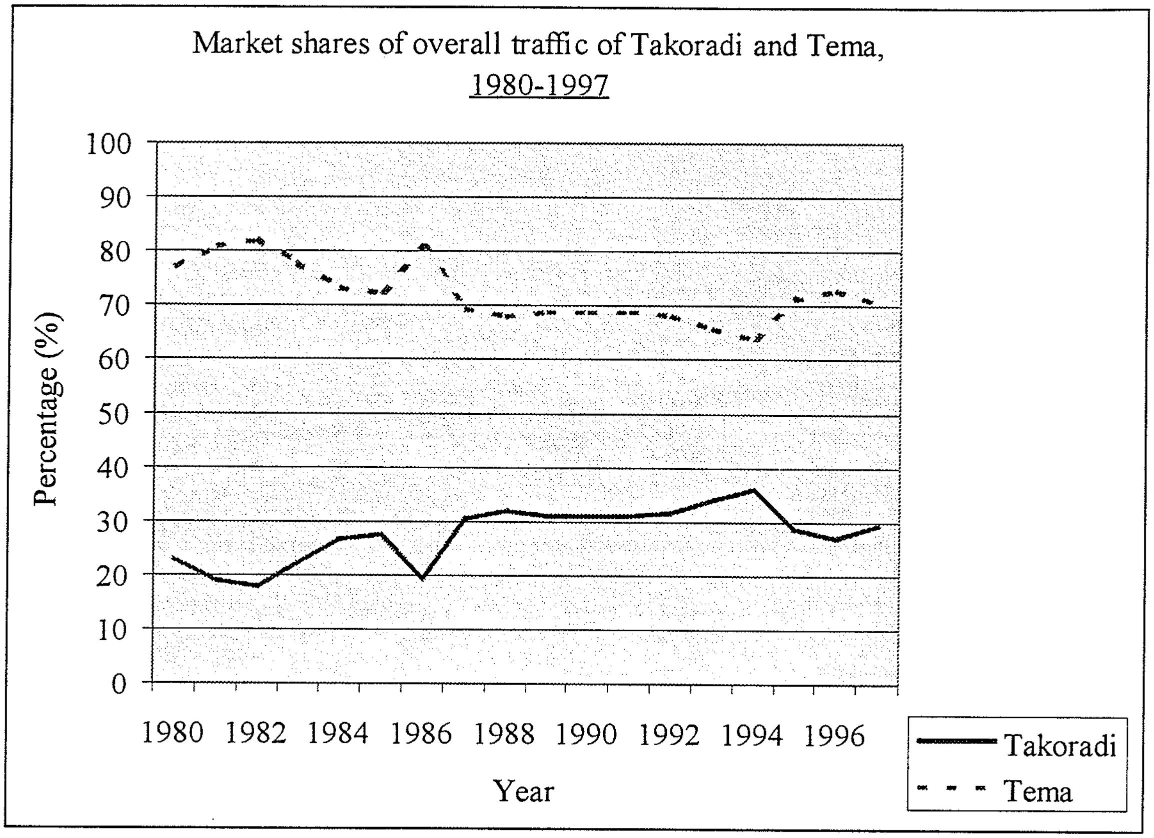
Table 4.1

Overall traffic concentration at Ghanaian ports, 1980-1997

	Market shares (%)	
Year	Tema	Takoradi
1980	77.1	22.9
1981	81.0	19.0
1982	82.0	18.0
1983	77.7	22.3
1984	73.2	26.8
1985	72.5	27.5
1986	80.7	19.3
1987	69.5	30.5
1988	67.9	32.1
1989	68.9	31.1
1990	69.0	31.0
1991	69.0	31.0
1992	68.4	31.6
1993	66.0	34.0
1994	63.9	36.1
1995	71.3	28.7
1996	73.1	26.9
1997	70.6	29.4

Source: Calculated from Appendix II

Figure 4.2



Source: Prepared from Appendix III

From Figure 4.2 we notice a wide gap between the two ports from 1980 – 1983, after which there was a gradual convergence – with the exception of 1986 – until 1994. Tema, however, started picking up again from 1995, as the open end of the figure shows. As already mentioned, gross tonnage figures conceal a lot of information and therefore do not provide a full appreciation of a port. For a broader and a more meaningful analysis of the ports we ought to break down the gross tonnage statistics into their respective components. One such component is the variety or type of traffic.

4.2 Variety of traffic

The various types of goods passing through Takoradi and Tema differ significantly. Table 4.2 shows the throughput of the ports by type of goods in 1996.

Table 4.2
Traffic concentration at Ghanaian ports by type of goods, 1996, (MT)

Type of good	Percentage shares			
	Tema		Takoradi	
	A	*B*	*A*	*B*
Bulk cargo:	70.7	31.0	29.3	41.4
Liquid bulk	88.4	32.3	11.6	11.5
Dry bulk	53.0	29.7	47.0	71.4
General cargo	82.7	5.5	17.3	3.1
Containers	82.6	10.5	17.4	10.5
Bagged cargo	84.2	18.4	15.8	5.3
Iron/Steel	100.0	1.4	0	0
Aluminium	100.0	2.3	0	0
Forest products	0.1	0.04	99.9	8.2

Source: Compiled from GPHA-*Cargo Throughput Data*

A=Percentage of national share (traffic), *B=Percentage of port's share (traffic)*

Table 4.2 reveals the traffic handling specialisation of both Takoradi and Tema. Whilst Tema handled all the aluminium and iron/steel, Takoradi handled 99.9 per cent of the national forest products traffic, which mainly comprised exports. For Tema this represented 0.04 per cent of its total traffic and for Takoradi 8.2 per cent. In terms of bagged and general cargo Tema's share of the national traffic was about 84.2 and 82.7 per cent as opposed to Takoradi's 15.8 and 17.3 per cent. At the individual port level bagged and general cargo represented 18.4 and 5.5 per cent of Tema's overall traffic whilst they made up 5.3 and 3.1 per cent of Takoradi's overall traffic. With respect to bulk cargo Tema handled about 70.7 per cent of the national traffic, which represented 31 per cent of its overall traffic. Takoradi's share of the national bulk cargo was 29.3 per cent; however, this represented about 41.4 per cent of its total traffic. Furthermore, Tema seems to handle the lion's share (88.4%) of the national liquid bulk traffic with Takoradi handling the residual. Dry bulk constitutes Takoradi's second major traffic after forest products. It had 47 per cent of the national dry bulk traffic but this constituted 71.4 per cent of its total traffic. This reveals the importance of the dry bulk — which consists mainly of manganese and bauxite — to Takoradi's traffic. While Tema's share of the national dry bulk traffic was 53 per cent, this represented 29.7 per cent of the port's total traffic. In terms of containerisation, Tema is ahead of Takoradi, enjoying 82.6 per cent of the market share against Takoradi's 17.4. However, it is interesting to note that for both ports containerisation represented just 10.5 per cent of their respective total traffic, an indication that both ports are way behind in the container revolution.

4.2.1 Container traffic

Table 4.3 shows the container traffic for Takoradi and Tema from 1991 to 1997.

Table 4.3
Container traffic at Takoradi and Tema (TEU), 1991-1997

	Takoradi		Tema		Market shares	
Year	Imports	Exports	Import	Export	Takoradi	Tema
1991	20,610	46,182	397,663	103,904	11.8	88.2
1992	24,408	38,315	441,871	152,625	9.5	90.5
1993	26,279	48,938	446,968	183,548	11.4	88.6
1994	31,921	86,512	405,640	189,033	16.6	83.4
1995	33,525	133,972	514,800	221,144	18.5	81.5
1996	37,016	151,759	625,353	272,797	17.4	82.6
1997	68,786	176,074	701,945	292,592	19.8	80.2

Source: MIS, Tema

Table 4.3 reveals Tema's dominating position of the container traffic in the Ghanaian port system. Its market shares of the 1991 and 1997 container traffic were 88.2 and 80.2 per cent as against Takoradi's 11.8 and 19.8 per cent. When it comes to rate of growth, on the other hand, Takoradi is in the lead, for its container traffic grew by 8 per cent while Tema's decreased by 8 per cent between 1991-1997. Tema's lead in the container traffic is bolstered by the use of the port for transhipment of containers to other West African countries. In 1996, for example, 145 TEUs comprising 51 x 20-foot and 47 x 40-

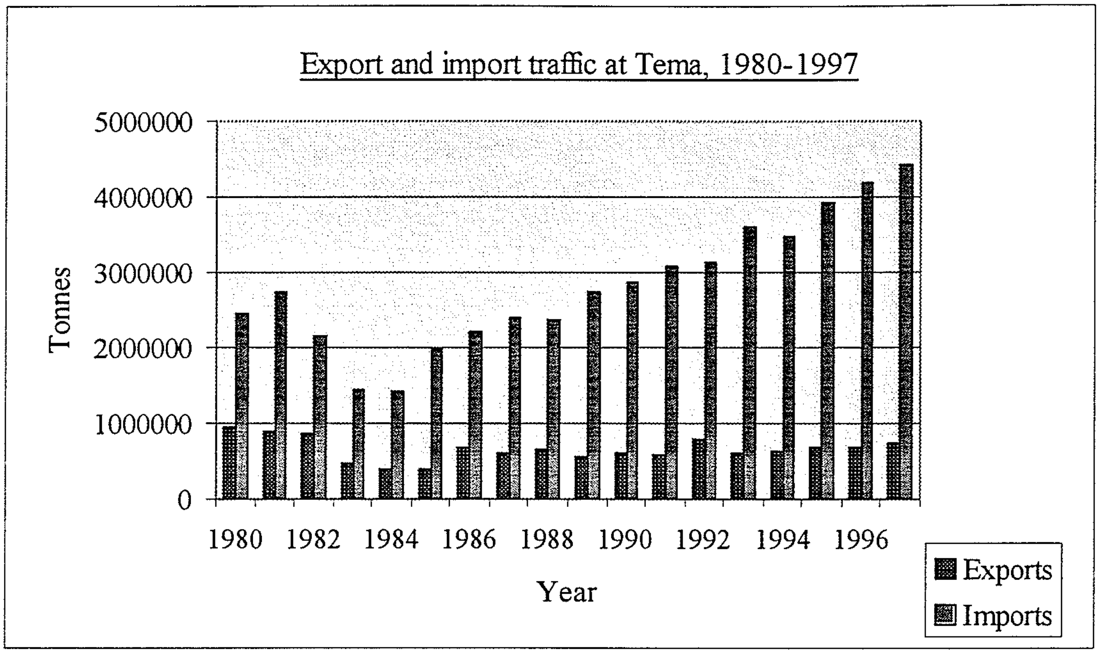
foot containers were transhipped via Tema. In 1997, this traffic increased to 1,145 TEUs, and consisted of 781 x 20-foot and 317 x 40-foot containers. Major items involved were general merchandise, used clothing and vehicles. Major destinations were Lagos in Nigeria, Lome in Togo and Douala in Cameroon. What is more, Tema's export traffic is relatively more diversified than that of Takoradi. Whilst Takoradi export base consists mainly of traditional bulky products like minerals and logs, Tema's exports are shifting more towards non-traditional lightweight products like fruits, cassava chips and fish, which are not only *container friendly*[25] but also *container necessary*. In other words, Tema has more need for reefer containers than Takoradi. In 1997, Tema's reefer container traffic was by 40 per cent higher than its 1996 performance. The 40-foot container dominates this traffic. The leading commodities involved here were frozen fish (55%), pineapples (25%) and bananas (14%).

4.3 Balance of traffic

Like most other ports in the region, the traffic flow of the Ghanaian ports is characterised by extreme imbalance between imports and exports. Both ports, since their inception, have concentrated on one aspect of traffic, with Takoradi concentrating on exports and Tema on imports. The export traffic of Takoradi constitutes about 57.1 per cent of its overall traffic. In the case of Tema this amounts to only 12.2 per cent of its overall traffic. Thus, in a sense, Takoradi is relatively more balanced in its trade than Tema. Let us concentrate on import traffic alone for now. Appendix III evinces the overall import traffic of the ports from 1945 to 1967. The statistics show the dominant position of Takoradi in the import trade from 1945 until 1963 when Tema took over. It ought to be pointed out, however, that before Tema's take-over, Takoradi had begun losing ground to the surf ports. Accra, for example, was making respectable strides until its demise was caused by the emergence of Tema. Tema began to make great strides from 1963. From a modest market share of 7.8 per cent in 1961 it increased its share of the import traffic to 80 and 86.1 per cent in 1965 and 1967 respectively. The gap between Takoradi and Tema, however, became pronounced during the *consolidation period* (Figure 4.3).

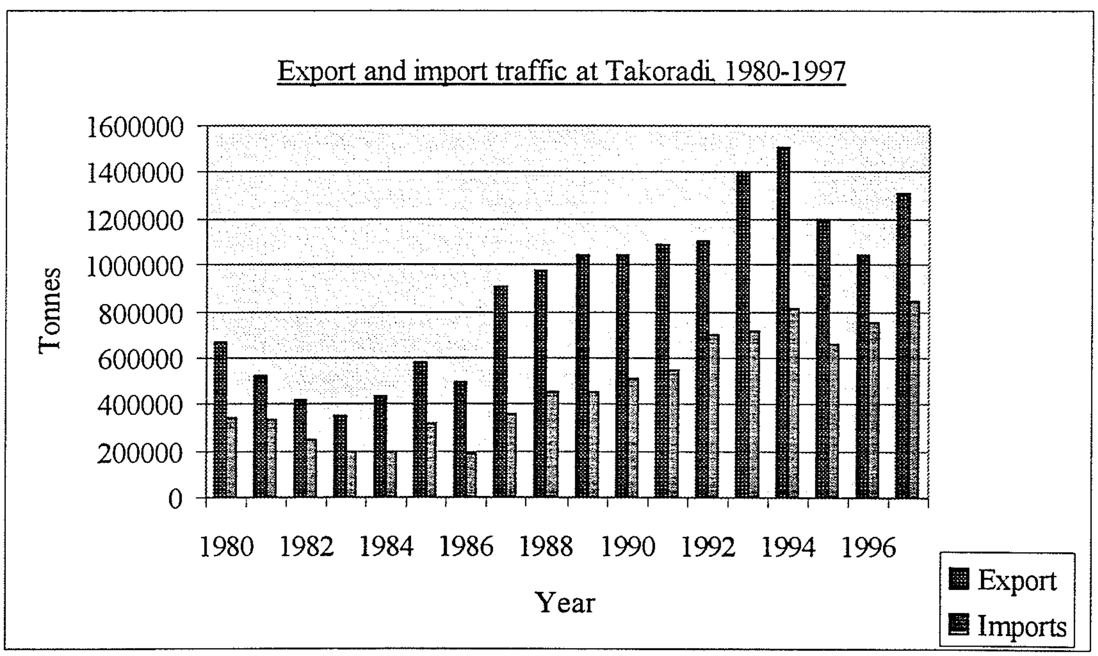
[25] By *container friendly* I am referring to cargoes that lend themselves easily to container use like cocoa, bananas and pineapples. *Container necessary* I refer to cargoes whose shipment in containers can be considered mandatory due to their nature, for example, fruits and vegetables.

Figure 4.3



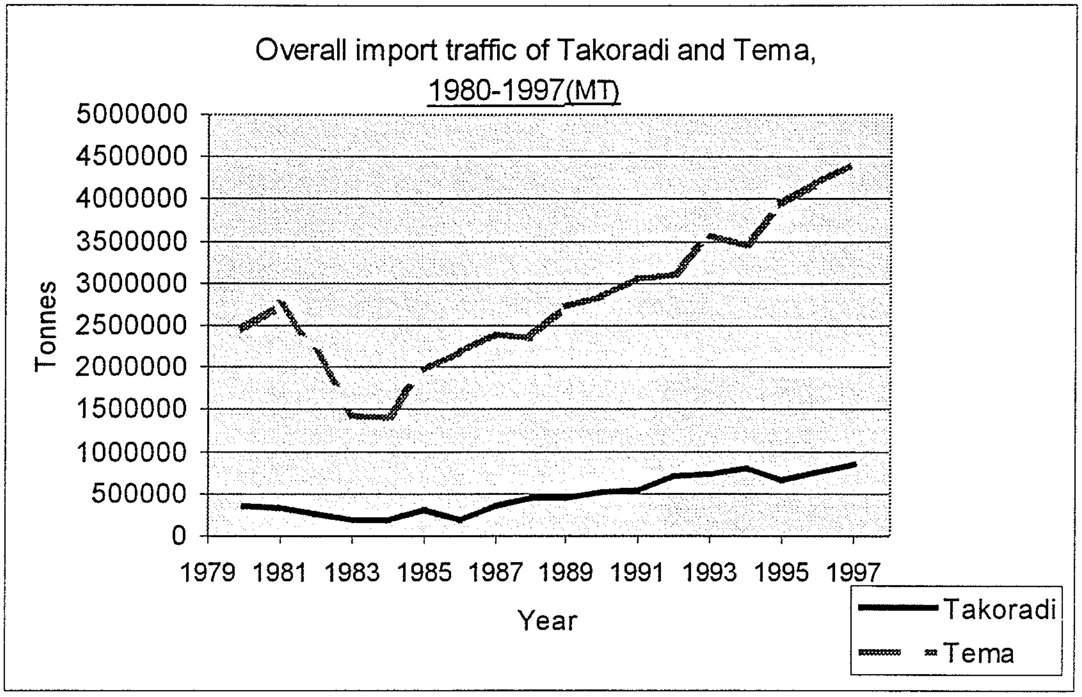
Source: Data from MIS, Tema

Figure 4.4



Source: Data from MIS, Tema

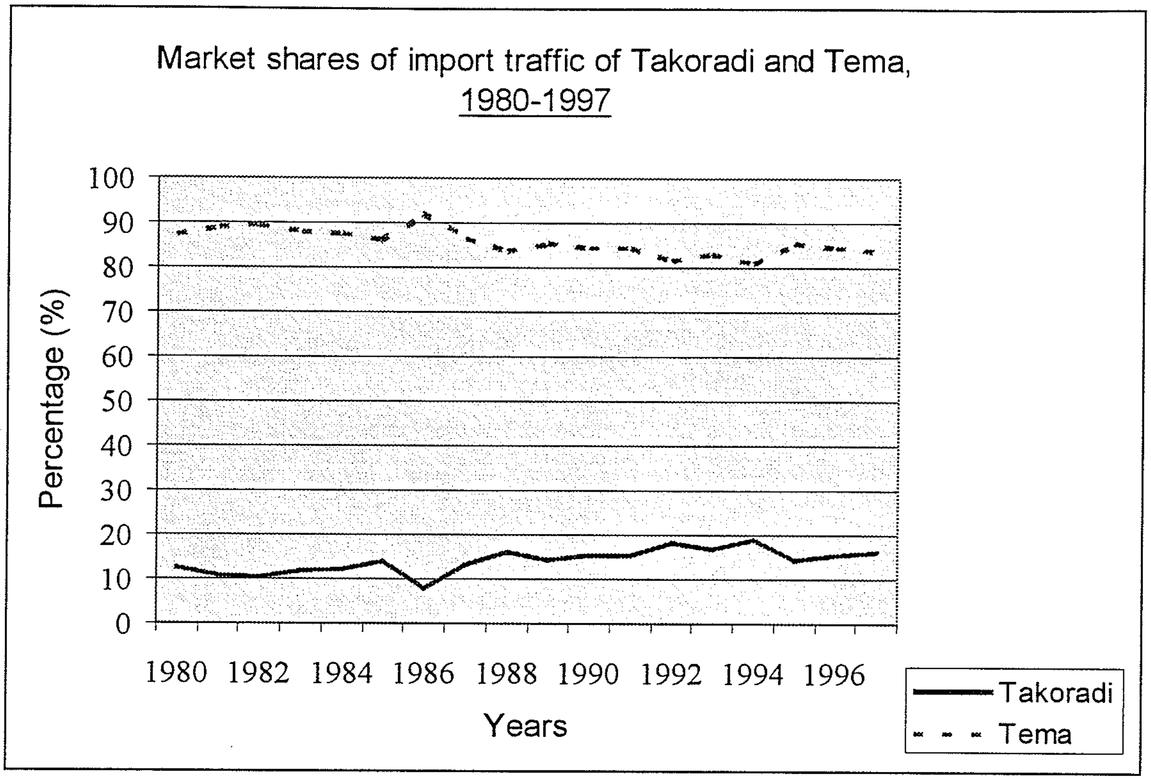
Figure 4.5



Source: Data from MIS, Tema

Figure 4.5 shows the widening gap between Takoradi's import trade and that of Tema especially from 1985. Looking at the gross volumes alone without further analysis is rather deceptive, however, as it conceals the modest gains Takoradi made over Tema in this trade. For example, when we subtract their market shares of 1980 from that of 1997, we see that Takoradi improved its import trade by 3.625 per cent whilst Tema's decreased by the same margin. However simplistic the methodology may look, it still gives an indication of which of the ports performed better within the period with regards to import trade. Figure 4.6 shows the market shares for Takoradi and Tema from 1980-1997.

