NATIONAL TRANSPORT RESEARCH CENTRE

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TRANSPORT SECTOR IN PAKISTAN
(AN EVALUATION OF DOMESTIC TRAFFIC)

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A B S T R A C T

The transport system in Pakistan is expanding regularly over several decades and is dominated by North-South network. The contribution of transport sector to GDP is around 8% with wide fluctuations in its growth rate for various years. The transport sector, compared to the rest of the economy, is more capital intensive and, therefore, need more capital to employ one worker. This difference is continuously increasing. The capital intensity has, however, matched by a high productivity of labour. The over all traffic intensity and mobility of transport in Pakistan is very high. The freight and passenger traffic is growing at compound rate of 5.1 % and 6.4% per annum. The growth rates and the elasticity with respect to GNP is, however, unevenly distributed among various sub-sectors. As a result the modal split has skewed significantly towards road transport.

The transport sector is consuming more energy to produce a unit of out put than rest of economy. The total energy consumption can only be reduced if a rigorous policy is adopted so as to divert traffic to more energy efficient modes of transport i.e. railways in the total transport system and large vehicles with in road transport.

The fiscal, monetary, credit and government investment policies for transport sector are not totally designed on economic/social considerations. As a result the various components of transport sector are not developing in an optimal way.

CHAPTER - 1

TRANSPORT AND ECONOMIC DEVELOPMENT

The role of transport and communication in the economic development of an economy has received attention from most of the development economists. (1). A cheap and extensive network of transport and communications, Lewis wrote about 38 years ago, is "the greatest blessing that any country can have from the economic point of view" (Lewis, 1955/p-73). In the "unbalanced growth" strategy of Hirschman (1958) infrastructure (with transport as a major component) plays the crucial role in "unbalancing" an economy to generate economic activities in the other sectors. According to Fogel, railways play the pioneering role in the economic growth of an economy. In absence of railways, road plays the role of opening. Rural roads have also been found to be of special significance. Such roads have a tremendous impact on the overall economic activity. Rural roads, on one hand, help in distribution of goods and services and on the other hand trigger some very important elements of development through increased access. According to Mwase (1989 p/238), highways which link various regions alone, without the rural feeder road system, would be of little use.

In the context of developed and developing countries the effect of transport sector has been found to be of different type. While in the developed economies the impact of various modes of transport is in terms of reducing the transport cost, in the developing economies it also induces agricultural production besides providing stability and equality in prices and income (2). According to Kindleberger (1958 p/16) the effect of transport system in developing countries is of vital importance. He observes that the development of transport sector reduces the rigidities of economy and increases the elasticities of demand and supply.

Youngson (1967 pp/55-78) has observed that investment in transport infrastructure and its services, in the new industrialized countries, tended to follow and was often in response to manifestation of bottlenecks in the transport system. Wilson et al. (1966 p/201) have also argued that for transport investments to have positive effects, certain preconditions with regard to general dynamism of the economy, the existence of marketing institutions and other facilities must already have been met. It might happen that because of opening of an area competition from outside might force the poorly equipped (and therefore less productive) farmer to abandone their jobs and achievements unless there is already enough potential in the economy for quick structural adjustment.

The two extreme views presented above clearly show that in order to make optimal investment in transport sector the relationship of transport to other economic activities should be examined in substantial detail. Transport investment can affect the location and even the pace of economic development. The opposite is also true; the pattern of economic development will play a crucial role in determining the demands placed on the transport system. Thus, the appropriate choice of transport plan will influence and be influenced by over all economic development. This implies that any comprehensive, long-run transport plan and the over all development strategy should take in to account the interdependency between the transport system and rest of the economy as well as the system or interaction effects within the transport network as demonstrated by Kresge and Roberts (1971).

It has been always recognized that transport sector is in the centre of every scenario of economic development. The study of pattern development of transport sector and its relationship with other economic activities thus provides an important insight of the economy. The comparison of transport sector with other countries is relatively difficult to interpret because it is country specific. However, wherever it is possible such comparison helps to identify the weak and strong points of the sector. Keeping in view this aspect it was felt that some important indicators of the transport sector in Pakistan be evaluated.

1.1 Objective and Scope of the Study

The basic objective of the study is to analyse some macro parameters of transport sector with further emphasis on domestic transport. For this purpose in the following two chapters, the role of transport sector and the evolution of capital stock in transport sector have been reviewed. In Chapter-4 freight traffic and passenger traffic and the modal split have been analysed. Chapter-5 has been devoted to analyze the energy consumption in the transport sector. In the last chapter conclusions from the preceeding sections have been drawn and possible fields for future research have been identified.

In an appendix to the study some terms and concepts used in this study have been briefly defined.