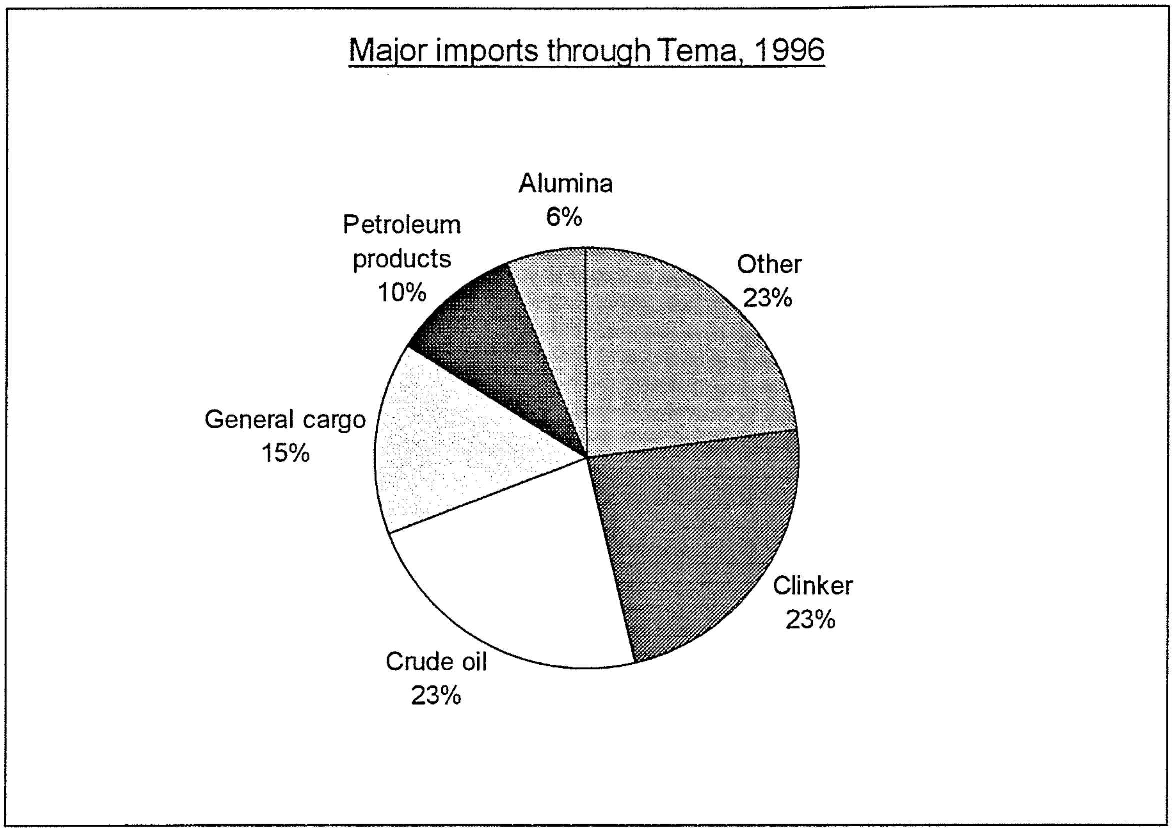
Figure 4.6



Source: Data from MIS, Tema

Now lets look at the import structure of the two ports. The five top imports through Tema are clinker (23.4%) for the cement factory, crude oil (22.5 %) for the Tema Oil Refinery, containerised —general cargo — (14.9 %), petroleum products (10.2 %) and alumina (6.1 %) for Valco, (see Figure 4.7). Together, these few items – out of a total of 32 – constitute 77.1 per cent of the overall import traffic through Tema.

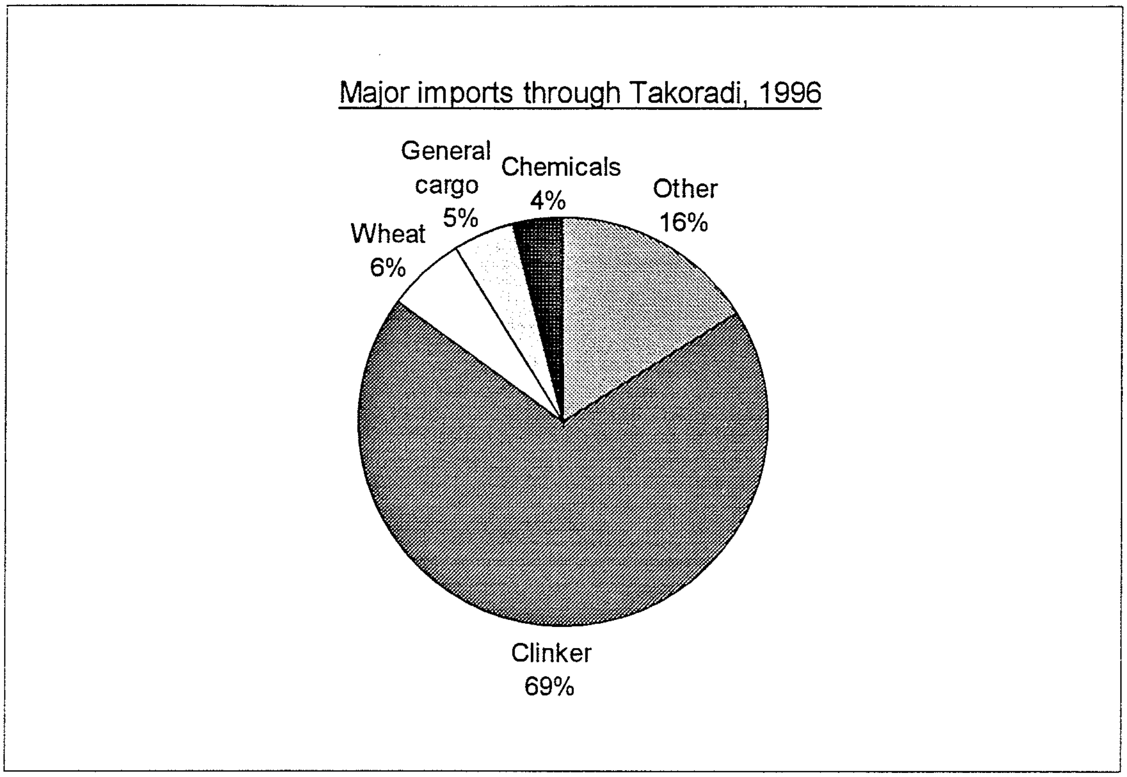
Figure 4.7



Source: Prepared from Ghana Shippers Council, 1996

In the case of Takoradi the top five imports – out of a total of 16 commodities – consist of clinker (69.8 per cent), wheat (5.5 per cent), container –general cargo (4.9 per cent) and chemicals (3.9 per cent). Together these constitute 92.8 per cent of the overall import traffic of Takoradi (Figure 4.8). Comparing the leading imports of the ports — Takoradi (69.8 per cent) and Tema (23.4 per cent) — gives us a glimpse of the specialisation level of Takoradi.

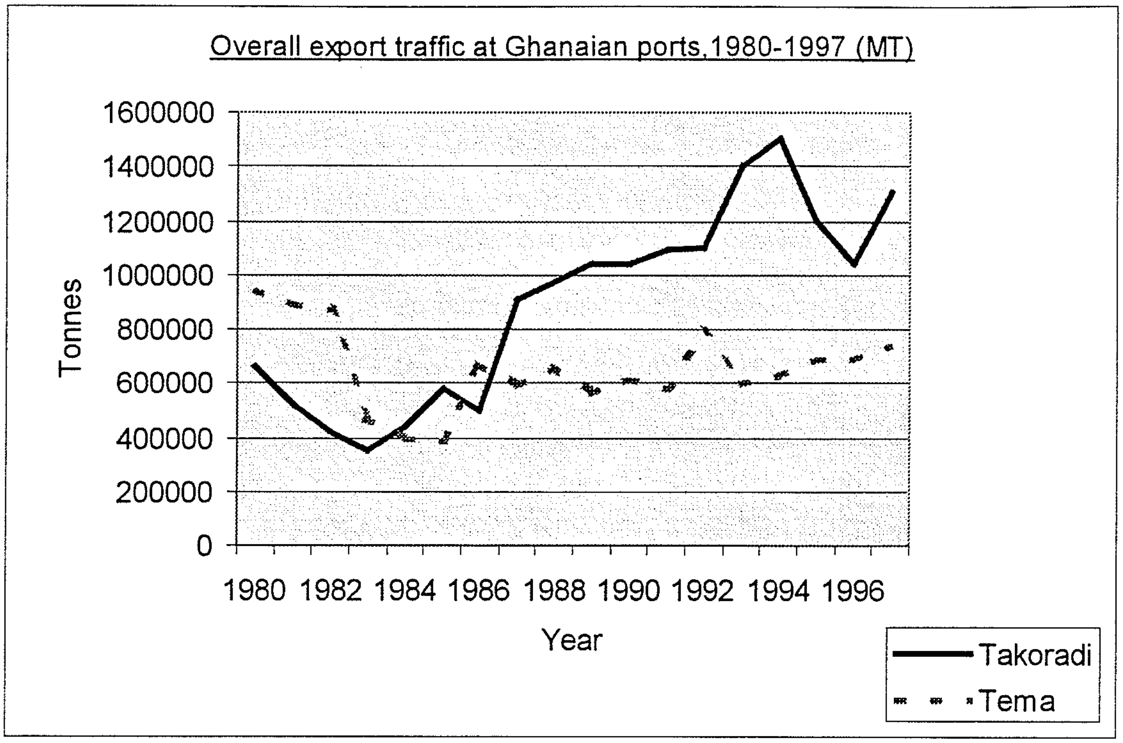
Figure 4.8



Source: Prepared from Ghana Shippers Council, 1996

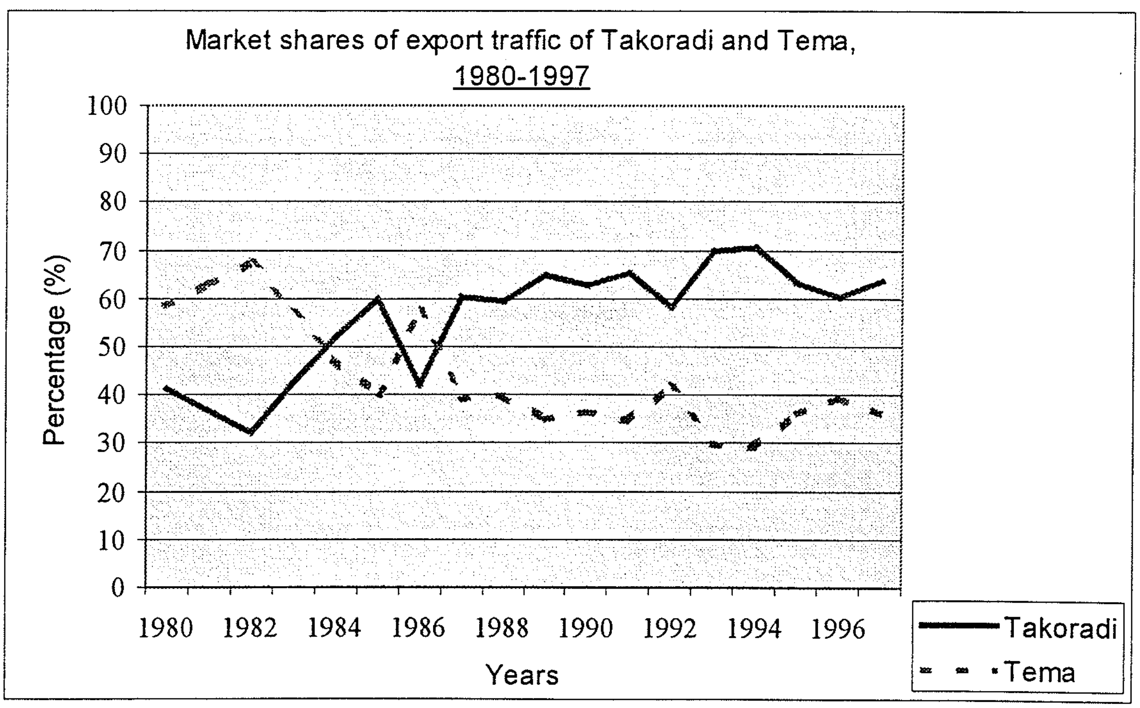
With respect to exports Takoradi's position is outstanding. In 1959, for example, it had almost 94 per cent of the entire export trade (Appendix IV). Tema, however, has been challenging this dominance; a challenge which was most telling in the 1980's (Figure 4.9). Between 1980-1983, for example, Tema's market share of the export market traffic of 59, 63 and 57 per cent surpassed that of Takoradi (Figure 4.10). Takoradi resumed its leadership from 1987. Figure 4.10 shows the market shares of the export traffic of the two ports.

Figure 4.9



Source: Data from MIS, Tema

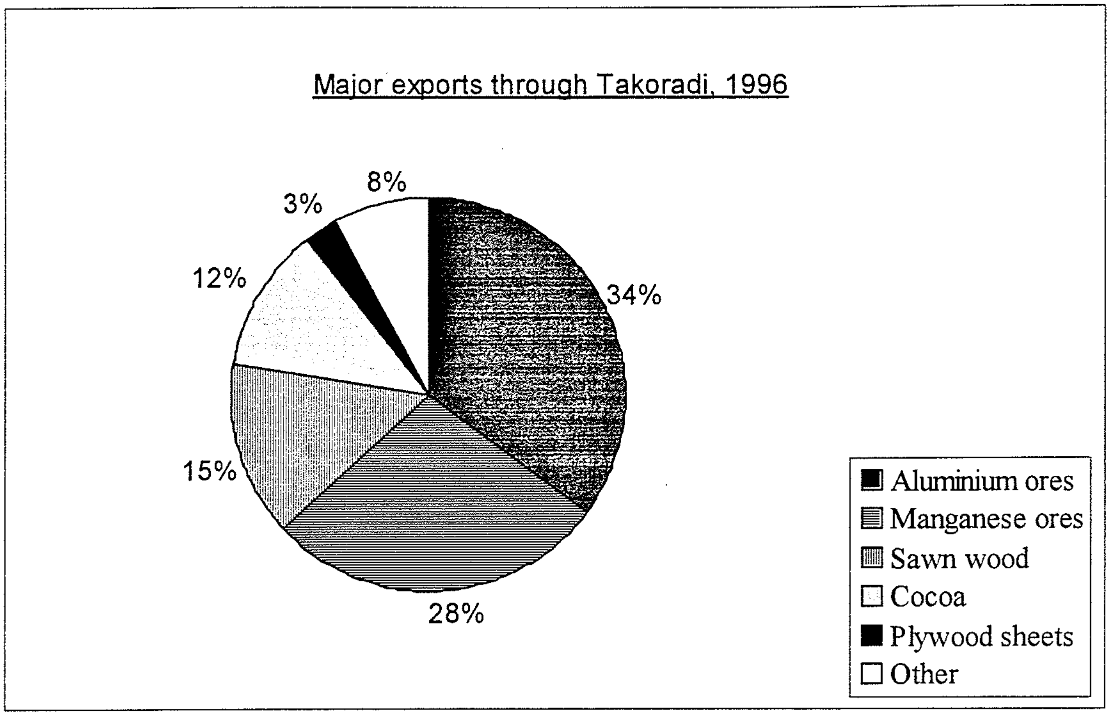
Figure 4.10



Source: Data from MIS, Tema

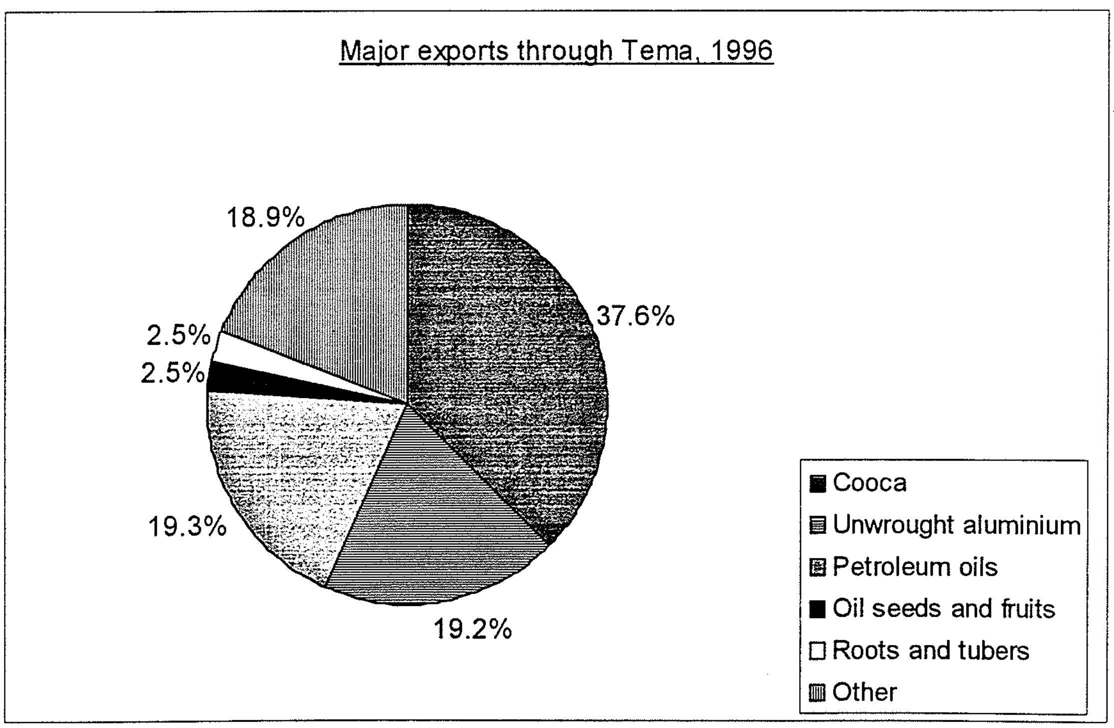
From Figure 4.10 we can appreciate the competition that occurred between Tema and Takoradi in the early years of the 1980s. Takoradi's dominance started again from 1987 through a policy directive from the Ghana Ports and Harbours Authority (GPHA). To prevent the stagnation of Takoradi, the GPHA used this policy instrument to restrict exports through Tema. Besides the policy instrument, another contributory factor is Takoradi's specialisation in the handling of bulk commodities such as manganese and bauxite. Of the forty-two items listed by the Ghana Export Promotion Council (GEPC) as the major exports through Takoradi, aluminium ores and concentrates (35.3 per cent) and manganese ore and concentrates (27.8 per cent) constituted about 63 per cent of the total export (Figure 4.11). The next three major exports were cocoa beans (11.9 per cent), sawn wood (14.5 per cent) and veneer and plywood sheets (2.6 per cent). Together, these three products accounted for 29 per cent of all exports from Takoradi. In effect, the top five exports – out of a total of 42 commodities listed by the Ghana Export Promotion Council (GEPC) as major exports from Takoradi – accounted for about 92 per cent of the total export tonnage. In the case of Tema the top five exports — out of a total of 118 commodities listed by the GEPC as major exports from Tema — accounted for 81.1 per cent of the total exports –These commodities are cocoa beans (37.6 per cent), unwrought aluminium (19.2 per cent), petroleum oils (19.3 per cent), oil seeds and oleaginous fruits (2.5 per cent) and roots and tubers (2.5 per cent). Unlike Takoradi where the top two commodities constituted 63 per cent of the total exports, at Tema the top two commodities constituted 56.8 per cent (Figure 4.12).

Figure 4.11



Source: Prepared from Ghana Export Promotion Council, 1996

Figure 4.12



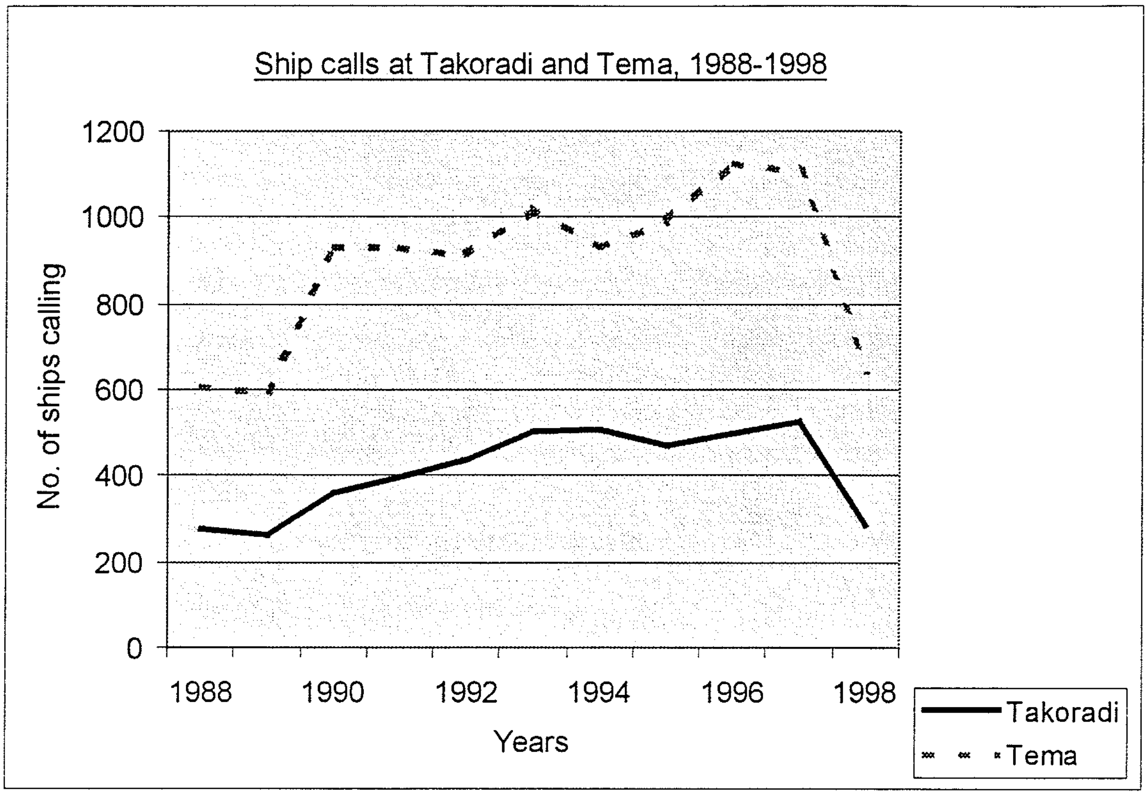
Source: Prepared from Ghana Export Promotion Council, 1996

A plausible deduction from these statistics is that a few commodities dominate the export traffic of both ports. In the case of Takoradi the export giants are manganese, bauxite, cocoa beans and wood products. What is more, four of the five major exports from Takoradi are raw materials whose modes of production have come under sharp criticism from both internal and external organisations, causing the government not only to review their mode of operation but to go so far as to ban the exportation of some, as in the case of logs. The policy has undoubtedly affected Takoradi's export traffic. As the port operations manager puts it, "the banning of logs export has seriously affected Takoradi's operations as logs export constitute one of the major export traffics of the port". Tema, on the other hand, has a more diversified portfolio.