CHAPTER - 2

TRANSPORT IN THE ECONOMY OF PAKISTAN

2.1 Introduction.

The development of transport sector evolves according to a number of factors such as population (and population growth), distribution of population, geographical characteristics of the country, international trade etc. The population of Pakistan, is very unevenly distributed with a very rapid growth (which is about 3.1% per annum). Table 2.1 illustrates this fact.

TABLE 2.1

POPULATION DENSITY PER SQUARE KILOMETRE

S.No.	Discription	1972	1981
1.	PAKISTAN	82	106
2.	NWFP	113	148
3.	FATA	92	81
4.	PUNJAB	183	230
5.	SIND	100	135
6.	BALUCHISTAN	7	12

Source: Economic Survey of Pakistan 1991-92.

The population between urban and rural areas is continuously changing its pattern with rising share of the urban areas. Table 2.2 shows this change.

Table 2.2

PERCENTAGE DISTRIBUTION OF POPULATION IN PAKISTAN BY URBAN AND RURAL AREAS, 1951 - 1981

		PERCENTAGE	
CENSUS	TOTAL	URBAN	RURAL
1951	100	17.8	82.2
1961	100	22.5	77.5
1972	100	25.4	74.6
1981	100	28.3	71.7

Source: Economic Survey of Pakistan 1991-92.

The major economic activity is taking place in province of Punjab, while Karachi, as a port city, is the largest industrial and trade centre where two ports (Karachi and Qasim) are also handling more than 90% of total imports and exports cargo.

2.2 Transport Infrastructure in Pakistan

In view of the characteristics described above the transport network of Pakistan is dominated by North - South extension and a major part of transport has developed on this pattern.

The existing road network is 169,502 kms out of which 87833 km are of high type and 81669 km of low type. This gives an over all density of 0.21 km per square km of the area as compared to 0.5 km per square km which is considered as the bare minimum for sustaining the economic development for a developing country like Pakistan. In order to achieve the optimal level of road net work another 228546 kms of roads have to be constructed. The present rate is only around 5,000 kms per year. A tremendous task is thus ahead.

According to Pakistan Railway's year book 1990-91, Pakistan Railways comprise 8,775 route kilometers, 907 stations and 78 train halts. Its major assets include 753 locomotives, 2,339 passenger coaches and 34,851 freight wagons.

Air transport is also an important mode of domestic and international passenger and freight traffic. Pakistan today has a total number of 40 airports and following fleet of commercial air crafts with PIA:

Table 2.3

PIA FLEET *

Type of Airport	No. of Aircrafts
Boeing 747-200	8
Airbus A300 - B4	8
Airbus A310 - 300	3
Boeing 707	5
Boeing 737 - 300	6
Fokker F-27	14
Twin Otter	2
B707 Freighter (leased)	1
Total:	47

Source: Economic Survey of Pakistan 1991-92.
* = As on 29.02.1992

At present PIA is operating at 43 international and 35 domestic stations.

There are two seaports in the country i.e. Karachi Port and Muhammad Bin Qasim Port. The existing capabilities of these two ports are as in Table 2.4.

Table 2.4

CAPACITIES OF PORTS

	Karachi Port	Port Qasim
	(Million Tons Per Annum)	
- Liquid Bulk	11.00	3.00
- Dry Cargo	9.00	6.00
- Iron & Ore	-	4.00
- Container handling	400,000 TEU	-

Source: Economic Survey of Pakistan 1991-92.

2.3 Value Added in Transport and Communication Sector

The share of transport sector in GDP is, more or less, stable around 8 percent though it was over 9 percent in the first half of 1980's (1). During 1960's and 1970's the share was between 6 and 7 percent. Table 2.5 shows a comparative position for various years both at current and constant (1980-81) prices Figure 2.1 shows the over all trend.

Table 2.5

SHARE OF TRANSPORT SECTOR IN GDP
(PER CENT)