4.4 Port performance comparison

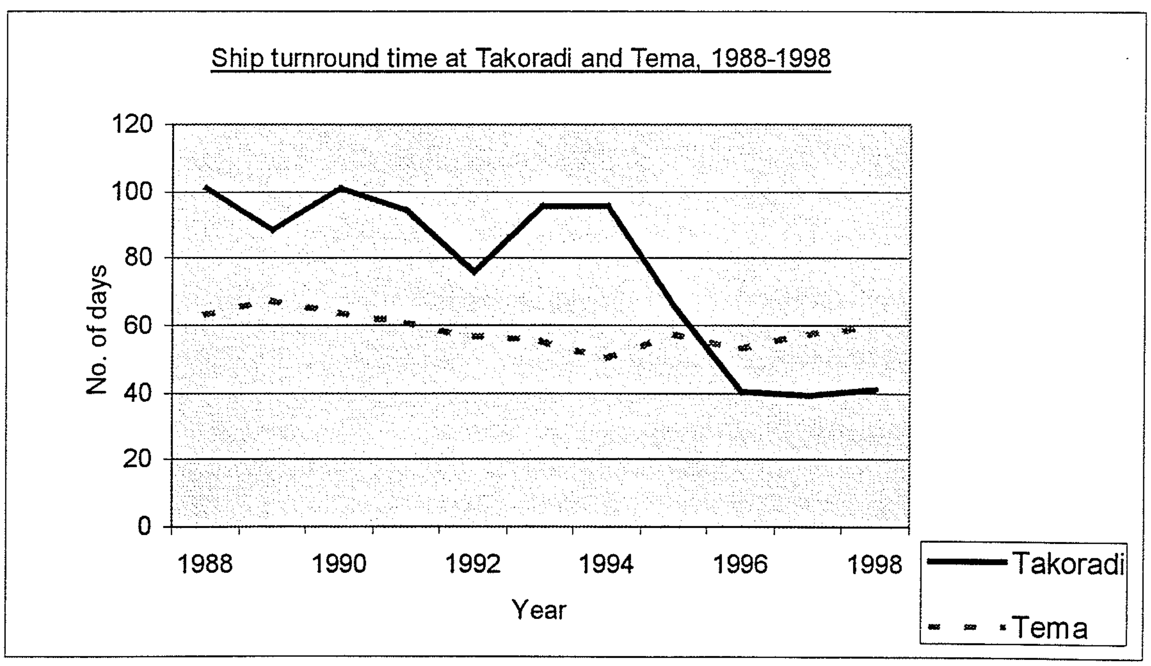
Port performance indicators, as already explained in Chapter Three are very crucial for effective planning and development of every port. In this section, I analyse the ports' performance indicators from 1988-1999. The analysis is restricted to the following physical and operational indicators; turnround time, ship calls, labour productivity, ship productivity, berth occupancy, gang hours and net registered tonnage. Figures 4.13 to 4.19 exhibit the indicators in graphical form. Figure 4.13-14 shows that Tema receives about two and half times more ships than Takoradi. Tema's peak period was 1996 when it received 1127 ships while Takoradi's peak occurred in 1997 with 527 ships. Despite its high number of ship calls, Tema still managed to turn round ships faster than Takoradi, until 1996. For the 1988-1998 period, Tema's average turnround time was 58.9 days as against Takoradi's 76.1 days. Figures 4.15-19 also show Tema ahead of Takoradi with respect to the other performance indicators. Now, the question is: to what extent do these performance indicators impact on overall tonnage of the ports? Put differently, what percentage of the ports' overall tonnage is explained or attributed to the ports' performance? The next section will be forthcoming with answers.

Figure 4.13



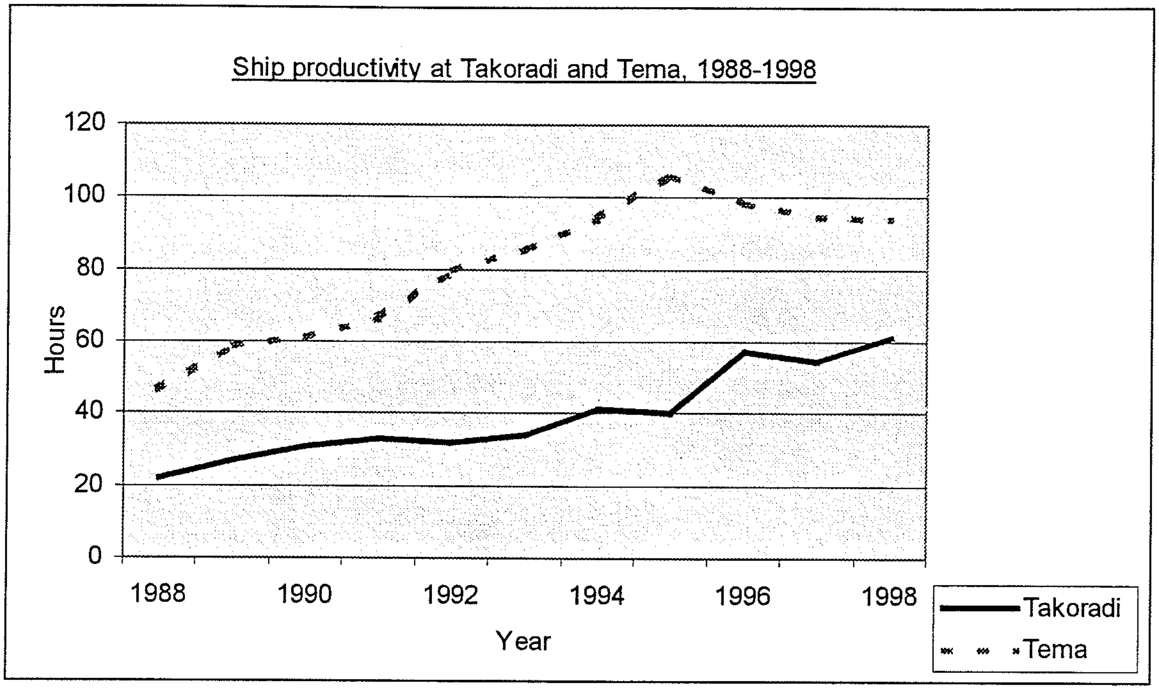
Source: Data from MIS, Tema

Figure 4.14



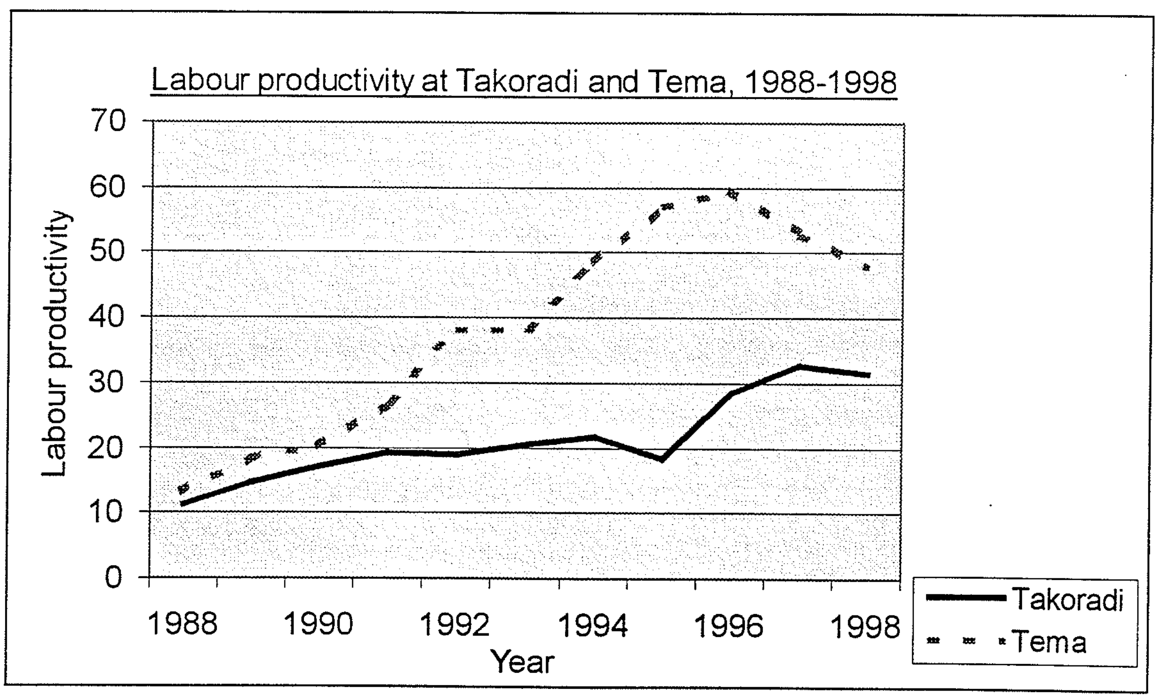
Source: Data from MIS, Tema

Figure 4.15



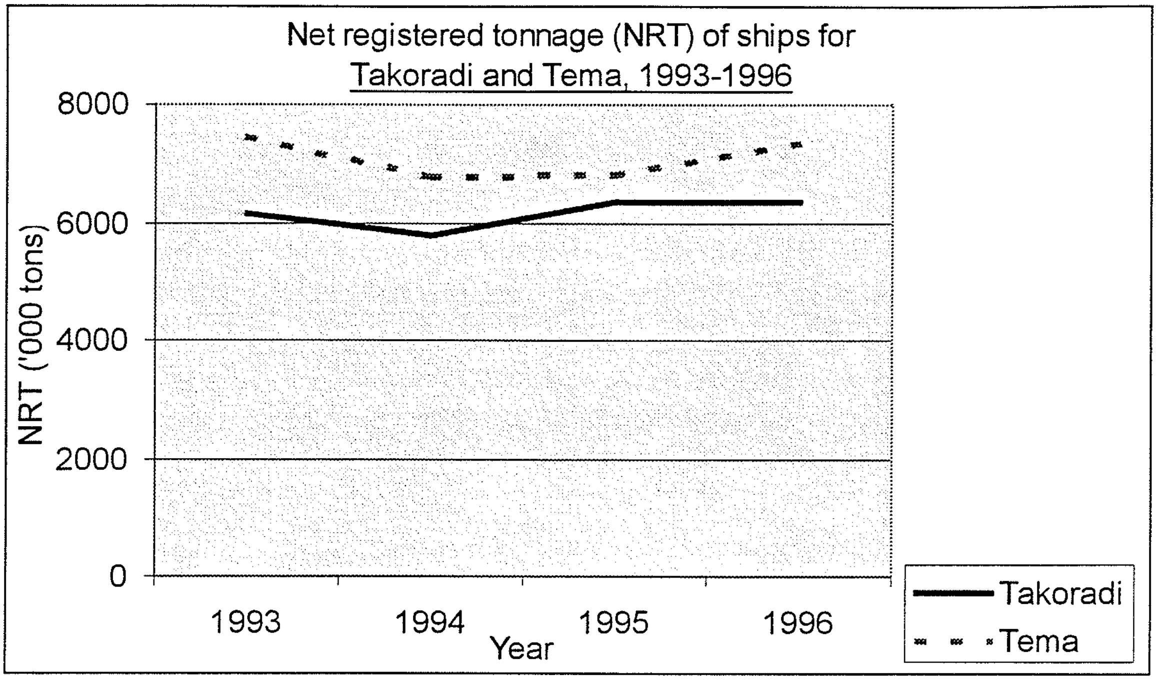
Source: Data from MIS, Tema

Figure 4.16



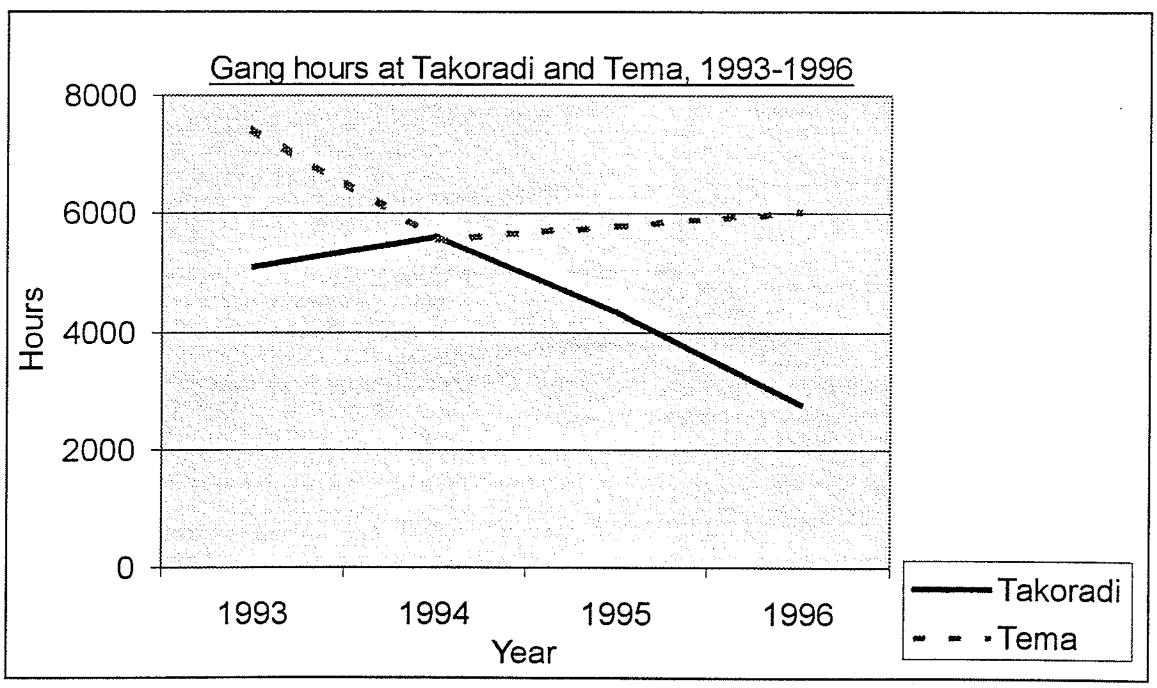
Source: Data from MIS, Tema

Figure 4.17



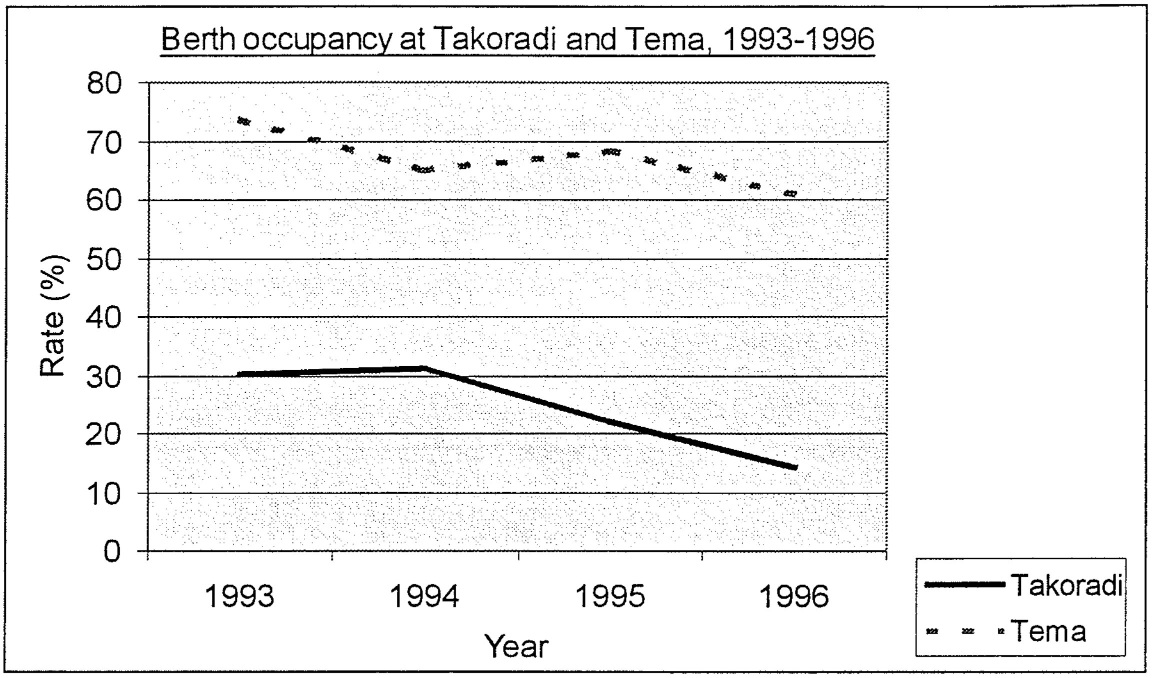
Source: Data from MIS, Tema

Figure 4.18



Source: Data from MIS, Tema

Figure 4.19



Source: Data from MIS, Tema

4. 5 Cargo tonnage and port performance: a synthesis

Having described the throughput statistics and the various port performance indicators, our task now is to attempt to establish a relationship between overall cargo tonnage and port performance. The statistical technique used here is the regression analysis. The analysis covers the 1993-1996 period (disaggregated on a monthly basis), the time for which data are available for all the required variables.

4.5.1 Evaluation of the regression results

4.5.1.1 Test of unit roots

A major precondition when dealing with time-series data is that they must be stationary[26]. A stationarity test was therefore performed using the Phillips-Perron (1988) test (PP-test) with a specification, which includes a constant, and a trend variable. The decision rule is that the data is stationary if the τ - and z -statistics are greater than the critical values at the chosen level of significance, which is 10 per cent in this case. The results are presented in Table 4.4 below.

Table 4.4

Phillips-Perron (PP-test) stationarity test results for Takoradi and Tema

Variable	τ -statistic *		z -statistic •		Conclusion
	Takoradi	Tema	Takoradi	Tema	
Overall tonnage	– 6.8363	– 7.2066	– 44.828	– 51.750	Stationary
Net registered tonnage	– 9.6457	– 6.5818	– 57.398	– 42.276	Stationary
Number of ship calls	– 5.8647	– 4.9165	– 41.349	– 32.022	Stationary
Ship turnround	– 4.8455	– 6.2619	– 32. 135	– 44.314	Stationary
Labour productivity	– 6.2815	– 5.7010	– 44. 654	– 39.658	Stationary
Berth occupancy	– 5.1927	– 3.9859	– 34.885	– 25.375	Stationary
Average gang hours	– 4.3890	– 5.8827	– 25.608	– 41.705	Stationary
Ship productivity	– 6.7519	– 6.3262	– 48.408	– 44.967	Stationary

* The asymptotic critical value at 10 % of the τ-test is –3.13.

• The asymptotic critical value at 10 % of the z-test is –18.2.

[26] Regression(s) based on non-stationary data tend to give spurious results. Consequently, inferences and conclusions derived from such regressions also tend to be erroneous and faulty. "A time series is said to be stationary if there is no systematic change in mean (no trend), if there is no systematic change in variance, and if strictly periodic variations have been removed. Most of the probability theory of time series is concerned with stationary time series, and for this reason time-series analysis often requires one to turn a non-stationary series into a stationary one so as to use this theory" (Chatfield, 1975:14).

The results presented in Table 4.4 indicate that all the variables are stationary, since the τ and z-statistics are all greater than the asymptotic critical values at 10%, which are –3.13 and –18.2. Consequently, we may reject the unit root hypothesis and use the levels of the variables in the analysis.

4.5.1.2 The regression results

The results of the regression of overall tonnage (OT) on the independent variables which have been corrected for autocorrelation[27] is presented in Table 4.5. A perusal of the P-values in Table 4.5 shows that only two of the variables —— ship calls and ship turnround —— are statistically significant at the 1 per cent level of significance. When the level of significance is raised to 10 per cent, gang hours become significant. Together, the three variables account for about 53 per cent of Takoradi's overall traffic. The remaining variables —— net registered tonnage, labour productivity, berth occupancy and ship productivity —— are statistically insignificant and thus have little or no impact on the port's traffic flow (cargo tonnage). In the case of Tema only labour productivity and gang hours are statistically significant at the 1 per cent significant level. The two variables account for about 38 per cent of Tema's overall traffic. The rest of the variables, as can be elicited from the Table 4.5, are statistically insignificant. The F-statistics indicate the simultaneous significance of all the variables at the 1 per cent level of significance. Takoradi has an F-statistic of 293.33 while Tema's is 387.67. Since the R^2 values are not very high, this may be taken to indicate the absence of a high degree of multicollinearity.

---

[27] The test for autocorrelation was done using the Durbin-Watson (DW) d test. Durbin-Watson value must be 2 or close to 2. The decision rule for the DW test is

$$d_u < d < 4 - d_u$$

where d = the DW test statistic from regression

d_u = upper limit of the DW d statistic critical value (from DW d test table)

Going by the decision rule, we find that both regressions are affected by autocorrelation. This is shown as follows:

For Takoradi: $d = 1.8494$, hence $d_u < d < 4 - d_u = 1.885 > 1.8494 < 2.115$

It can be seen that the left hand side of the inequality does not hold which indicates the presence of autocorrelation.

For Tema: $d = 2.5284$, hence $d_u < d < 4 - d_u = 1.885 < 2.5284 > 1.4716$

In the case of Tema, the right hand side of the inequality does not hold, which again indicates the presence of autocorrelation. See Appendix V for uncorrected regression results. Having corrected for autocorrelation the DW value is no more relevant, therefore, the DW values in Table 4.5 can be overlooked.

Table 4.5

Regression results of overall tonnage (OT) on the independent variables

Variable	Estimated coefficient		Standard error		T-ratio		P-value	
	Takoradi	Tema	Takoradi	Tema	Takoradi	Tema	Takoradi	Tema
Net registered tonnage	4.8040	6.2792	4.181	3.941	1.149	1.593	0.257	0.119
Ship call	2825.1	718.97	937.9	850.1	3.012	0.8457	0.004	0.403
Ship turnround	624.55	– 353.41	219.1	573.8	2.850	– 0.6160	0.007	0 541
Labour productivity	1841.2	3630.3	1370.0	1014.0	1.344	3.579	0.187	0.001
Berth occupancy	– 3.1682	– 874.07	694.4	1124.0	– 0.0045	– 0.7774	0.996	0.441
Gang hours	8.1837	28.436	4.403	6.578	1.859	4.323	0.070	0.000
Ship productivity	259.52	127.00	610.3	688.5	0.4252	0.1845	0.673	0.855

Adjusted R^2	F-statistic	Durbin-Watson
Takoradi = 0.5290	Takoradi F(8, 40) = 239.33	Takoradi = 1.8710
Tema = 0.3848	Tema F(8, 40) = 387.67	Tema = 2.1102
Rho (ρ)	**Degrees of freedom (Df)**	**Sample size (n)**
Takoradi = 0.00269	Takoradi = 40	Takoradi = 48
Tema = – 0.07460	Tema = 40	Tema = 48

Signs: We note in passing that all the statistically significant coefficients have the correct — positive — expected signs. Hence there is a direct relationship between overall tonnage and these variables.

4.5.2 Residual tests

Tables 4.6 and 4.7 summarises the results of the residuals tests (Normality, Equation specification error (RESET) and ARCH(P)) for both Takoradi and Tema.

4.5.2.1 Normality test[28]:

One of the assumptions underlying the classical linear regression model is that the error terms or residuals are normally distributed. Using the Jacque-Bera (JB) test, the test-statistic of 1.7479 with 2 degrees of freedom has a P-value of approximately 0.4500, which indicates that the residuals are approximately normally distributed. Tema's test-statistic of 2.0884 with 2 degrees of freedom has a P-value of approximately 0.4100. The residuals for Tema are also approximately normally distributed.

4.5.2.2 ARCH (p) test

With time-series data, it is pertinent to test for the twin problems of autocorrelation and heteroscedacity. The ARCH (p) model[29] is used for this purpose. The results indicate that the error variance is not affected by autoregressive conditional heteroscedasticity.

4.5.2.3 Reset test

This is a test for mis-specification of the regression equation, which is judged by the F-test statistic and the F-critical values. Tables 4.6 and 4.7 show these values for both ports. As is evident from the Tables, all the F-test statistics are less than the F-critical values at the 1 per cent significance level. Consequently we conclude that the model may not be affected by mis-specification bias or equation error.

---

[28] In the normality test a higher P-value - closer to 1.0 - is needed to reject the null hypothesis of non-normal residuals.

[29] The *ARCH (p)* model has the test statistic $nR^2 \sim \chi^2 p$ where n = number of observations and R^2 = coefficient of determination from the auxiliary regression of the square residuals on its different lags (Boame, 1998).

Table 4.6

Normality, equation specification error and ARCH (p) tests for Takoradi

Type of test	Test-statistic	Degree of freedom	P-value	Critical value (1%)	Conclusion
NORMALITY JACQUE-BERA	1.7479	2	≈ 0.4500		Approximately normally distributed
RAMSEY RESET					
RESET (2)	2.1926	F (1,39)		7.33	No mis-specification
RESET (3)	1.5981	F (2,38)		5.21	No mis-specification
RESET (4)	1.0403	F (3,37)		4.36	No mis-specification
ARCH (p)					
ARCH (1)	0.176		≈ 0.695		No autoregressive
ARCH (2)	0.3936		≈ 0.850		conditional
ARCH (3)	0.7584		≈ 0.895		heteroscedasticity

Table 4.7

Normality, equation specification error and ARCH (p) tests for Tema

Type of test	Test-statistic	Degree of freedom	P-value	Critical value (1%)	Conclusion
NORMALITY JACQUE-BERA	2.0884	2	≈ 0.4100		Approximately normally distributed
RAMSEY RESET					
RESET (2)	– 2.9524	F (1,39)		7.33	No equation error
RESET (3)	– 1.2225	F (2,38)		5.21	No equation error
RESET (4)	– 0.69308	F (3,37)		4.36	No equation error
ARCH (p)					
ARCH (1)	0.494		≈ 0.500		No autoregressive
ARCH (2)	0.7824		≈ 0.695		conditional
ARCH (3)	1.008		≈ 0.800		heteroscedasticity

4.5.2.4 Multicollinearity test

Multicollinearity is checked by using the Tolerance (*TOLj)* and the Variance Inflation Factor *(VIFi)*[30] tests from the auxiliary regressions. Below are the *VIFj* and *TOLj* values for both ports. The decision rule is that *VIFj* < 10 and *TOLj* approximately 1 but not 0, i.e $0 < TOLj \leq 1$.

Table 4.8

VIFj and TOLj for Takoradi and Tema

Variable	VIFj Takoradi	VIFj Tema	TOLj Takoradi	TOLj Tema
Net registered tonnage	1.3417	1.0134	0.7453	0.9868
Ship calls	1.8079	1.5858	0.5531	0.6306
Ship turnround	2.4820	1.3984	0.4029	0.7151
Labour productivity	3.9184	6.3898	0.2552	0.1565
Berth occupancy	4.0144	1.6072	0.2491	0.6222
Gang hours	4.3177	4.0193	0.2316	0.2488
Ship productivity	4.0016	2.4808	0.2499	0.4031

Table 4.8 affirms that the *VIFj* values for Takoradi — falling between 4.3177 and 1.3417 — are all less than 10, and the *TOLj* values — falling between 0.7453 and 0.2316 — are also not very close to zero. Tema's VIF_j values fall between 6.3898 and 1.0134 while its TOL_j values lie between 0.2488 and 0.9868. We thus conclude that the specification is not seriously affected by multicollinearity. Since even with near collinearity the OLS estimators are still BLUE and the problem of multicollinearity is a question of degree rather than the absence of it, we may accept the specification for our purpose.

[30] The *VIFj* is defined as, *VIFj* 0 $1/(1 - Rj^2)$, where Rj^2, is the R^2 in the (auxiliary) regression of *Xj* on the remaining (k - 2) regressors; Tolerance is defined as *TOLj = 1/VIFj* (See Boame, 1998).

4.6 Ghanaian and East African ports: throughputs comparison

Having described the Ghanaian ports vis-à-vis each other, we now place the two ports in a much wider context. In other words, I compare Takoradi and Tema with the East African ports of Mombasa and Dar es Salaam. Because of data problems the ports are compared on just three criteria; namely, overall traffic, container traffic and rate of growth. Using the shift-and-share methodology, we will assess which ports are growing faster and by extension, performing better. Table 4.9 shows throughput statistics for Takoradi, Tema, Mombasa and Dar es Salaam.

Table 4.9

Overall traffic at Ghanaian and East African ports, 1983-1993 (MT)

Year	Takoradi	Tema	Mombasa	Dar es salaam
1983	546352	1905974	6494000	3155000
1984	663000	1810000	6548000	3466000
1985	898000	2365000	6339000	3158000
1986	687000	2874000	6930000	3476000
1987	1271674	2898496	6918000	3601000
1988	1427577	3026125	6772000	3944000
1989	1497503	3310820	7238000	4000000
1990	1560709	3476687	7525000	3741000
1991	1639468	3647010	7144000	3857000
1992	1802690	3909661	7992000	4602000
1993	2123099	4130204	7989000	4485000

Source: MIS, Tema and Hoyle and Charlier, 1993

We see from Table 4.9 that in terms of overall traffic Takoradi and Tema are easily overshadowed by their counterparts in East Africa. If we consider the two regions as consisting of a single port system, Takoradi and Tema possessed just 4.5 and 15.8 per cent of the market share, respectively. Together, therefore, they had 20.3 per cent of the market share in 1983. The remaining 79.7 per cent was shared between Mombasa and Dar es Salaam, with Mombasa alone having as much as 53.7 per cent and Dar es Salaam having 26 per cent. On the other hand, Takoradi and Tema seem to be grew more than their East African counterparts. Tema, for example, is catching up with Dar es Salaam. In 1993, a decade later, Takoradi and Tema's portion of the market share were 11.3 and 22.1 per cent, respectively. These compare with 42.7 and 23.9 per cent for Mombasa and Dar es Salaam for the same year. Thus, Takoradi and Tema experienced an increase in concentration of 6.8 and 6.3 per cent, respectively, as compared with a decrease in concentration experienced by their East African counterparts, negative 11 and 2.1 per cent for Mombasa and Dar es Salaam, respectively. These changes are shown in Table 4.10.

Table 4.10

Change in concentration at Takoradi, Tema, Mombasa and

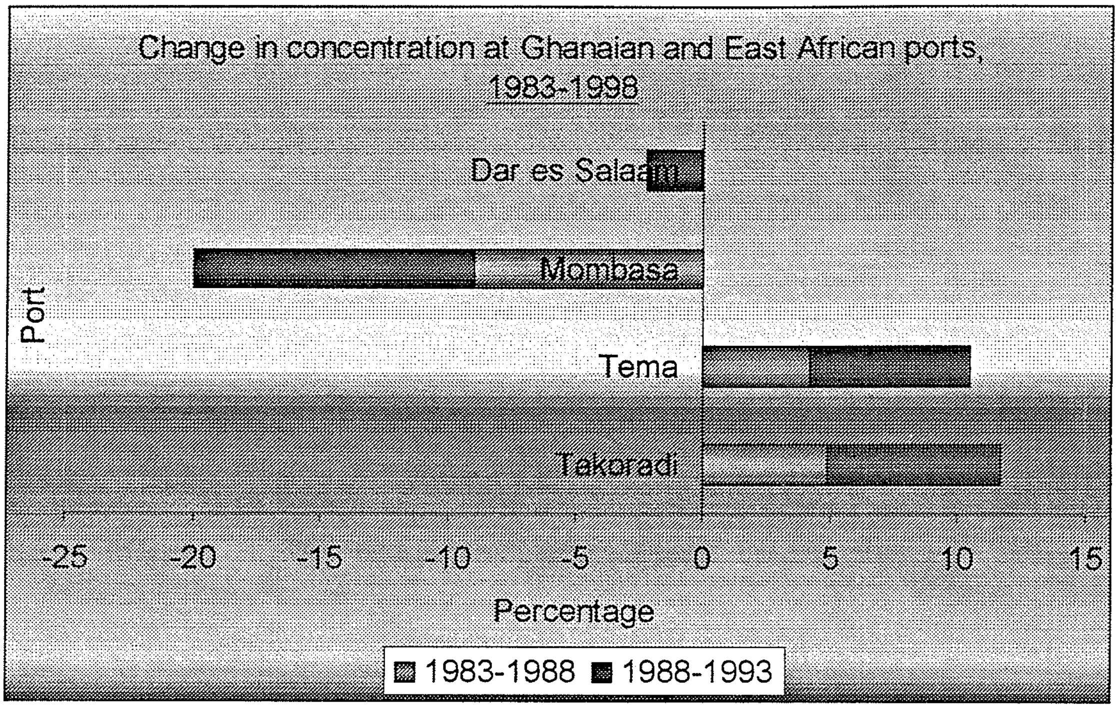
Dar es Salaam, 1983-1993

Year	Takoradi	Tema	Mombasa	Dar es Salaam
1983-1988	4.9	4.2	-9.0	-0.1
1988-1993	6.8	6.3	-11.0	-2.1

Source: Data from MIS, Tema and Hoyle and Charlier, 1995

The information implicit in Table 4.10 is made more evident in Figure 4.20. The Figure shows that the Mombasa and Dar es Salaam shares of the market have been falling steadily. The worse affected in this scenario is Mombasa. It had a negative growth rate of 9 per cent and 11 per cent in 1988 and 1993, respectively. The winner in all this was Takoradi, with a growth rate of 4.9 and 6.8 per cent in 1983 and 1993, respectively. Tema follows Takoradi with a growth rate of 4.2 and 6.3 per cent within the study period. Dar es Salaam took the third position with a negative growth rate of 0.1 and 2.1 per cent.

Figure 4.20



These changes in concentration can be made explicit by translating them into absolute terms using the shift-and-share technique discussed in the previous chapter. Stated differently, this procedure attempts to calculate the difference between the actual tonnage of a port in 1993 and the hypothetical figure showing what the tonnage would have been if the port had grown at the system's[31] rate between 1983-1993. The result[32] shows that if Takoradi had grown at the system's rate its tonnage in 1993 would have been 845,460.56 tons (hypothetical growth) instead of 2,123,309 tons. This means Takoradi had a comparative gain of 1,227,638 tons. Tema's hypothetical growth was 2,949,573.675 tons. Tema thus had a comparative gain of 1,180,630.325 tons. Dar es Salaam, on the other hand, had a hypothetical growth of 4,882,493.122 tons, which makes its comparative loss to be –397,493.12 tons. Mombasa also registered a comparative loss of –2,060,733.9 tons, having had a hypothetical growth tonnage of 10,049,733.86 tons.

[31] The system here is defined as consisting of the Ghanaian port system plus the East African port system.
[32] See Appendix V for detailed computations.

The impressive growth rate of Takoradi and Tema notwithstanding, the fact still remains that Mombasa and Dar es Salaam enjoy throughputs larger than their Ghanaian counterparts, as evidenced in Table 4.10, though Tema seems to be rubbing shoulders with Dar es Salaam, especially after 1990. Takoradi's overall throughput, however, is about half that of Dar es Salaam and one-third that of Mombasa.

With respect to container trade, Takoradi and Tema are still minor players compared with Mombasa and Dar es Salaam. Table 4.11 shows the container traffic for Mombasa, Dar es Salaam, Takoradi and Tema.

Table 4.11

Container traffic at Ghanaian and East Africa ports, 1991-1993 (MT)

Year	Takoradi	Tema	Mombasa	Dar es Salaam
1991	66792	501567	1390000	840000
1992	62723	604496	1420000	858000
1993	75217	630516	1567000	1091000

Source: MIS, Tema and Hoyle and Charlier, 1993

As Table 4.11 reveals, the Ghanaian ports, most notably Takoradi lag behind their counterparts in East Africa. In 1993, for example, while the two East African ports recorded container traffic of over a million tonnes — Mombasa (1567000), and Dar es Salaam (1091000) — Tema recorded 630516 while Takoradi managed just 75217.

4.7 Summary

This chapter has described the throughput and performance indicators of the two Ghanaian ports of Takoradi and Tema. Analysis of the throughput statistics shows Tema ahead of Takoradi in almost all the criteria with the exception of exports. Even this is a little misleading; Takoradi's leadership in exports, as we noted, is owed to a government policy which restricted exports through Tema. What is more, Takoradi's exports are bulky products — bauxite, manganese and timber — which have the tendency to exaggerate its total tonnage. With respect to performance, Tema was again ahead of

Takoradi in all the indicators. It must be pointed out, however, that from 1996 Takoradi began turning round ships faster than Tema.

The results of the regression analysis, which was performed to investigate the impact of the performance indicators on total tonnage, revealed that Takoradi's performance explained 53 per cent of its tonnage as against Tema's 38 per cent though Tema's performance were comparatively better than Takoradi's. Now, the question that begs to be answered is this: Why does Tema enjoy a higher overall traffic than Takoradi when its performance indicators accounts for only 38 per cent of its output? Again, why do the East African ports continue to have much larger throughputs than their Ghanaian counterparts when the Ghanaian ports are performing better than them on the shift-and-share analysis. As we noted in the first chapter, a port's overall tonnage (OT) is a function of its performance (P) and hinterland (H), which can be rendered mathematically as $OT = P + H$, which can be re-arranged as $H = OT - P$. Thus, the answer to the question posed above seems to lie in their hinterlands. This being the case we now turn our attention to the hinterlands of the ports, the subject of Chapter Five.

CHAPTER FIVE

THE PORTS AND THEIR HINTERLAND

5.0 Introduction

In Chapter Four we discussed the throughput statistics and the performance indicators of the ports as well as the impact of performance on overall tonnage. Results of the regression analysis of performance on overall tonnage indicated that Tema's performance contributed only 38 per cent to its overall tonnage compared with Takoradi which performance accounted for 53 per cent per cent to its overall tonnage. We also noted, with respect to rate of growth, that Takoradi and Tema performed better than Mombasa and Dar es Salaam. However, the proviso needs stressing: the volumes of the Ghanaian ports fell short of those handled by the East African ports. The hinterlands of the ports provide likely reasons accounting for these tonnage differences. In this chapter, therefore, I discuss the hinterland of the ports, paying particular attention to the distribution and pattern of economic activity and the transport network connecting the ports to their hinterlands. Takoradi and Tema are considered first.

5.1 The Ghanaian hinterland

5.1.1 The distribution and pattern of economic activity

The specialisation of the ports in their traffic handling has been described as a logical conclusion of the hinterland links and the distribution of economic activity in the country (Hilling, 1975). Naturally, therefore, the issue arises, as to the distribution and pattern of economic activity in Ghana and, by extension, the mode and means whereby this activity is linked to the ports. I now discuss the distribution and pattern of economic activity of Ghana.

5.1.2 The mineral deposits

Four principal minerals are exported from Ghana; namely, gold, diamond, manganese and bauxite. The bauxite deposits occur in most hill tops in the country. The earlier largest discovered deposits were those on top of Mountain Ejuanoma at Nkawkaw and Kibi in the Eastern region, Yenahin in the Ashanti region and Awaso in the Western region. Despite their early discovery (1921), development of the deposits did not start until 1941 when, as a result of the German invasion of France, Britain's main source of supply was cut off. In addition, the mechanisation – the introduction of excavators, aerial ropeways, diesel dumpers, crushing and washing machines – of the mining process and the completion of the railway line from Dunkwa-on-Ofin to Takoradi in 1944 are considered as further catalysts to bauxite development in the country. The largest of the bauxite deposits occurs at Awaso.

The manganese deposits occur in Birrimian rocks. The largest and richest deposits of the mineral are at Nsuta in the Western region, where they are found in two parallel ridges. The Nsuta deposit is the largest deposit and the only one being mined at the moment. Other deposits exist between Takoradi and Axim, but these are not mined at the moment. At Nsuta, manganese occur mainly as a carbonate, the top layers of which have weathered into oxides, of which some 27 million tonnes have so far been produced. In 1956 production reached 750 000 tonnes but this fell steadily to 300 000 tonnes in 1984. Production was 340 000 tonnes in 1997. With the exhaustion of the oxides, attention is now being turned to the carbonates which are, by a new process, being converted into oxides. Mining is very simple. The top soils of the ridge in which they occur are removed from the ridges in which the deposits occur and the exposed mineral-bearing rock broken up with dynamite. With the use of mechanical shovels the debris are collected and dumped into small railway trucks, washed and then sent to Takoradi by rail for export.

Principal gold bearing areas include the Ankobra and Ofin river areas around Prestea, Tarkwa, Obuasi, and Konongo. With the exception of the Ankobra and Ofin deposits, which are dredged, mining is by the open-cast and underground methods. In the case of diamonds, they occur in many parts of the country but the principal deposits are found at Birim field, the Bonsa field, the Dunkwa-Jimi field and the Nyamfoman field. Production in the Dunkwa-Jimi field stopped in 1978.

5.2 Agriculture

Among the many crops grown and exported from Ghana are cocoa, oil palm, sheanut, coffee, pineapple, kola nut, tobacco, yams, cassava and rubber, to mention just a few. Cocoa is the most important of all the cash crops. It accounts for about two-thirds of the country's foreign exchange. Cocoa is grown almost everywhere in the forest region, but the maximum cocoa growing areas are found within a belt that extends from Sunyani in the Brong-Ahafo region to Swedru in the Central region. This belt covers the following growing centres:

1. The Ahafo district with Bechem, Hwidiem, Goaso, Kukuom and Tepa as buying centres;
2. The central districts of Ashanti Region;
3. The roughly triangular piece of land lying across the Eastern and Central Regions and with Asamankese, Akim Oda and Agona Swedru at the corners.

The cocoa hinterland is shared between the two ports even though Takoradi could have dominated this hinterland with ease had the authorities thought it fit to provide good direct transport links between it and the cocoa-producing areas. For this reason, cocoa from the highly productive areas in the west-central part of the country is moved to the collecting centre in Kumasi from where it can be moved with equal facility to either Takoradi or Kumasi, depending on availability of port space[33] (Hilling, 1975).