YEAR	CONSTANT 1980-81 PRICES	CURRENT PRICES
1959-60	6.5	5.7
1970-71	7.2	6.6
1980-81	9.7	9.6
1990-91	10.1	8.4

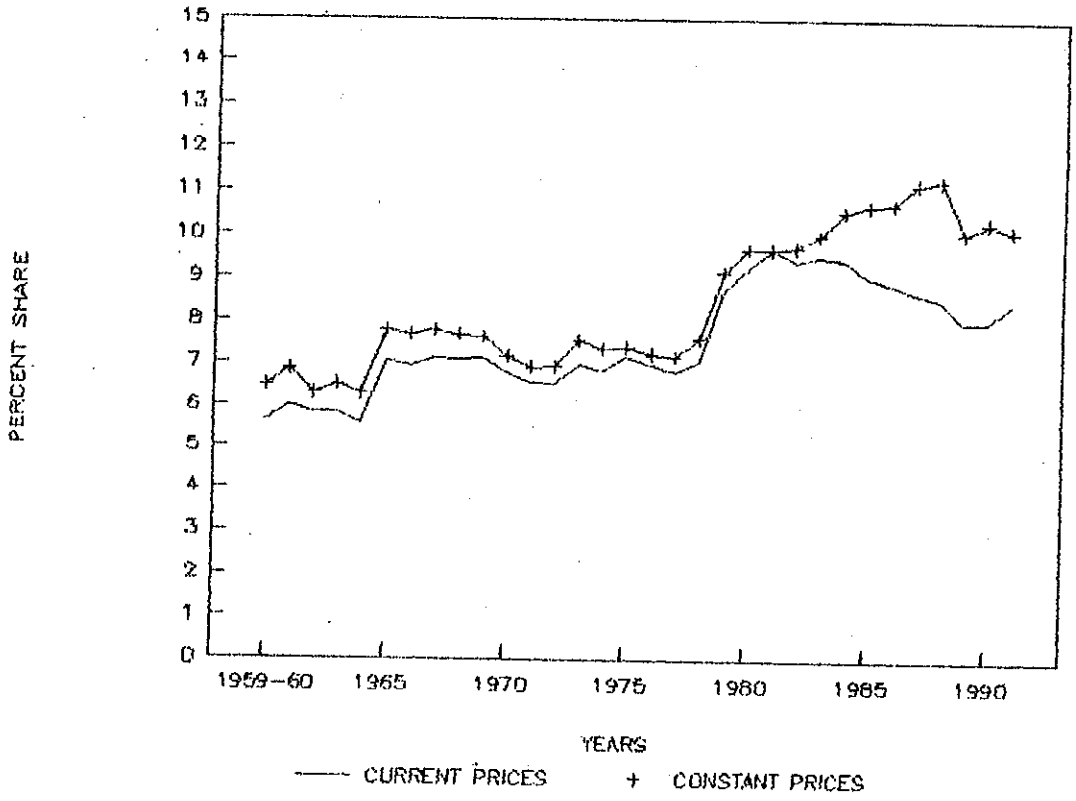
Source: Economic Survey of Pakistan 1991-92.

Yenny and Lily (1985, p/1) have observed that share of transport sector in GDP increases over time in the earlier years of development and decreases when a certain level of development is achieved. According to these authors the share of GDP for India and Korea has increased from 4.9 percent and 4.1 percent during 1950-60 to 5.3 percent and 6.5 percent during 1970-77 respectively. On the other hand during the same period for U.S.A. and Japan it has declined from 6.6 percent and 8.1 percent to 6.4 percent and 6.3 percent respectively. For China the same figure is stable around 4.1 percent. The over all share of transport in GDP for Pakistan, both in current and constant prices, seems to has touched its highest point.

The difference in share of transport sector at constant and current prices indicates either a change in terms of trade of transport sector vis a vis rest of the economy or there are some problems in valuation of output of transport sector. The implicit GDP deflators estimated from data of National Income Accounts, reported in Survey of Pakistan (1991-92), depict a quite contradictory picture under two different methodologies of estimating GDP (2). The general price rise in Transport and Communication Sector, with base 1959-60 (under old methodology), is higher than rest of the sectors of the economy, which

FIG-2.1 SHARE OF T&C IN GDP

[CURRENT AND CONSTANT 1980-81 PRICES]



indicates that a net transfer of resources has taken place over the years from other sectors of the economy to transport sector. However, according to the revised methodology adopted for estimating GDP, as mentioned in Survey of Pakistan, the terms of trade between transport sector and rest of the economy are clearly adverse to transport sector. Table 2.6 and Figures 2.2 and 2.3 explain this contradiction.

Table 2.6

DEFLATORS FOR DIFFERENT SECTORS
(1959-60 AND 1980-81 BASE)

YEAR	DEFLATORS			TERMS OF TRADE OF T&C VS OTHER SECTORS
	TRANSPORT AND COMM.	G.D.P	GDP EX. T & C	
BASE 1959-60				
1959-60	100.0	100.0	100.0	100.0
1961	103.7	104.0	104.0	99.7
1962	108.1	102.3	102.0	106.1
1963	105.1	102.2	102.0	103.0
1964	109.3	107.4	107.3	101.8
1965	116.5	112.2	111.9	104.2
1966	119.0	115.2	115.0	103.5
1967	132.0	125.9	125.5	105.2
1968	163.0	128.5	128.0	106.3
1969	137.7	129.0	128.3	107.3
1970	145.3	134.0	133.3	109.0
1971	152.3	140.5	139.8	109.0
1972	160.5	148.6	147.9	108.6
1973	180.9	171.7	171.0	105.8
1974	226.6	212.5	211.6	107.1
1975	287.6	259.3	257.4	111.7
1976	320.1	290.4	288.4	111.0
1977	349.3	320.7	318.8	109.6
1978	372.5	349.9	348.3	106.9
1979	402.5	368.9	366.5	109.8
1980	443.1	406.4	403.7	109.7