Coffee is the second major cash crop after cocoa. The exportation of coffee started in the 1850s. The main producing areas are western Brong-Ahafo Region, Sefwi in the Western Region, southern Ashanti region, the Hohoe area in the Volta Region and the Nkawkaw area in the Eastern Region. The rubber industry has not been as successful as the cocoa and coffee industry. The main rubber growing areas are found around Dompin, Manso, Amenfi, and Enchi, all in the Western Region. The State Farms Corporation (SFC) also own rubber plantations in Avrebo, Nsuaem and other places in the Western Region. Palm oil has also gained prominence as an export crop of late. The export of palm oil and palm kernels especially from southern Ghana, gathered momentum during the first half of the

[33] Interview with officials at the cocoa shed, port of Tema.

nineteenth century as a replacement for the slave trade. The main oil palm belt extends from Asesewa in the Eastern Region to Aiyinase in the Western Region.

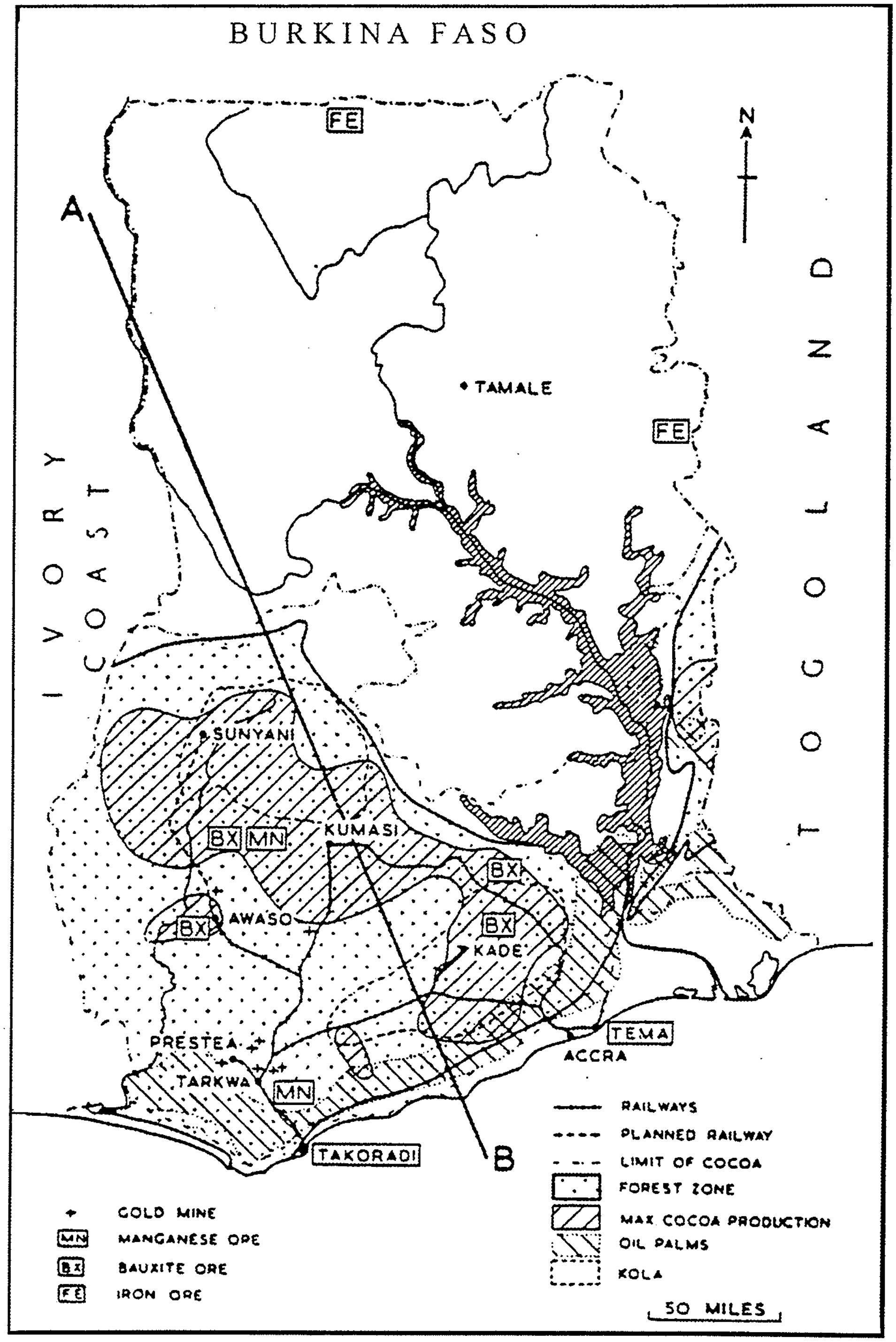
5.3 The forest areas

The timber industry has been a major source of foreign exchange since the nineteenth century. Initial exports of timber were small, beginning with about 84,950 cubic metres in 1888, but this increased gradually. From 1973, however, there was a drop from over one million tons to about 90, 000 tons in 1984. The Western Region is the oldest and still the largest producer of timber in the country. During the surf ports days the logs were floated down the Ankobra, Tano, and Ofin-Pra Rivers to Axim, Half Assini and Shama for shipment. Takoradi is now the main port for timber export.

The remaining forest areas did not witness any appreciable development in the timber industry due to the absence of adequate land transport and of large swift rivers on which the logs could be floated down to the coast. The Eastern and Central Regions, for example, began to produce timber on an appreciable scale only when the Accra-Kumasi and the Huni Valley-Kade railway lines were completed. With these new transport networks timber could be transported easily to Takoradi and Accra. The timber industry is managed by private companies, which export not more than a dozen of the large number of species of trees in the forest. The principal timbers, arranged in descending order of importance, are *wawa* or *obeche, sapele, mahogany, utile, kokrodua* and *makore.* The method of operation is fairly simple. The trees are felled by hand saw and axe, cut up into logs *in situ* and with the help of caterpillar tractors dragged to a prepared clearing site and then transported to the port for final shipment (Dickson and Benneh, 1984). Figures 5.1 and 5.2 show the distribution of agriculture and mining areas of Ghana.

Figure 5.1

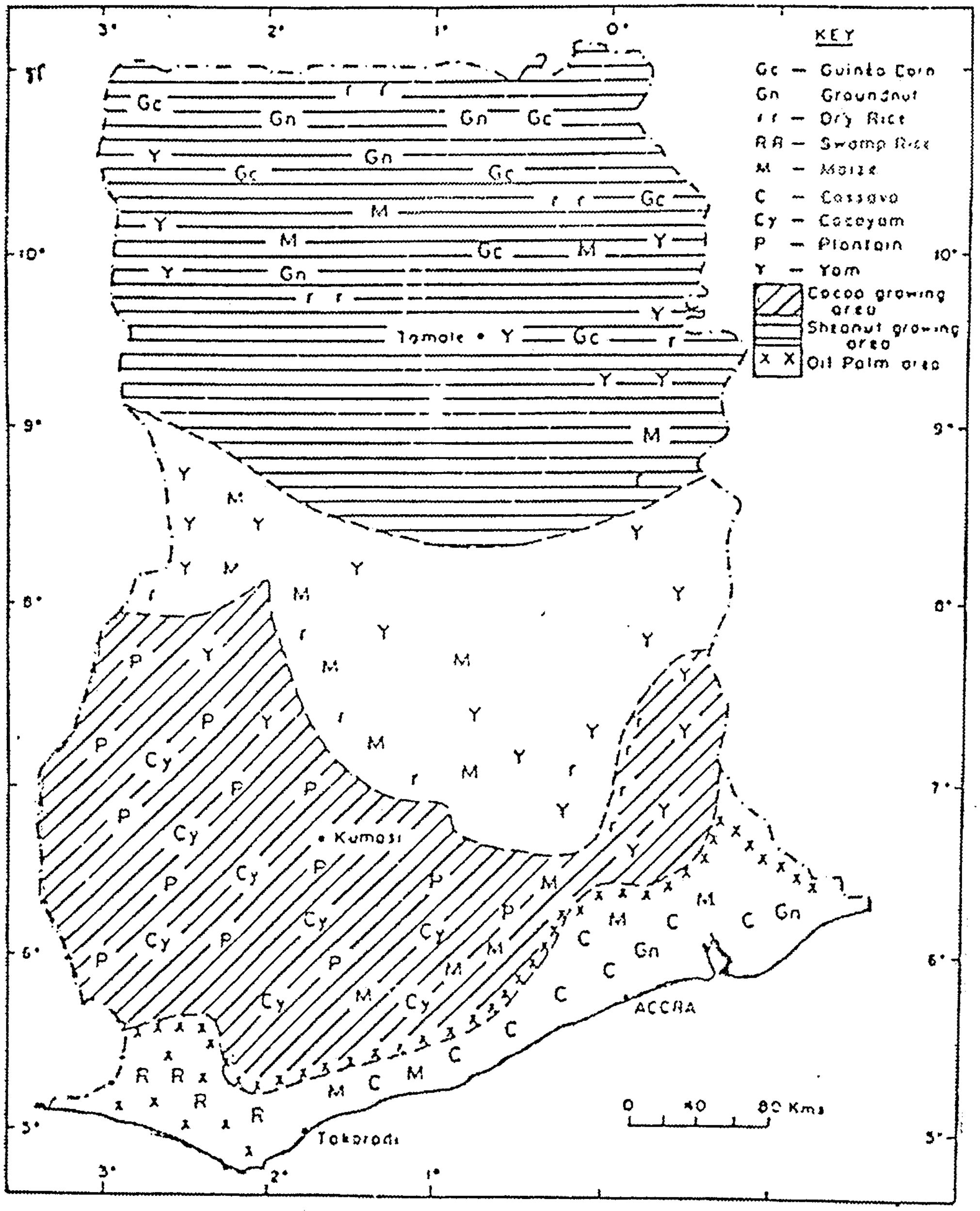
Ghana – Agriculture and Mining



Source: Hilling, 1970

Figure 5.2

Ghana - Commercial Agriculture



Source: Hilling, 1970

Having described the distribution and pattern of economic activity of the country the appropriate question to ask now is: how is this economic landscape shared between Takoradi and Tema? Using the 1996 export data (core crops and minerals) I attempt an answer to this question. The statistics are from the Ghana Shippers Council, 1996. An export is considered as belonging to the hinterland of a port if that port receives 70% or more of the market share of that export. It is considered a shared or competitive hinterland if the market share for both ports is even or differs by 20 per cent or less. The selection of these figures is arbitrary. Figures 5.3 a- l show the percentage shares of the core exports of Takoradi and Tema.

Figure 5.3a-d

<u>Percentage shares of core exports – Takoradi and Tema</u>

Figure 5.3a

The cocoa hinterland

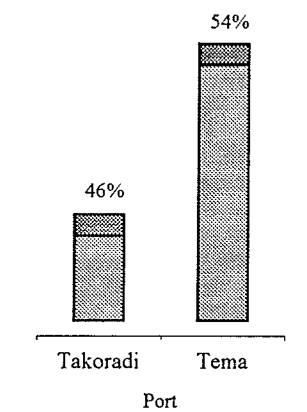


Figure 5.3b

The coffee hinterland

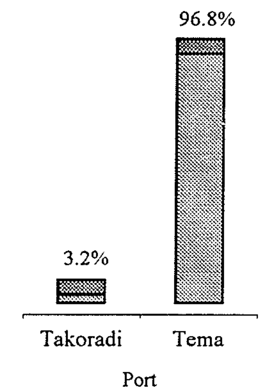


Figure 5.3c

Foodstuffs hinterland

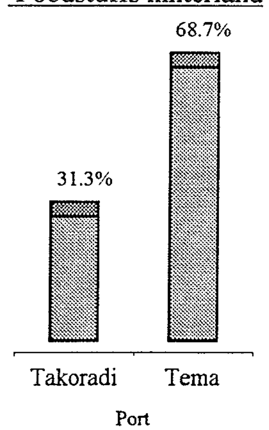


Figure 5.3d

The pineapple hinterland

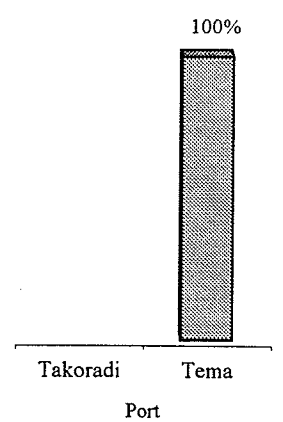


Figure 5.3e-h

Percentage shares of core exports – Takoradi and Tema

Figure 5.3e
The sheanut hinterland

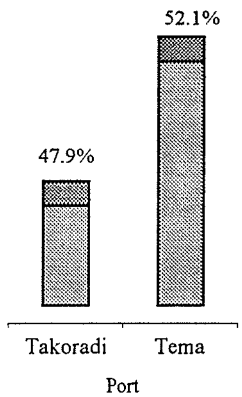


Figure 5.3f
The timber/lumber hinterland

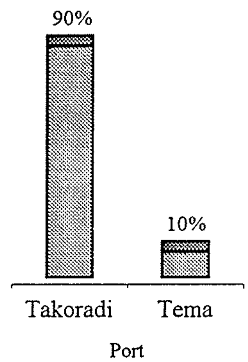


Figure 5.3g
The rubber industry

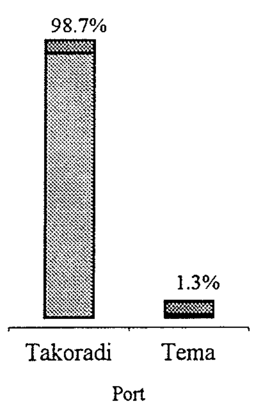


Figure 5.3h
The mineral hinterland
(Bauxite and Manganese)

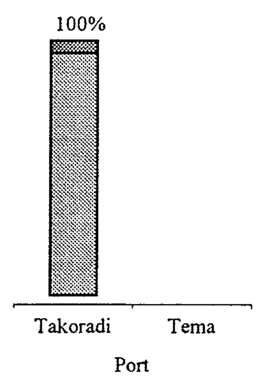


Figure 5.3i-l

Percentage shares of core exports – Takoradi and Tema

Figure 5.3i

The petroleum hinterland

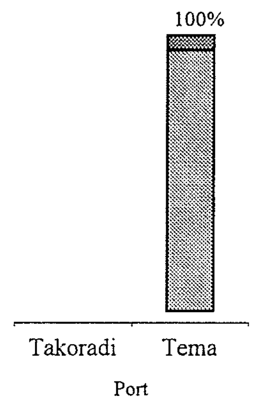


Figure 5.3j

The oil palm hinterland

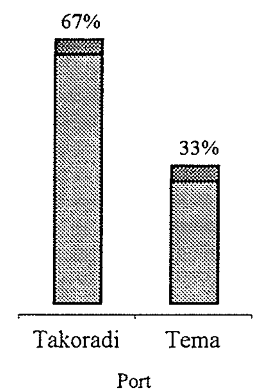


Figure 5.3k

The cola nut hinterland

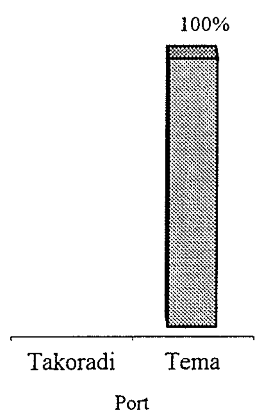
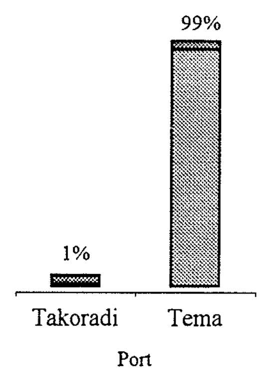


Figure 5.3l

Other non-traditionals hinterland



From the Figures 5.3a-l we can draw the following conclusions. First, each of the two ports still controls its natural hinterland, which is region 1 for Takoradi and region 2 (Hilling, 1970) for Tema. This is due to the monopoly both ports have on those traffics found in their natural hinterlands, monopoly reinforced by their handling equipment. Thus, Takoradi is specially equipped with facilities for handling dry bulks such as minerals and timber while Tema is equipped with facilities for handling wet bulk such as petroleum products. Apart from the competitive hinterlands of cocoa and shea nuts, Tema dominates the rest of the hinterland — cola nut, pineapple, coffee, local foodstuffs and other non-traditional crops — which mostly lie in regions 3 and 4 (Hilling, 1970). Even for the competitive hinterlands of cocoa and shea nuts, Tema has a larger share — 54 and 52.1 per cent as against 46 and 47.9 per cent for Takoradi. Evidently, then, without any shadow of imagination, it can be concluded that Tema now controls the regions 3 and 4, a factor contributing to its leading stand in the market share of the overall tonnage. Nonetheless, we must recognise that like all hinterland demarcations the result is necessarily subjective, but reasonably accurate, based on the writer's knowledge of Ghana gained from reading and as a native of the country (Hoyle, 1967).

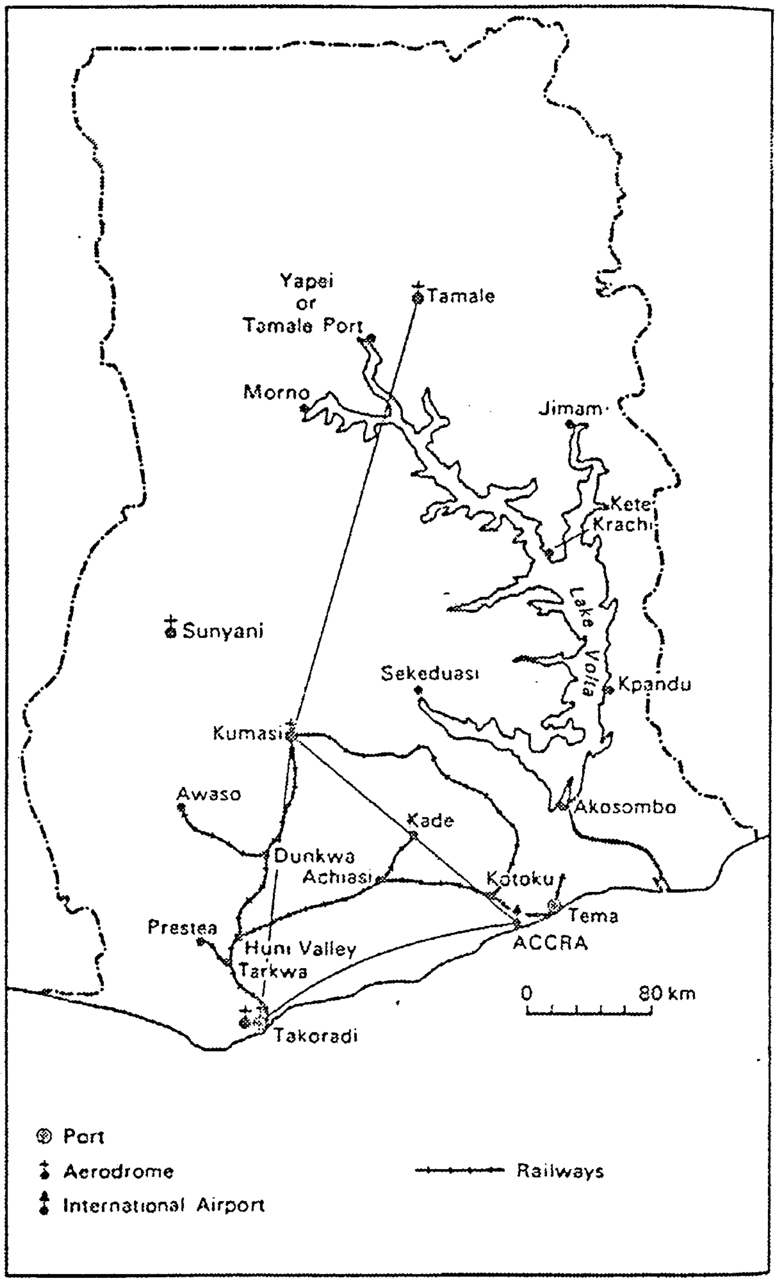
Let us now examine some problems and factors that have contributed to the current hinterland structure of the ports. One of the contributing factors to the current hinterland structure is the transport network linking the ports and the interior. Takoradi is predominantly a railway port while Tema is a road port. Takoradi's reliance on the railway is borne out by the port's handling of bulky cargo like bauxite and manganese. In 1983, about 80 per cent and 40 per cent of Takoradi's cocoa and timber was also carried by the railway (Mensa, 1993). The railway network centres on 3 principal lines in the pattern of a rough letter 'A' or triangle. The apex of the system is in Kumasi, the capital of the Ashanti region, and the bases end in Takoradi (Western Line - WL) and Accra/Tema (Eastern Line - EL). The WL, which is the oldest begun in 1898 from Sekondi, reached Tarkwa in 1901, Obuasi in 1902 and Kumasi in 1903. The Tarkwa-Prestea branch line was completed in 1911. The EL, which was started in 1909 and completed in 1923, runs from Accra to Kumasi. The Central Line, which was completed in 1927, forms the bar of the triangle and runs from Huni Valley on the WL to Kotoku Junction on the Eastern Line.

There are also three major branch lines, of which two connect the WL; the first, from Dunkwa to the bauxite mine at Awaso (about 75 km) and the second from Tarkwa to the gold mine at Prestea (about 30 km). The third branch line to Kade (about 40 km) is connected to Achiasi Junction on the Central Line. The network, which has a total length of about 947 km, is of single-track metric gauge (1067 mm) with the exception of about 30 km of double track between Takoradi and Manso, which is justified by the relatively high traffic density between the two towns. The network is shown in Figure 5.4 below. A combination of factors has plagued the railways, causing Takoradi to lose a significant portion of its hinterland. These factors are discussed below.