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YEAR	DEFLATORS: TRANSPORT AND COMM.	DEFLATORS: G.D.P	DEFLATORS: GDP EX. T & C	TERMS OF TRADE OF T&C VS OTHER SECTORS
BASE 1980-81				
1980	100.0	100.0	100.0	100.0
1982	105.8	109.6	110.0	96.2
1983	111.2	115.4	115.8	96.0
1984	116.2	126.5	127.6	91.1
1985	116.9	132.1	133.8	87.4
1986	120.1	136.3	138.1	87.0
1987	121.3	142.3	144.7	83.8
1988	129.9	155.9	158.9	81.8
1989	144.0	169.1	171.7	83.9
1990	150.5	179.9	183.0	82.3
1991	180.4	203.9	206.3	87.5

The value added in Transport and Communication Sectors has shown an over all upwards trend at an average rate of about 7% per annum. The trend growth equation, estimated with semi-log method, is as following :-

$$\text{T-GDP} = 8.43 + 0.072\ \text{TREND} \qquad [2.1]$$

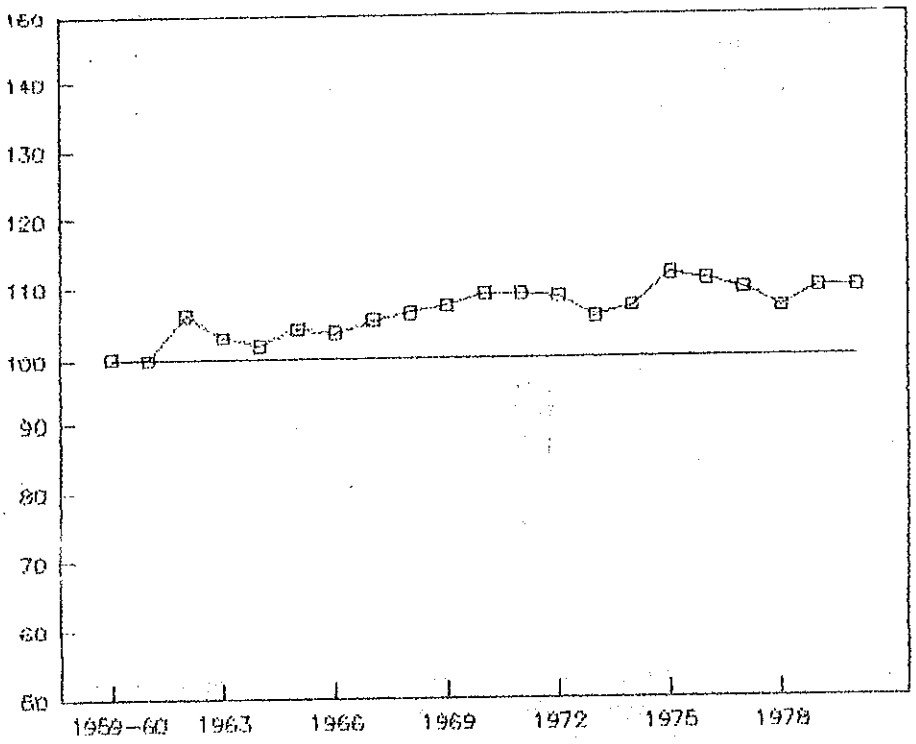
(T-GDP stands for share of Transport and Communication Sector in total GDP at factor cost 1980-81).

There is, however, significant fluctuations in the growth rate over various years, which is quite visible in Figures 2.4 and 2.5. Such fluctuations normally are expected in agriculture sector, because of its dependence on nonpredictable natural factors. The fluctuations in transport sector could not be explained and need further investigation.

The average rate of growth for total GDP, as compared to value added in Transport and Communication Sector, is only about 5 percent per annum (at constant 1980-81 factor cost (3). As a result the share of Transport and Communication Sector in total GDP has increased over the years (though it is partly offset in current prices by adverse terms of trade discussed above).