One main problem besetting the railways is the old and meandering nature of the network. As most of the railways were built during the colonial era, they follow river courses — which was the cheapest technology at the time — making the railways winding and dangerous to travel on. At the moment 40 per cent of the WL is on curves and many have a radius as low as 150 metres. The steepest gradients are 1.25 per cent on the main line and 2.5 per cent on the branch line. What is more, poor design and inadequate drainage have made most of the lines subject to flooding during the rainy season as they lie in valleys. In addition, in some of the stations, the length of the crossing loops do not exceed 400 metres, limiting operations to trains exceeding 30 commercial wagons. The entire rolling stock fleet uses a vacuum brake system, another factor that limits the train's length. Ghana railways have not yet adopted dynamic braking. On the WL there are about 1440 sleepers per kilometre, with most of the sleepers being made of timber rather than steel. The absence of the culture of maintenance has also meant the rapid decay of the sleepers with the upshot of derailments of trains (DanRail Consult AS Consortium, 1996). Because of these problems, speed limits of as low as 8 kilometres per hour are in force over large segments of the track. This speed limitations notwithstanding, poor track conditions accounted for 55 derailments in 1994. An additional seven collisions arose as a result of human error in the train control system (Intermodal Transport Study, Vol. 1, 1996).

Figure 5.4

The railway network of Ghana



Source: Benneh and Dickson, 1984

Besides the physical and technological problems, the railway also is faced with an economic problem, which comes in the form of competition from road hauliers, especially in the carrying of cocoa and timber. The inability of the railway to compete with the road hauliers has been due to their high rates in comparison with those of the road hauliers. The road hauliers can afford to charge lower fares as they have the advantage of taking cargo on their way back from Takoradi. The trains, on the other hand, have to return with empty wagons, hence the umcompetitivenes of the railways. Moreover, most of the sawmillers have acquired their own transports and thus do not use the railways[34]

Furthermore, the railway corporation is plagued with managerial and administrative problems. For example, the accounting systems of the Ghana Railway Corporation (GRC) is deemed too elementary to provide any useful information for meaningful corporate and business planning. Unsurprisingly, the GRC's operating losses continue to mount. The corporation's operating loss increased from ¢1,009 million in 1990 to ¢10,810 million in 1993 and to about ¢14 million in 1994[35]. Foreign debt service made up 60% of GRC's expenses and the biggest contributor to its operating losses. This was followed by staff costs (25%) and fuel costs (10%). As a result of these problems plaguing the railways, and it being the major transport network feeding the port, Takoradi has been cut off from a large portion of its real and potential catchment areas, thus seriously affecting its output levels.

Takoradi could not find consolation in its road network either, since roads in the Western Region, Takoradi's tributary, are among the poorest in the country (Ghana Haulage Truck Drivers Association (GHTDA))[36]. Though the drivers acknowledge recent improvements in the road sector as a result of the rehabilitation exercise undertaken by the government, they are quick to add that the exercise concentrated on the main trunk roads, leaving the feeder roads untouched. Thus there are still connectivity problems between the inland production centres and the buying centres. Consequently, only ten-ton trucks are used to carry the products from the production centres to the buying centres, from where the heavy-duty articulated trucks can then transport them to the ports. This problem, according to the drivers, is very discouraging and has caused loss of interest on the part of drivers to go to the port. In large part, therefore, Takoradi's low tonnage problem can

[34] Conversation with the railway deputy traffic manager operations - Mr. Sankah
[35] $US 1.00 = ¢1500.00 (1994)
[36] Information based on discussion with the GHTDA.

be seen as a reflection of its connectivity problems with its hinterland. Indeed, the distance between Kumasi and Takoradi is shorter than between Kumasi and Tema; yet port users prefer to use Tema rather than Takoradi[37] This finding is supported by Mensa (1993). He noted that the cost of transporting a log from Kumasi to Takoradi was three times as much as it was to transport the same log to Tema. Compounding matters was the inconvenience of the drivers having to go to Takoradi via Accra because of the poor condition of the shorter links to Takoradi. In fact, such was the near atrophy of Takoradi — losing its export hinterland — that the GPHA had to intervene with a policy in 1987 to restrict exports through Tema. Thus, the deterioration of Takoradi's transport network has been a significant contributing factor to the port's low throughput figures.

Tema, on the other hand, has been insulated from the railway problem, as it is completely road dependent. Tema is linked to its hinterlands by relatively better roads than those serving Takoradi. Tema's trade was further boosted by the construction of the Kumasi-Nsawam road and the construction of small river ports on Lake Volta. Some sheanuts, cashew and cotton seeds now move from the Northern and Upper East and Upper West regions through the Buipe river port to Akosombo from where they are transported via trucks to Tema. Alternatively, they can be transported via the Kumasi-Nsawam road to Tema.

With Kumasi as a major collecting centre for cocoa, and the existence of a relatively better road network between Kumasi and Tema, much of the cocoa traffic now goes to Tema. Cassava chips also come from the Volta region to Tema via the primary road that connects Tema to the north and lies along the country's eastern border. Yams also come from the Northern, Upper East and Upper West regions through either the lake or Kumasi to Tema. Tema also receives yams from as far as Sunyani and Techiman in the Brong-Ahafo region. Timber is also delivered from Mim in the Western Region, and Kumasi, Sunyani, Kete Krachi and Hohoe in the Volta Region. Other traffic such as coconuts, cocoyam, bamboo, tiger nuts, palm kernel, coffee, and maize move from the Western, Central and Brong-Ahafo Regions to Tema. The irony is that about 99 per cent of the traffic from the Western, Central and Brong-Ahafo regions could have gone to Takoradi were the transport network, especially the railway, efficient, for these regions are closer to Takoradi than to Tema[38]. Figure 5.5 (insertion) shows the road network of Ghana.

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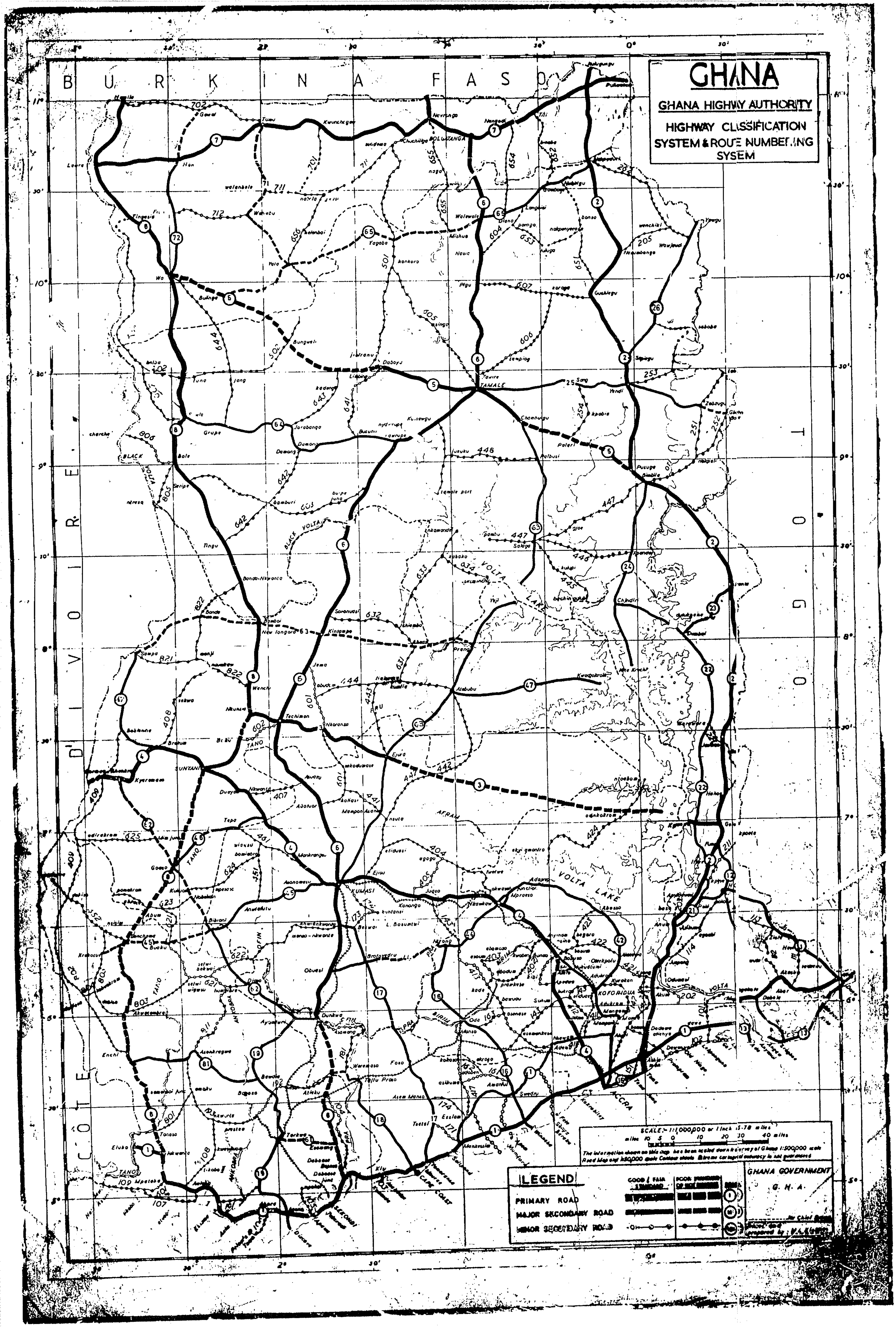
[37] Information based on an interview with the acting port operations manager at Takoradi.
[38] Interview with GHTDA and officials at the export shed, Tema.



GHANA
GHANA HIGHWAY AUTHORITY
HIGHWAY CLASSIFICATION
SYSTEM & ROUTE NUMBERING
SYSEM
BURKINA FASO
CÔTE D'IVOIRE
TOGO
TAMALE
KUMASI
KOFORIDUA
ACCRA
CAPE COAST
BLACK VOLTA
VOLTA LAKE
AFRAM
TANO
LEGEND
PRIMARY ROAD
MAJOR SECONDARY ROAD
MINOR SECONDARY ROAD
GHANA GOVERNMENT
G. H. A.

Figure 5.5

The road network of Ghana

Source: Ghana Highway Authority

Takoradi's other problems are to do with the public's perception of the port, the ban on log export, bureaucratic custom arrangements, the spectre of privatisation, and the adequacy of storage and container stacking areas. There is the perception among the public that Takoradi is an export port catering for only bulky mineral cargo. Consequently, a majority of the public is unaware of Takoradi's ability to cater for imports and non-bulk exports as well. What is more, there is no customs, excise and preventive service (CEPS) unit in Takoradi, forcing users of Takoradi to process their customs duties at Tema. The inconvenience of shuttling between Takoradi and Tema has led to the use of the latter so as to avoid this problem. The spectre of privatisation hanging over Takoradi has also created a reluctance to invest in the port by the government. To this end, Takoradi faces continuous deterioration of its equipment and other port infrastructure.

Furthermore, though both Takoradi and Tema have problems with congestion resulting from limited storage areas, Takoradi's problem is more acute than that of Tema. Its open storage and container stacking areas are woefully inadequate compared with Tema's. Indeed, all these problems have combined to work against Takoradi, causing the port to lose a significant part of its hinterland to Tema. It was not surprising, therefore, that the GPHA intervened in the 1980's to restrict exports through Tema to save Takoradi from precipitate decline.

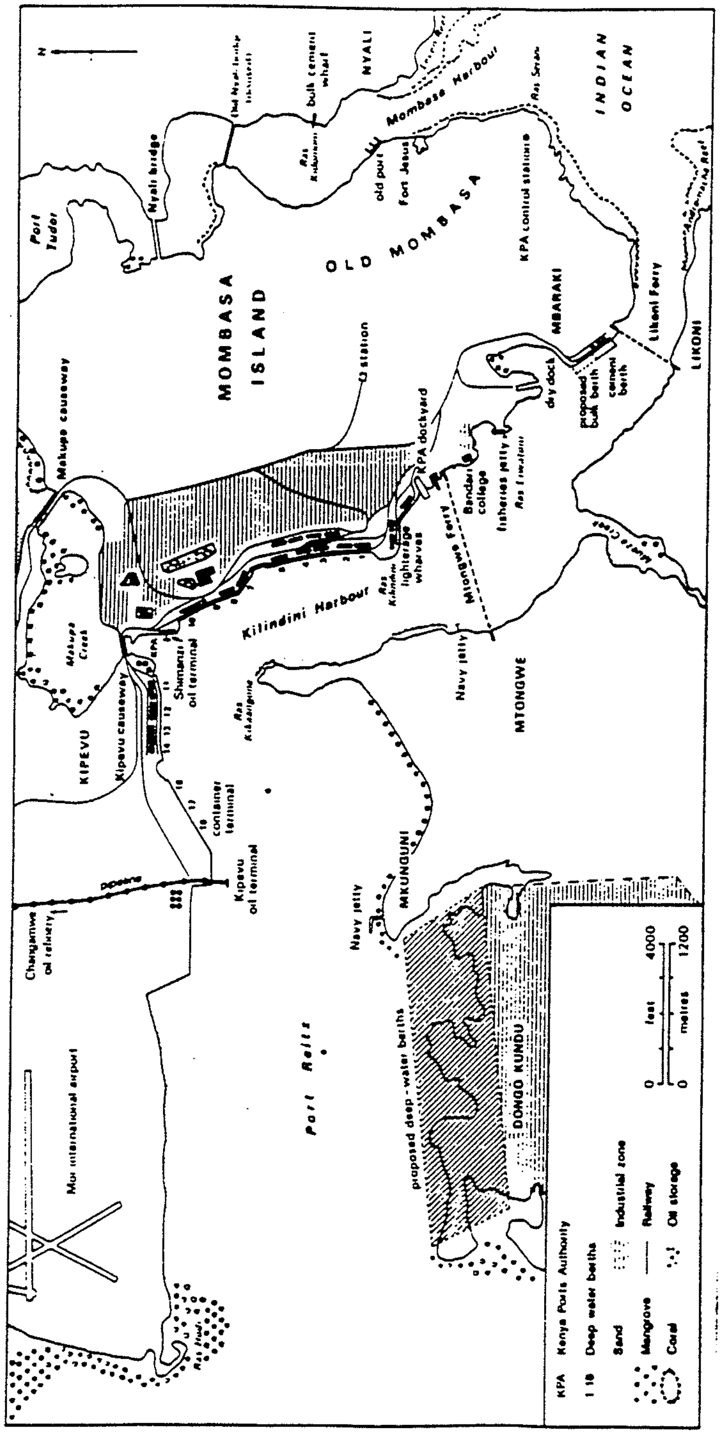
Differences in hinterland also underlie the differential port tonnages occurring between the Ghanaian ports and their East African counterparts between Mombasa and Dar es Salaam. We examine the case between Mombasa and Dar es Salaam first.

5. 4 Hinterland: Mombasa and Dar es Salaam compared

A major contributing factor responsible for the throughput difference between Mombasa (Figure 5.6) and Dar es Salaam (Figure 5.7) is the difference in their respective national hinterlands, which is a reflection of their uneven development, with Kenya having a relatively better economy than Tanzania. In addition, the two ports also have access to the extra-national hinterlands of Malawi, Rwanda, Zaire and Burundi.

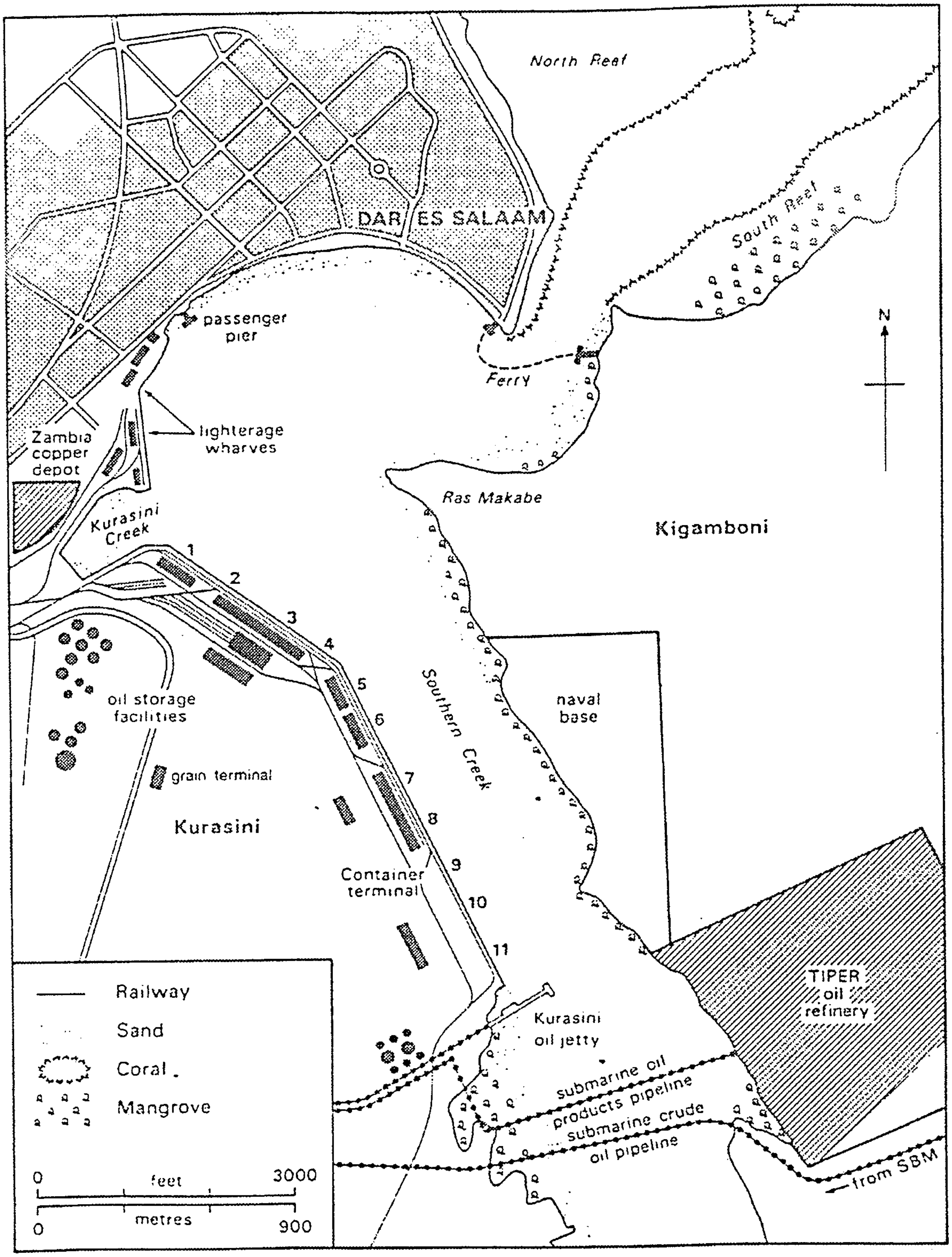
Figure 5.6

The port of Mombasa, Kenya



Source: Hoyle and Charlier, 1995

Figure 5.7
The port of Dar es Salaam, Tanzania



Source: Hoyle and Charlier, 1995

Table 5.1 shows both the national and extra-national dry cargo traffic[39] for Mombasa and Dar es Salaam from 1983 –1993.

Table 5.1

Import/export and continental transit traffic of dry cargo at Mombasa and Dar es Salaam – excluding transhipments – ('000 t), 1983-1993*

Year	Mombasa				Dar es Salaam			
	Kenyan traffic	Transit traffic	Overall traffic	Share of transit	Tanzanian traffic	Transit traffic	Overall traffic	Share of transit
1983	2989	495	3393	14.6	624	847	1471	57.6
1984	3924	485	3509	13.8	827	974	1801	54.1
1985	3357	381	3738	10.2	865	918	1783	51.5
1986	3250	420	3670	11.4	749	983	1732	56.8
1987	3283	507	3790	13.4	998	1084	2082	52.1
1988	3106	360	3466	10.4	849	1200	2049	58.6
1989	3014	549	3563	15.4	783	1155	1938	59.5
1990	3505	595	4100	14.5	962	922	1884	48.9
1991	3038	527	3565	14.7	817	1077	1894	56.9
1992	3311	1210	4521	26.8	967	1379	2346	58.8
1993	3735	1126	4861	23.2	1169	1284	2453	52.3

Source: Hoyle and Charlier, 1995
*Note: 1992 and 1993 figures were inflated by food – especially grain – imports as a result of the drought in Ethiopia and Southern Africa.

Table 5.1 shows that about half of Dar es Salaam's dry bulk came from its extra-national hinterlands. In 1989 the share of transit traffic for Dar es Salaam was as high as 59.5 per cent. The lowest share of its transit traffic was 48.9 per cent and this was in 1990. The figures for Mombasa for the respective years were 15.4 and 14.5 per cent. Despite the marginal role of transit traffic in Mombasa's activity, it competes with Dar es Salaam for traffic from the land-locked countries (LLCs) of Uganda, Rwanda, Burundi and the Democratic Republic of Congo (formerly Zaire). In actual fact, part of Mombasa's extra-national hinterland is north-western Tanzania. About 24,000 tons of traffic was sent from

[39] This comprised dry bulk and general cargo, excluding transhipment.

this part of Tanzania through Mombasa in 1993. The actual competition between the two ports, however, is the battle for traffic from the LLCs – the extra-national hinterlands[40].

The LLCs have the choice of using either Mombasa or Dar es Salaam, and their policy has been one of diversification in order to avoid over-reliance on a particular port, as they used to do in the past, when Mombasa served Uganda and Rwanda and Dar es Salaam served only Burundi. There is a relatively efficient transport network between these ports and their extra-national hinterlands. There is the *northern corridor* which links Mombasa and Kigali (Rwanda) through Nairobi, Tororo, Kampala and Kasese (Van Dongen, 1963, Tandon, 1973 in Hoyle and Charlier, 1993), with the *central corridor* linking Dar es Salaam and Bujumbura through Tabora and Kigoma (Hance and Van Dongen, 1958 in Hoyle and Charlier, 1993). Though both are railway-routes, an optional link by train and ferry exists via Lake Victoria between Kisumu and Jinja or Port Bell in the first leg, and a final leg between Kigoma and Bujumbura (Burundi). These traffic routes to/from Mombasa and Dar es Salaam constitute the main activity on these lakes, whose capacity for international exchanges is said to be greatly under-utilised (Hoyle and Charlier, 1994).

A diversification has been introduced into the transport network by road-vehicle operators who have managed to capture a significant proportion of the most lucrative traffic along these two routes. They have achieved this despite higher cost coupled with the numerous problems they face when crossing Kenya or Tanzania – a series of controls and high transit fees plus poor road conditions. The civil war in Rwanda in 1994 gave rise to a new route to Rwanda and Burundi via Rusomo Falls, thus the trucks linking Mombasa with the two countries no more go through Uganda but circle around the southern part of Lake Victoria to rejoin those coming from or going to Dar es Salaam.

There has been another route diversion favouring traffic from Uganda and Rwanda to Dar es Salaam. Traffic from Uganda now can be hauled over Lake Victoria between Port Bell and Mwanza, and then use the Mwanza branch of the Tanzanian central railway. On this same branch line there is now the option of traffic from Rwanda to use the Isaka rail-road transfer facility, which opened in January 1994. The Isaka rail-road facility is also used to serve Burundi. On the whole, Mombasa is Uganda's chief port for dry cargo – about

[40] The competition discussed here excludes traffic from eastern DR Congo (formerly Zaire), as traffic to/from the Kivu Province can for practical purposes be only routed via Mombasa (about 78 000 tons in 1993) and that to/from Shaba Province also through Dar es Salaam (about 136 000 tons in 1993).

475000 tons in 1993 against 17000 tons through Dar es Salaam – but most of Uganda's oil imports now pass through Dar es Salaam. Dar es Salaam continues to handle the bulk of Burundi's traffic, with about 163000 tons in 1993 as against 22000 tons through Mombasa. In 1993 Dar es Salaam became Rwanda's main transit port with about 158000 tons compared with about 124000 tons through Mombasa.

Besides the important role the transport network has played in extending the hinterlands of these two East African ports beyond their national boundaries, the introduction of the intermodal concept in their operations — especially the idea of *inland container depot* (ICD) — has also been a significant factor in reaching these far hinterlands. Mombasa, in particular, has gained from this innovation. The Isaka rail-road transfer facility mentioned above is just one of the ICDs. In Kenya there is the ICD in Kisumu which was opened in 1994. The Kisumu ICD is connected with Mombasa by container block trains and serves both local and international traffic, namely Uganda and Rwanda. The Kisumu ICD is considered a miniature of the Embakasi ICD in Nairobi, the capital city, constructed in 1984 with a direct *railtainer* service from Mombasa. Having realised that the battle for intermodal traffic cannot only be won at sea and in the ports but also in the inland domain, the Kenya Ports Authority is doing everything within its power to buttress its position. For example, it is planning to establish another ICD in Eldoret, to which point the Mombasa-Nairobi oil pipeline has been extended, with a branch to Kisumu, again with an eye on transit traffic, by rail from Eldoret or by tanker barges from Kisumu.

The Tanzania Harbours Authority (THA), on the other hand, has yet to adopt the ICD strategy. The THA, for example, is not involved in either the new Isaka rail-road transfer facility or the Mbeya dry port on the Tanzania-Zambia Railway (TAZARA). In conjunction with a Malawi cargo centre in Dar es Salaam, the Mbeya facility is used for Malawi's transit cargoes, which are a welcome addition to the TAZARA traffic. Unlike in Kenya, there has not been any plan in Tanzania to establish an ICD in the capital Dodoma or anywhere in the interior, except perhaps in the Moshi/Arusha area where such a facility could be served by rail from Dar es Salaam as well as from Mombasa. Table 5.2 shows the dry cargo transit traffic to Mombasa and Dar es Salaam from 1983-1993. The statistics show both ports aggressively fighting for traffic from the land-locked countries.

Table 5.2

Dry cargo transit at Mombasa and Dar es Salaam,

1983-1993 ('000 t, excluding transhipment)

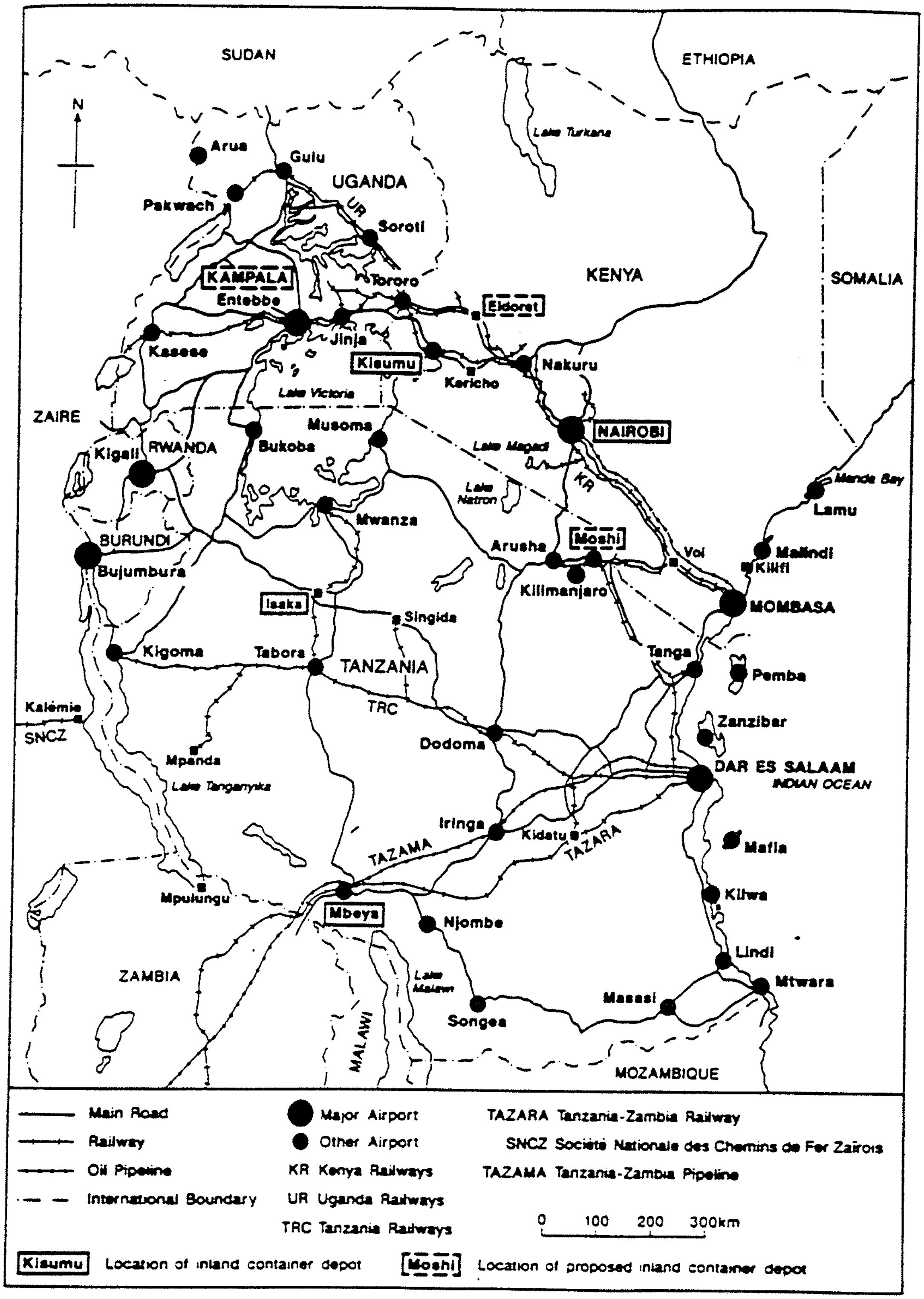
	Mombasa				Dar es Salaam			
Year	Central Africa	Tanzania	Other	Overall	Central Africa	Zambia	Other	Overall
1983	475	3	17	495	150	668	29	847
1984	470	3	12	485	200	751	23	974
1985	374	3	4	381	199	703	16	918
1986	406	8	6	420	218	751	14	983
1987	480	18	9	507	292	771	21	1084
1988	350	4	6	360	337	821	42	1200
1989	487	42	20	549	337	778	40	1155
1990	544	32	19	595	296	578	48	922
1991	488	18	21	527	381	549	147	1077
1992	734	15	461	1210	282	939	158	1379
1993	699	24	403	1126	474	664	146	1284

Source: Hoyle and Charlier, 1995

The statistics presented in Table 5.2 shows that Mombasa received the largest share of the traffic from Central Africa. In 1983 it received 475,000 tons of dry cargo from Central Africa. By 1993 this had increased to 699,000 tons. As mentioned already, Mombasa also received some traffic from north-western Tanzania, though this is not substantial. In the case of Dar es Salaam, traffic from Malawi, indicated as 'other', has been on the increase, notably from 1991. On the other hand, dry cargo from Zambia has been on the decrease. The decrease in Zambia's dry cargo to Dar es Salaam is due to Zambia's attempt to redirect its traffic towards South Africa or Mozambique ports after turning to a large extent to Dar es Salaam in the 1970's and 1980's following the construction of the Tanzania-Zambia Road (TANZAM), Tanzania-Zambia Pipeline (TAZAMA) and TAZARA. Zambia used to direct its traffic towards the South African ports until 1965 when Southern Rhodesia (now Zimbabwe) unilaterally declared itself independent. The civil wars in Angola and Mozambique also prevented Zambia from using their ports, thus leaving Zambia with little option than to use Dar es Salaam. Thus far we see that, apart from their own national traffic, the extra-national hinterland of the two ports have contributed immensely to their overall throughput, especially for Dar es Salaam where transit traffic represented about half of the port's dry cargo traffic in 1993. In the case of Mombasa this was about 28 per cent. Undoubtedly, the extra-national hinterlands of Mombasa and Dar es Salaam act as major contributory factors in the ports' growth and development. Figure 5.8 displays the East African port system, its attendant transport network, and associated internal and external hinterlands.

Figure 5.8

The East African port and transport system



Source: Hoyle and Charlier, 1995

5.5 Summary

This chapter has discussed the significance of hinterlands in the development of Ghanaian ports and has gone on to draw comparisons with the two major East African ports of Mombasa and Dar es Salaam. In all the cases, ports with high throughputs were found to have access to productive hinterlands complete with a relatively efficient transport network between the ports and their hinterland. This was clearly demonstrated in the case studies of Tema over Takoradi, Mombasa over Dar es Salaam and Mombasa and Dar es Salaam over Takoradi and Tema. With respect to the case of the East African ports versus the Ghanaian ports, the difference we realised lies in the extra-national hinterlands. The East African ports have access to rich hinterlands beyond their national boundaries, a phenomenon, which their Ghanaian counterparts lack. From all these revelations, it becomes obvious that no port authority can take its hinterland for granted. Indeed, all efforts must be made by port authorities to fight for new hinterlands and redouble their efforts to secure what they already possess. This being so, policy measures needed to acquire new hinterlands and revamp old ones should become core constituents of the corporate goals of every port authority. In Chapter Six I present some policy recommendations of value to Ghana's government and ports authority.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.0 Introduction

Hinterlands, as has been demonstrated, are the *lifeblood* of ports and therefore deserve maximum attention from port authorities. In this chapter I advance some recommendations for consideration by the Ghana government and Ghana Ports and Harbours Authority, recommendations suggesting how to approach the hinterland problems of Takoradi in particular and the two Ghanaian ports in general. The chapter is divided into two sections. The first section is a summary of the thesis while the second section deals with policy recommendations. To begin with, a thesis summary is helpful.

6.1 Thesis summary

Chapter One revolved round three main themes. The first theme provided a vindication of the sub-disciplines of transportation and port geography. Establishing the existence of these disciplines was necessary to justify the writing of the thesis within the confines of geography. Geography, we noted, shares at least three concerns with transportation. The first meeting point is the geographer's concern with the transport sector itself. Within the transport sector the geographer is interested in the network of the various modes of transport, popularly referred to as network analysis. The dominant technique of analysis here has been the graph theory. Secondly, the geographer is interested in the provision of scheduled services. Here, emphasis is on frequency in time and space and the impact of deregulation policies on scheduled services. The third geographical interest in transport is on the movement of people with special emphasis on the number of trips originating and terminating from one point to the other, the flows between these points and the allocation of traffic between competing modes. Fourthly, is the geographer's involvement in commodity flow analysis, using techniques such as flow and factor analysis. The last but not the least interest is in the field of terminal analysis. Terminal analysis has been particularly focused on the temporal and spatial development of the terminal facilities, their morphology as well as inter- and intra-facility competition.

The second relation between geography and transportation results from the role transport plays as an agent of geographical change. The notion of transport investment spurring development is considered axiomatic, although the search for evidence to buttress the claim often runs into problems. Lastly, geography and transportation intersect on environmental issues. Geographers are concerned with the new geographical patterns that will arise should transport use be restrained and the new geographical patterns that would contribute to such a restraint (Hay, 1991).

It became obvious from the discussion that the present study fell within the terminal and commodity movement studies, which, together, could also be conveniently studied under what has been termed as port geography. Port geography, with its many different facets, is concerned with "what happens at the waterfront, across the frontier between land and maritime space, wherever trade is carried out, whether that interface is set in a technologically primitive context or in the context of advanced transport systems" (Hilling and Hoyle, 1984:1). The preoccupation of this thesis, which is the hinterland, falls under the historico-genetic facet of port study (Bird, 1984).

The second theme in Chapter One explored the relationship between transport infrastructure and development. Three views on this theme were recognised; namely, the positive, passive and negative schools of thought. In line with the positive school of thought, the impact of port infrastructure on African development was considered, with special emphasis being directed to its role in urbanisation and industrialisation in Ghana. Tied to the port-development debate was a discussion of the research problem — the relationship between port performance, hinterland and overall traffic, — from which the working statement/hypothesis and research objectives were developed. The working statement/hypothesis was that hinterlands are fundamental to port development and that inaccessibility to them by whatever reasons can lead to low throughput. The thrust of the research objectives was therefore to demonstrate the importance of hinterlands to the development of the Ghanaian ports.

As a sequel and due to the centrality of hinterland to the study, Chapter Two was devoted to the hinterland concept, it proceeded by exploring the theoretical, classification and functional ramifications of hinterlands. Case studies from Mombasa and Dar es Salaam in East Africa, Beira in Mozambique, Genoa in Italy and ports in Malaysia were provided to corroborate the hitherto theoretical discussions. The importance of hinterlands to port growth and development was confirmed in all instances. Following the hinterland concern was a discussion on the methodology to be used in the study. This was the focus of Chapter Three. A combination of methodologies was employed. The first was Carter (1962) and Rimmer's (1966a and b) multi-criteria approach. In short, the approach stressed the need to adopt a multiplicity of criteria in assessing and comparing ports. The second technique used was regression analysis. Based on the working statement/hypothesis that overall traffic (OT) is a function of performance (P) and hinterland (H) — [OT = P + H] —, I used the regression analysis to find what percentage of a port's overall tonnage was due to performance. Thus, knowing what percentage was due to performance, we could, by simple manipulation of the equation know what percentage was due to hinterland effects. The shift-and-share technique was the third methodology used. The technique was employed to evaluate the rate of growth among the Ghanaian ports and the East African ports of Mombasa and Dar es Salaam. These chapters were by way of introduction as well as providing a background to the empirical study, which comprised Chapters Four and Five.

In Chapter Four the multi-criteria approach was applied in comparing the ports of Takoradi and Tema. The throughput statistics selected were overall tonnage, variety of traffic, balance of traffic, container traffic and leading traffics. With respect to variety of traffic the two ports seem to be specialised in different cargoes. For instance, in 1996 Tema handled all the aluminium and iron/steel while Takoradi handled about 99.9 per cent of the forest products. What is more, Takoradi's liquid bulk cargo comprised 11 per cent of the national share and 11.5 per cent of its own overall traffic while these were 88.4 per cent and 32.3 per cent for Tema. While dry bulk cargo does not contribute unduly to Tema's traffic (29.7 per cent) it formed 71 per cent of Takoradi's overall traffic. In addition, Tema had about 83 per cent of the market share of the general, bagged and container cargo with Takoradi having the remaining 17 per cent. When it comes to balance of traffic, Tema was found to be more import-oriented while Takoradi concentrates on exports. However, we found that Tema challenged Takoradi's dominance of the export traffic and indeed overtook Takoradi in the early 1980's but was restrained by a directive from the Ghana Ports and Harbours Authority. In 1980 and 1997 Takoradi's market share of the export traffic was 41.2 per cent and 63.7 per cent while Tema's share was 58.8 per cent and 36.3 per cent, respectively. It must be noted that the 1997 figure is a little deceptive due to the export restrictions imposed on Tema by the Ghana Ports and Harbours Authority. Market shares for the import traffic for 1980 and 1997 were 12.4 per cent and 16.0 per cent for Takoradi and 87.6 per cent and 84.0 per cent for Tema, respectively.

Major imports through Takoradi in 1996 were clinker (69 per cent), chemicals (4 per cent), wheat (6 per cent), general cargo (5 per cent), and other cargo (16 per cent). For Tema, the major imports were clinker (23 per cent), crude oil (23 per cent), general cargo (15 per cent), petroleum products (10 per cent), alumna (6 per cent) and other cargo (23 per cent). Takoradi's major exports were aluminium ores and concentrates (35.3 per cent), manganese ore and concentrates (27.8 per cent), cocoa beans (11.9 per cent), sawn wood (14.5 per cent) and veneer and plywood (2.6 per cent). Major exports routed through Tema were cocoa beans (37.6 per cent), aluminium (19.2 per cent), petroleum oils (19.3 per cent), oil seeds and oleaginous fruits (2.5 per cent) and roots and tubers (2.5 per cent). Overall, Tema's traffic exceeds that of Takoradi. In 1980 and 1997, for example, Tema's market share of the overall tonnage were 77.1 and 70.6 per cent as against 22.9 and 29.4 per cent for Takoradi.

Results of the regression analysis which related overall tonnage to selected performance indicators showed Takoradi's performance contributing more (53 per cent) to its overall tonnage than that of Tema (38 per cent), though Tema's overall tonnage far exceeds that of Takoradi. Findings of the study, as evidenced in Chapter Five, revealed the hinterland as the main explanatory variable responsible for the tonnage difference between the Ghanaian ports and their East African counterparts. The nature and condition of the hinterlands of the ports were consequently examined in detail. With the importance of the hinterland to port development established, it is now opportune to present a number of recommendations.

6.2 Recommendations

Takoradi has a serious problem with perception. The port is regarded erroneously by the public as an export and mineral (bulky) port. Consequently, traffic originating in Takoradi's natural hinterland and which could be easily exported/imported through it is diverted to Tema. With the adoption of a market economy by the government, Takoradi must realise that the protection it is enjoying will soon end. In fact, there is the uncertainty of impending privatisation hanging over Takoradi at the moment[41] (Intermodal Transport Study, Vol. 1). The chief of corporate planning at Tema also underscored this perception problem facing Takoradi. There is, therefore, the need for the port authority to market and sell to both the local and international markets its services, strengths, capabilities and abilities. This can be achieved in large measure through advertisements in both local and international media.

The internet is another means the port authority can use to advertise the port. There is no official website maintained by the port authority and the present internet sites of the port are nothing but a sham. What exist are just one-page statements about the port by benevolent people or organisations. Perhaps the Takoradi port authority should take a cue from the ports in South Africa which maintain impressive internet sites (http://www.portnet.co.za). This marketing strategy would enable Takoradi to extend its hinterland and thus help diversify its traffic base. In 1996, for example, Takoradi's major traffic was still the port's traditional trade of manganese, bauxite, timber/lumber and cocoa beans. These four products made up 53.7 per cent of Takoradi's overall tonnage. This shows that Takoradi's traffic has seen little variety or change, at least in terms of tonnage. There is therefore the need for the port to diversify its traffic base, especially as the government is putting more emphasis on non-traditional exports following the decline in the prices of the traditional exports on the world market. One reason underlying

[41] Interview with Takoradi's port operations manager.

Tema's success is its relatively wide traffic base. In 1996 the GEPC listed 118 export items transferred through Tema but only 42 through Takoradi. Of the 42 export items through Takoradi just eight exceeded 40000 tonnes whilst the figure for Tema was eighteen. Clearly this is a policy Takoradi authorities have to consider with all seriousness.