FIG–2.2 TOT OF T&C VS.OTHER SECTORS

[OLD METHODOLOGY WITH 1959–60 BASE]



FIG–2.3 TOT OF T&C VS.OTHER SECTORS

[NEW METHODOLOGY WITH 1980–81 BASE]

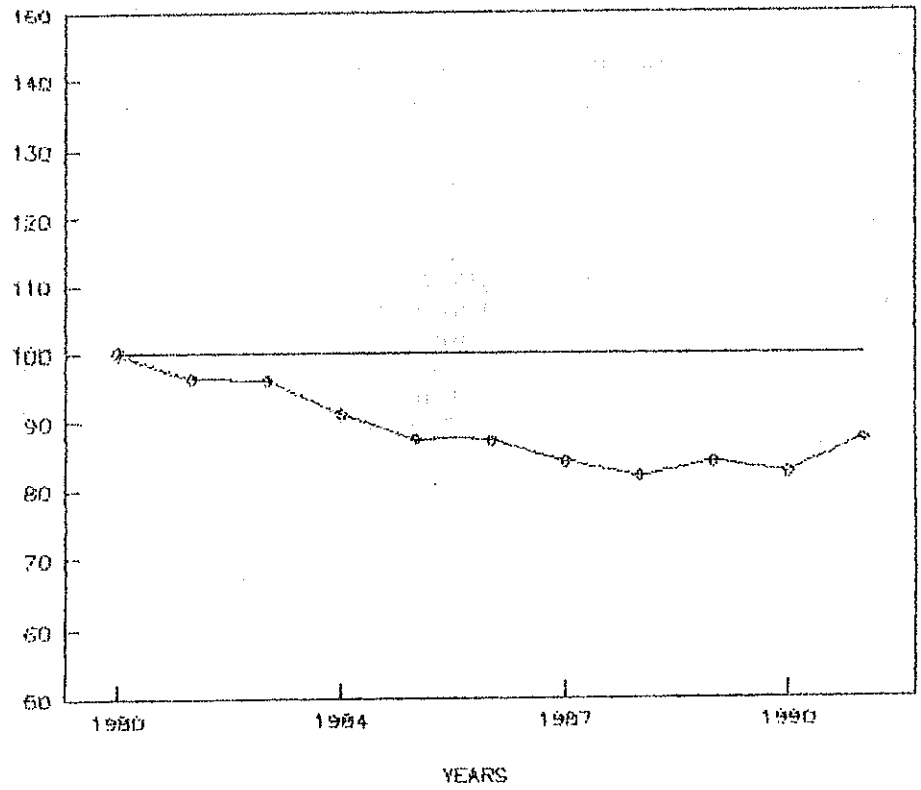


FIG-2.4 VALUE ADDED OF T&C IN GDP
[1980-81 FACTOR COST]

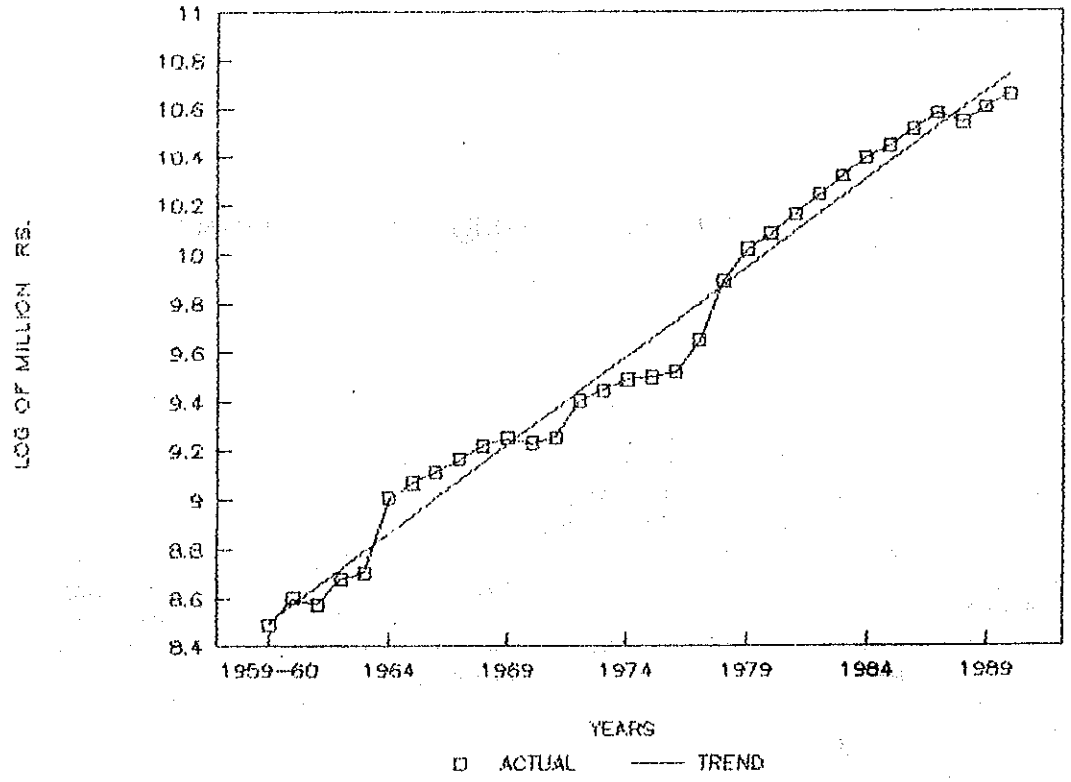
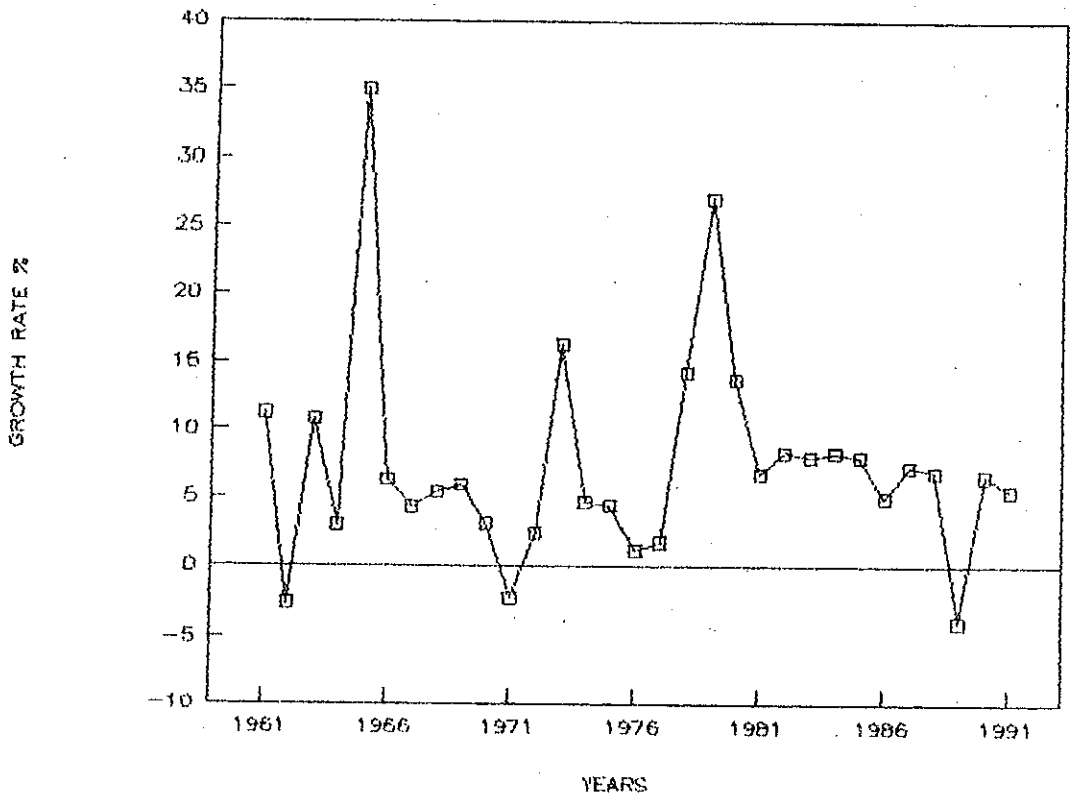


FIG-2.5 GROWTH OF VALUE ADDED OF T&C SECTOR
[1980-81 FACTOR COST]



CHAPTER - 3

EVOLUTION OF CAPITAL STOCK ASSETS AND INVESTMENT IN TRANSPORT SECTOR

3.1 Capital Stock Series of Transport Sector

In order to estimate the average and marginal productivity of capital for a sector as a whole the capital stock series for that sector is needed. In addition the capacity expansions of a sector depends on gross investment less consumption of existing capital stock (i.e depreciation). Unless there is some estimate of total capital stock and the average rate of depreciation of the capital stock, it is not possible to have a realistic estimate for capacity expansion. In other words it is net investment (i.e gross investment less depreciation) which is important indicator of capital formation and not the gross investment.

Since some sectors have rapidly depreciating stock the total investment requirement of such sectors, other things being given, is higher. The rate of depreciation of capital stock in transport sector is, for example, higher than other sectors. According to National Accounts Statistics of United Nations (1985) the rate of depreciation of capital stock for various sectors in Pakistan is as in Table 3.1.