But as Kirk (1976) has noted, in making sure a product is right for the market, the marketing function must be a major contributor to both pricing decisions and product design. He notes further that, "product design in the case of port services includes items such as berth specification, speed of turnround, assistance with document procedures, storage facilities, damage-free transit, ….." (Kirk, 1976:205). By extension, Takoradi needs to improve these products before selling them, especially in the areas of documentation assistance, storage facilities, containerisation and equipment. At the moment open storage areas and sheds are woefully inadequate, so are the container stacking areas. The port's container technology is obsolete, to say nothing of the fact that the port lacks the necessary equipment and is plagued by the shallow depths of the berths. In the light of the ongoing privatisation and free market philosophy being pursued by the government, not to mention the continual whining about lack of money, and the port's authority inability to finance these projects, it is recommended that certain aspects of the port's operations be privatised. Some of these areas could include the stevedoring, container services and the storage areas. In essence, opportunity should be given to private individuals who have the means and are interested to build and operate these facilities. Takoradi can, in fact, capture a greater portion of the cocoa hinterland if it could build more sheds and storage facilities. At the moment one of the main deciding factors regarding which port receives cocoa traffic is the availability of sheds. It will therefore be in Takoradi's interest to have more sheds to enable it capture a greater portion of the cocoa hinterland, for it already has the advantage of proximity to the cocoa growing areas[42]. Another reason why Takoradi needs to develop its container trade is to do with the rapid containerisation of timber, sawn logs and cocoa taking place. Refusal to

[42] Interview with officials at the Tema cocoa shed and the Ghana Haulage Truck Drivers Association (GHTDA).

adopt an extensive container technology could see the complete diversion of this traffic from Takoradi to Tema.

With respect to documentation processing Takoradi has a major hurdle to jump — as already pointed out. There is no Customs Excise and Preventive Service (CEPS) office at Takoradi. To save time port users prefer using Tema where they can receive both customs and port services at the same place. Therefore, decentralising and devolving some authority to a CEPS unit in Takoradi is highly recommended. This would enable Takoradi to attract more traffic and thus widen its hinterland base.

As noted in the previous chapter, the transport network, notably the railway, linking Takoradi with the rest of the country is very poor, and requires urgent attention. As Hilling (1975:16) aptly cautioned, "no port can be more efficient than its hinterland links permit". Against this backdrop it is suggested that a massive rehabilitation of the railway network — repairing and replacing old and outdated tracks and wagons, modernising the railway system with state-of-the-art technology — serving Takoradi be undertaken by the port authority and the government. This of course is a huge investment, far beyond the capabilities of the Takoradi port authority. The government would therefore have to shoulder this responsibility. In this light, the government is urged to act on the recommendations prepared by the Thorburn Colquhoun International and partnership (1996). A summary of their recommendations, drafted on the belief that the railway can again provide economically and financially viable transport services, is reproduced below.

6.2.1 Financial

1. The government should assume the railway's long-term debt.
2. The necessary funds should be provided for completion of the ongoing rehabilitation projects and for one-time expenditures on restructuring.
3. The railway be fully responsible for financing its operations, maintenance, and investment without government subsidy.

4. The railway be free to set its cost and tariff structure to its own advantage for products that can be transported by road. For products such as minerals where the railway has a natural monopoly, tariffs would be set according to formulas agreed with the government. An exception will be social services mandated by the government and which are not financially profitable.

6.2.2 Operational scope

1. The railway should focus on developing its most productive element - the WL - to be fully competitive with road transport, and to recapture its lost traffic, especially in cocoa. It should also aim to transport a significant number of containers, both for import and export.
2. The railway corporation should actively participate with the government and private sector in developing the concept for the inland container depot at Fumoase, near Kumasi.

6.2.3 Organisational

The Ghana Railway Corporation should assign all its management resources to pursuit of its core business: the operation of a modern transportation service of which railway operations would form the most important component. All things being equal, the railway should be able to compete with the road haulers after its rehabilitation. This should enable Takoradi to recapture some part, if not all, of its lost hinterland.

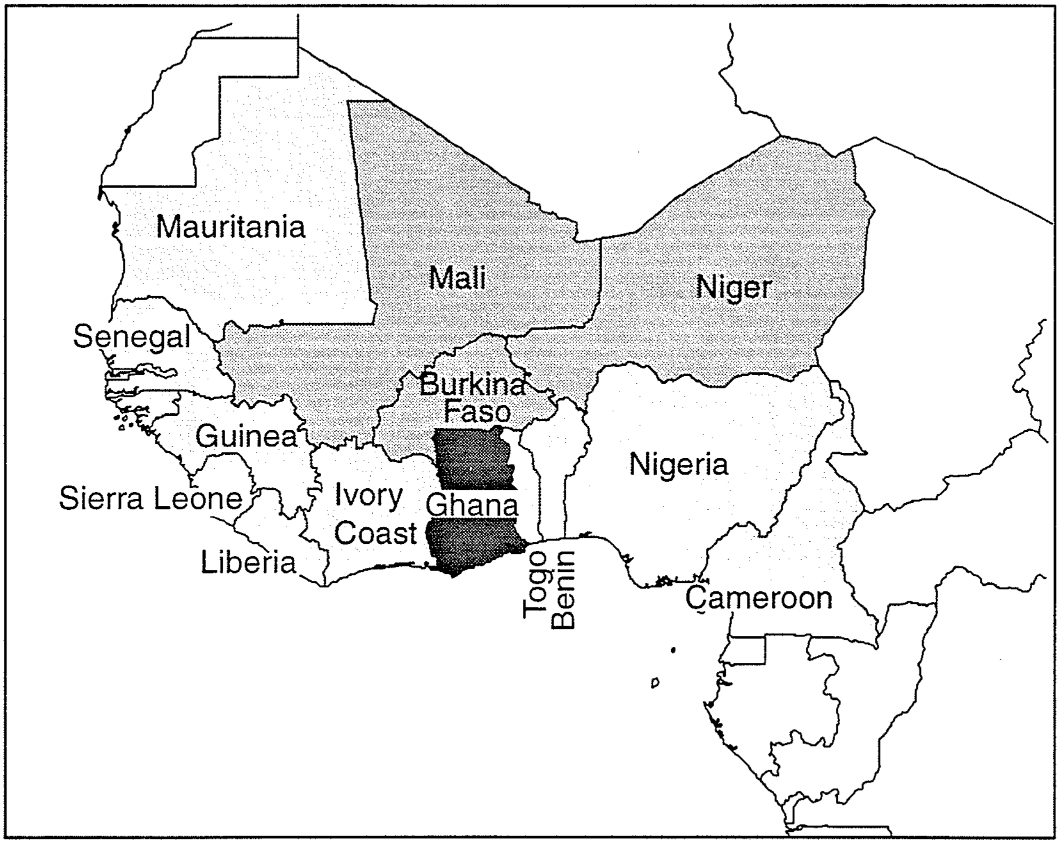
With regards to roads, attention needs to be directed at the feeder roads which connect the production centres in the interior with the primary and secondary roads, which link the collection centres. There is the need to upgrade the feeder roads to an all-weather road status to enable their use all year round.

Now let us consider the two ports as a whole, that is, the Ghanaian port system. One of the main factors, which underlie the differences in tonnage between the Ghanaian ports and their East African counterparts, is the hinterland. The East African ports have access to extra-national hinterlands, which their Ghanaian counterparts do not have. This has been made possible by the relatively efficient transport network linking the ports to these external hinterlands. There is a vast international hinterland beyond the boundaries of Ghana, especially in relation to the landlocked countries of Burkina Faso, Niger, and Mali (Figure 6.1) that the Ghanaian ports can aspire to access. At the moment only a small amount of traffic from these external hinterlands makes its way through the Ghanaian corridor, although the Ghanaian ports are capable of handling tons of traffic from these landlocked countries. A trial import of 7000 tonnes of rice through Tema from Burkina Faso in 1998, for example, took only four days to unload. This compared with the usual eight days it took the importer to unload the same amount of cargo through Abidjan in Côte d'Ivoire (Ivory Coast). Consequently a whole shed has therefore been reserved for Burkina Faso at Tema. Although the GPHA is making the effort to enter this international hinterland it faces the problem of poor transport connections from Ghana into these countries. A major help here is needed from the government. The government must create the enabling environment by improving the transport network linking Ghana to these external hinterlands.

The following roads will need special attention in this regard: the Kumasi-Kitampo, Techiman-Kitampo, Techiman-Hamle, Wa-Tumu-Navarongo and the Techiman-Bamboi-Hamle-Wa. These roads link Ghana to its northern neighbouring countries. The Techiman-Kitampo road, for example, which is only 54km, takes drivers about five hours to travel at the moment. The Bamboi-Hamle road is untarred. It is described as a driver's nightmare, as it causes frequent tyre deflation which compels drivers to refuse to carry traffic on this road[43]. With a good transport network and efficient marketing, Takoradi, it is envisaged, could easily enter the Niger and Burkina Faso hinterland[44]. Tied to this is the need for the GPHA and the government to actively pursue and adopt the intermodal and inland container depot (ICD) concept, a concept fully adopted by Mombasa.

[43] Interview with GHTDA.
[44] Interview with Chief of Corporate Planning, GPHA, Tema.

Figure 6.1
Map of West Africa



The operation of an ICD, for instance, can help alleviate the congestion problems facing the ports, since cargo meant for the interior can be directly sent via the intermodal system and thus avoid storage and its attendant congestion problems. In the 1980's, for example, Tema lost traffic to Lome, Togo, as a result of congestion problems. The ICD will also help in reducing container transit time at the ports. The long proposed ICD at Fumoase, near Kumasi, should therefore be given the needed push to become a reality. Despite the advantages of ICDs and intermodalism the government has still not sanctioned them for security reasons[45] (Amoyaw, 1991, Hilling, 1976).

A discussion with an official of one of the major shipping lines revealed the problems involved in operating intermodalism in the country. The official recounted of the delays involved in getting permission from the government including the number of government security personnel who have to follow and inspect the containers at their destinations. Thus in the end, the purpose and goal of the intermodal concept ends up defeated. A roundtable discussion by GPHA with the government on the importance of these concepts to the development of the ports would therefore be in order (Intermodal Transport Study, Vol. 1, 1996)[46].

While on this, it will also be appropriate for the GPHA and the government to reduce the customs formalities involved at the ports. Today's shipping business is operated on speed so any port where shipping procedures take too much of the shipper's time is surely at the loosing end. There are estimated 26 steps in 5 stages required of shippers at Ghanaian ports (see Appendix VI). Presently, the average dwelling time for a container at the port is 25 days. This compares with one day in European and North American ports. Even Israel with all its security problems has a container dwelling time of one day. It is estimated that ship-owners and the Ghanaian economy as a whole could save as much as 295 US dollars per container if the dwell time were reduced to seven days. On this note, it is recommended that the customs procedures be reduced to minimum by reducing the

[45] The major security reason is the fear of people smuggling arms into the country to overthrow the government. (Interviewee's identity cannot be disclosed) .

[46] Name and company of the official spoken with in connection with the intermodal problems in the country cannot be divulged.

amount of cargo examined, reducing the number of documents examined and there must be a better co-ordination between customs and port authorities and port users. There is also the need to expedite the efficient use of the Automated Systems Customs Data (ASYCUDA) documentation process, which was implemented some years back.

Furthermore, to be able to enter the international hinterland, the Ghanaian ports will have to be competitive in terms of their tariff. At the moment the Ghanaian ports are the most expensive along the West African coast, with the exception of discharging import containers where Lagos charges US$ 181.53 for a 20-foot container as against US$ 168.11 charged by Tema/Takoradi. Abidjan has the lowest charge of US$ 82.43. Douala, Lome and Cotonou charge US$ 82.43, US$ 101.79, and US$ 102.62 respectively for the same 20-foot container. Again, the US$ 100.45 charged for handling empty containers at the Ghanaian ports is uncompetitive compared with the US$ 36.66 and US$ 42.83 charged by Lagos and Abidjan. At the moment Abidjan controls a greater portion of the hinterland of the landlocked countries. They already enjoy the 'French fraternity' with the landlocked countries plus their cheaper tariffs. For the Ghanaian ports to capture these landlocked hinterlands, therefore, would require a restructuring of their tariffs to a more competitive level.

There is also the need for the GPHA to set up a French department at both ports considering the fact that all the landlocked countries are francophone nations. To this end the GPHA must begin to employ French-speaking personnel to smoothen documentation process and its customer relations with their potential customers.

There are some operational issues that need to be tackled as well if the Ghanaian ports are to expand their hinterlands to include the landlocked countries. With ships increasingly becoming larger with their attendant reduced cost of sea freight[47]; the current draft at the ports constitutes a major limitation to the ports' operations. Besides the draft problem, there is the need for more operational berths. Currently only two berths (Berth 1 and 2)

[47] The cost per TEU kilometre (mile) of a vintage 1200 TEU vessel is $.03 US dollars while for a modern 3000 TEU vessel it is $.018 US dollars.

are in operation at Tema with depths of 9.6 metres. The remaining ten are too shallow to be used. Discussion with two major shipping companies entailed tales of complaints and dissatisfaction of the services provided by the GPHA. The consensus was that there should at least be two berths for each container terminal with deep depths to accommodate much larger ships. Equipment is also a big problem. Most of the equipment are broken down whilst there is the complete lack of needed and modern equipment such as gantry cranes.

Also the ports, especially Tema need dedicated container terminals. Tema, for example, receives about 165000 container boxes annually. It is recommended that more berths be dredged and expanded to accommodate modern ships. The decision by the port authority to pull down sheds 1 and 2 to make more room for container terminals is a good idea and therefore should be taken up with all urgency. Also, stock should be taken to assess which equipment need to be acquired, replaced or repaired. Indeed this will require financial investments GPHA cannot meet alone. It is estimated that about US$ 50-60 million will be needed to undertake a project as recommended above. In this light, it is suggested the government use its good offices to secure a loan from the international community like the World Bank and other international financial institutions to help finance the project, especially the aspect to do with dredging since private investors would not likely be able to bear such a cost. In addition, the stevedoring aspect could be privatised to interested investors. It is believed that when these recommendations are given due attention by all the parties involved the Ghanaian ports will be able to expand their hinterlands both within and without and can thus become a force to reckon with in the region in the dynamic and competitive port and shipping business.

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APPENDICES

Appendix I

Market shares of overall traffic at Ghanaian ports, 1945-1967 (%)

Year	Takoradi	Tema	Accra	Other
1945	89.8	-	10.2	0
1946	89	-	10.7	0.3
1947	85	-	13.6	1.4
1948	85.6	-	12.7	1.7
1949	82.5	-	14.9	2.6
1950	82.7	-	13.8	3.5
1951	81.7	-	15.2	3.1
1952	82.6	-	14.9	2.4
1953	79.7	-	17.2	3.1
1954	78	-	18.6	3.4
1955	76	-	20.8	3.2
1956	77.1	-	20.1	2.8
1957	78.2	-	19.1	2.8
1958	75.9	-	21.5	2.6
1959	75.1	-	22.4	2.5
1960	74.8	-	22.7	2.5
1961	66.6	5.2	25.8	2.4
1962	68.5	24.7	5.2	0.6
1963	63.1	36.9	-	-
1964	46.3	53.7	-	-
1965	34.3	65.7	-	-
1966	51.2	48.8	-	-
1967	44.794	55.206	-	-

Source: Calculated from Hilling, 1970b

Appendix II

Overall imports at Ghanaian ports, 1945-1967 (1,000 tons)

Year	Takoradi	Tema	Accra	Other	Total
1938	299	-	92	40	431
1945	282	-	62	-	344
1946	320	-	93	1	414
1947	355	-	156	7	518
1948	444	-	184	18	646
1949	556	-	273	35	864
1950	583	-	245	51	881
1951	675	-	320	53	1048
1952	711	-	312	33	1056
1953	717	-	390	51	1158
1954	719	-	387	54	1160
1955	854	-	512	60	1426
1956	799	-	529	56	1384
1957	874	-	543	55	1472
1958	764	-	583	50	1397
1959	815	-	675	55	1545
1960	1007	-	791	45	1843
1961	1107	172	877	57	2213
1962	736	622	206	17	1581
1963	717	1010	-	-	1727
1964	448	1699	-	-	2147
1965	382	1537	-	-	1919
1966	417	1357	-	-	1774
1967	242	1510	-	-	1752

Source: Hilling, 1970b

Appendix III

Overall exports at Ghanaian ports, 1945-1967 (1000 tons)

Year	Takoradi	Tema	Accra	Other	Total
1938	477	-	129	54	660
1945	1135	-	99	-	1234
1946	1206	-	91	4	1301
1947	986	-	58	15	1059
1948	1179	-	56	14	1249
1949	1319	-	65	25	1409
1950	1280	-	66	27	1373
1951	1378	-	61	25	1464
1952	1317	-	55	27	1399
1953	1403	-	69	31	1503
1954	1157	-	60	28	1245
1955	1272	-	69	30	1371
1956	1529	-	78	28	1635
1957	1679	-	80	35	1794
1958	1525	-	65	27	1617
1959	1720	-	81	29	1830
1960	1892	-	89	51	2032
1961	1558	35	155	38	1786
1962	1562	206	-	7	1775
1963	1504	291	-	-	1795
1964	1513	578	-	-	2091
1965	1643	658	-	-	2301
1966	1597	584	-	-	2181
1967	1436	558	-	-	1994

Source: Hilling, 1970b

Appendix IV

Regression results of overall tonnage (OT) on the independent variables

Variable	Estimated coefficient		Standard error		T-ratio		P-value	
	Takoradi	Tema	Takoradi	Tema	Takoradi	Tema	Takoradi	Tema
Net registered tonnage	4.5958	8.3835	4.202	4.552	1.094	0.073	0.281	0.280
Ship call	2774.2	415.66	939.3	1021.0	2.954	0.686	0.005	0.064
Ship turnround	621.43	115.95	218.9	607.3	2.839	0.850	0.007	0.030
Labour productivity	1888.2	3269.7	1365.0	1259.0	1.343	0.013	0.187	0.380
Berth occupancy	21.201	-1515.1	697.2	1347.0	0.03041	0.268	0.976	-0.175
Gang hours	8.1607	26.066	4.405	7.566	1.852	0.001	0.071	0.478
Ship productivity	283.41	-207.34	607.7	815.4	0.4663	0.801	0.644	-0.040

Adjusted R^2	F-statistic	Durbin-Watson
Takoradi = 0.5288	Takoradi F(8, 40) = 239.233	Takoradi = 1.8494
Tema = 0.2978	Tema F(8, 40) = 339.028	Tema = 2.5284
Rho (ρ)	**Degrees of freedom (Df)**	**Sample size (n)**
Takoradi = 0.01611	Takoradi = 40	Takoradi = 48
Tema = – 0.29562	Tema = 40	Tema = 48

Appendix V

Traffic concentration at Takoradi, Tema, Mombasa and Dar es Salaam, 1983-1993 (tonnes)

Year	Takoradi	Tema	Mombasa	Dar es Salaam	Total	
1983	546352	1905974	6494000	3155000	12101326	
1984	663000	1810000	6548000	3466000	12487000	
1985	898000	2365000	6339000	3158000	12760000	
1986	687000	2874000	6930000	3476000	13967000	
1987	1271674	2898496	6918000	3601000	14689170	
1988	1427577	3026125	6772000	3944000	15169702	
1989	1497503	3310820	7238000	4000000	16046323	
1990	1560709	3476687	7525000	3741000	16303396	
1991	1639468	3647010	7144000	3857000	16287478	
1992	1802690	3909661	7992000	4602000	18306351	
1993	2123099	4130204	7989000	4485000	18727303	

Source: MIS, Tema, and Hoyle and Charlier, 1995

Calculation of rate of growth

Takoradi:
Yp = 2123099
Xp = 546352
Yn = 18727303
Xn = 12101326
Hp=546325*(18727303/12101326)
= 845460.56
Yp - Hp = **1277638.4**

Tema:
Yp = 4130204
Xp = 1905974
Yn = 18727303
Xn = 12101326
Hp = 1905974*(18727303/12101326)
= 2949573.675
Yp - Hp = **1180630.3**

Dar es Salaam:
Yp = 4485000
Xp = 3155000
Yn =18727303
Xn =12101326
Hp = 3155000*(18727303/12101326)
= 4882493.122
Yp -Hp = **-397493**

Mombasa:
Yp = 7989000
Xp = 6494000
Yn =18727303
Xn =12101326
Hp = 6494000*(18727303/12101326)
= 10049733.86
Yp - Hp = **-2060734**

Appendix VI

Stop undue delays at ports - Abodakpi

Accra, Ghana, Jan. 7 - Mr Dan Abodakpi, deputy minister of Trade and Industry, has asked port authorities to reduce the number of checks on imported goods in order to enhance Ghana's competitiveness in the sub-region. He said there is undue extra examination of goods, especially the imported ones, adding that this must be stopped if the Gateway Project is to succeed. The deputy minister was reacting to complaints about undue delay of goods at the ports because of extra examination points. The complaints were made during a visit to the Tema Port on Tuesday by the Minister of Trade and Industry, Dr John Abu and officials of the Private Enterprise Foundation, Association of Ghana Industries and Value Added Tax (VAT) Service to assess the impact and interpretation of the new tax system. Mr Abodakpi noted that a lot of money has gone into the Gateway Project which must not be allowed to go down the drain by the actions and inactions of officers posted to the ports. He called on port authorities to urgently convene a meeting and resolve the causes of such delays by the close of the month. The Ghana News Agency found that imported goods sometimes take about one month or more to be cleared. One importer, Mr. Kingsley Yaw who was angry about delays and extra check points, said he was contemplating using a neighbouring port. He said: "I recently had to clear some goods at the Tema Port and I had to go through as much as 65 different check points. "Most of them were just customs officers and Ghana Ports and Harbours Authority officials sitting at tables and virtually doing nothing but going through people's goods and extorting money and gifts from them".

Source: http://gww.ghana.com/