Table 3.1

AVERAGE RATE OF DEPRECIATION

S.No.	Sector	Percent
1.	Agriculture	5
2.	Mining	5
3.	Industry(L)	10
4.	Industry(S)	5
5.	Gas & Electricity	7
6.	Construction	2.5
7.	Transport & Communications	10

Source: National Accounts Statistics, United Nations (1985)

Note: L and S in parenthesis stand for Large Scale and Small Scale.

It is quite clear from the data in Table 3.1 that rate of depreciation in the Transport and Communication sector is highest only equated by the large scale manufacturing. In other words, other things being equal, the investment demand of Transport and Communication Sector must be relatively larger in order to compensate for the higher rate of depreciation.

Sectoral (as well as total) capital stock series are not readily available for Pakistan (1). However, the capital stock series can be developed by using the relationship between capital stock and value added as recommended by Dadkhah and Zahedi (1986). According to their methodology the capital stock for a particular year can be determined on the basis of the following relationships :-

$$Qt = aKt + Et \qquad [3.1]$$

$$Kt = (1-L)Kt-1 + It \qquad [3.2]$$

and therefore

$$Qt = a(1-L)Kt-1 + aI + Vt \qquad [3.3]$$

$$= (1-L)Qt-1 + aI + Vt \qquad [3.4]$$

Where:

Qt = Output (i.e value added)

Kt = Capital Stock

L = Rate of depreciation of capital stock

It = Gross Fixed Investment.

a = Output Capital Ratio (and 1/a is, therefore, conventional capital output ratio)

Et = error term

Vt = Et-(1-L)Et-1

If the rate of depreciation is known or fixed in advance then equation [3.4] can be simply solved for 'a' and capital stock for a particular year estimated as following :

$$a = (Qt - (1-L)Qt-1)/It \qquad [3.5]$$

and

$$Kt = Qt/a \qquad [3.6]$$

The equation [3.4] is also quite suitable for Ordinary Least Square (OLS) regression. The error term 'E' by definition is assumed to be randomly distributed with zero mean. The regression has an additional advantage that it also estimates the rate of depreciation. The regression approach was used for estimating '1-L' and 'a'. The estimated equation is as following :-

$$Qt = 0.91\ Qt\text{-}1 + 0.55\ It \qquad [3.7]$$

(25.3) (4.0)

(The percise estimate of 'a' is 0.54997 which has been rounded in equation to 0.55). (Figures in parenthesis are 't' ratios and significant at 1%).

Where:

Qt = Value Added in Transport and Communication Sector at constant 1980-81 prices.

It = Gross Investment of Transport Sector at constant 1980-81 prices.

The parameters ('1-L' and 'a') are very much up to the expectation. As reported in Table 3.1, according to United Nations National Income Accounts, the average rate of depreciation for transport sector in Pakistan is 10 percent per annum. The estimated parameter 0.91 (=1-L) gives the rate of depreciation of 9 percent per annum as following :-

$$1\text{-}L = 0.91 \qquad [3.8]$$

and therefore,

$$L = 1 - 0.91 \qquad [3.9]$$
$$= 0.09 \quad \text{i.e. } 9\% \text{ (per annum)}$$

According to equation 3.6 the value of capital stock, at constant 1980-81 prices, for 1978-79 will be as following (2) :

$$K77\text{-}78 = Qt\ 1977\text{-}78 / a \qquad [3.10]$$
$$= 11973 / 0.54997 \qquad [3.11]$$
$$= 21770 \text{ Million Rs.}$$

(11973 is value added in million Rs. during 1977-78 for Transport and Communication Sector at constant 1980-81 prices). After estimating this base line figure the capital stock series can

easily be developed forwards and backwards using the relationship described in equation [3.2].

The data for gross capital formation in transport sector is separately available in current prices for following sub-sectors for the period 1978-79 onwards.

1. Private Sector

2. Public Sector

   (i) Railways
   (ii) Post Office and T&T
   (iii) Other

Investment in 1 and 2, but excluding 2(ii) has been taken as investment of transport sector. Investment has been brought to constant prices by using the overall GDP deflator described in Chapter-2 (3). The total investment, capital stock and total depreciation for the transport sector in Pakistan is estimated to be as in Table 3.2.

Table 3.2

INVESTMENT, CAPITAL STOCK AND DEPRECIATION *
(CONSTANT 1980-81 PRICES) (Million Rs.)

Y E A R	GROSS CAPITAL FORMATION	CAPITAL STOCK	DEPRECIATION
1977-78	3,583.8	21,770.0	-
1979	4,272.0	23,394.5	1,959.3
1980	9,162.7	25,561.0	2,105.5
1981	5,875.0	32,423.2	2,300.5
1982	5,638.7	35,380.1	2,918.1
1983	4,406.8	37,834.5	3,184.2
1984	4,811.5	38,836.2	3,405.1
1985	6,730.8	40,152.5	3,495.3
1986	6,859.8	43,270.6	3,613.7
1987	7,177.3	46,235.1	3,894.3
1988	6,344.8	49,251.3	4,161.2
1989	5,923.9	51,163.5	4,432.6
1990	5,616.1	52,482.8	4,604.7
1991	6,907.6	53,375.4	4,723.4

* Depreciation @ of 9%.

On average capital stock in transport sector, in real terms, has been increasing at compound rate of about 7 percent per annum. The semi-log growth equation for capital stock is as following :-

$$kT = 10.02 + 0.07\ TREND \qquad [3.12]$$

(kT Stand for natural log of capital stock in transport sector)

Figure 3.1 shows the overall rising trend of capital stock.

As a result of significant variations in the net investment (to be discussed in detail in the following section) the different rate of change in capital stock is quite visible in Figure 3.1.

3.2 Investment in Transport Sector

In order to achieve rapid economic growth, Pakistan has adopted the conventional wisdom of accelerating the rate of investment. In view of limited domestic resources it has resorted heavily on foreign capital to achieve this objective. In this regard the economic strategy has been particularly influenced by the development and growth theories of 1950s and 1960s. Development of infrastructure has, therefore, received special attention. In this section the investment pattern of transport sector, in the recent past, has been analyzed.

The share of transport sector investment (in real terms), as percent of total investment, has been varying from year to year as shown in Table 3.3.

FIG--3.1 TRANSPORT SECTOR CAPITAL STOCK

[CONSTANT 1980-81 PRICES]

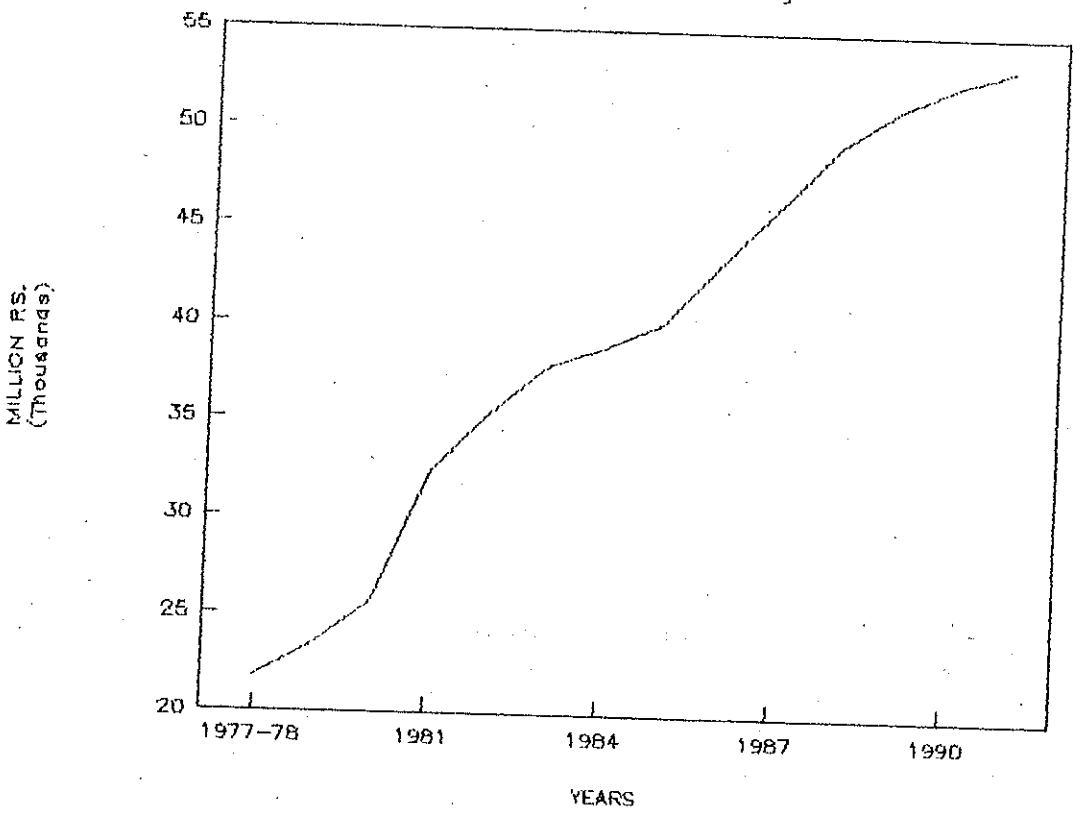


Table 3.3

TRANSPORT SECTOR INVESTMENT AS% OF TOTAL INVESTMENT

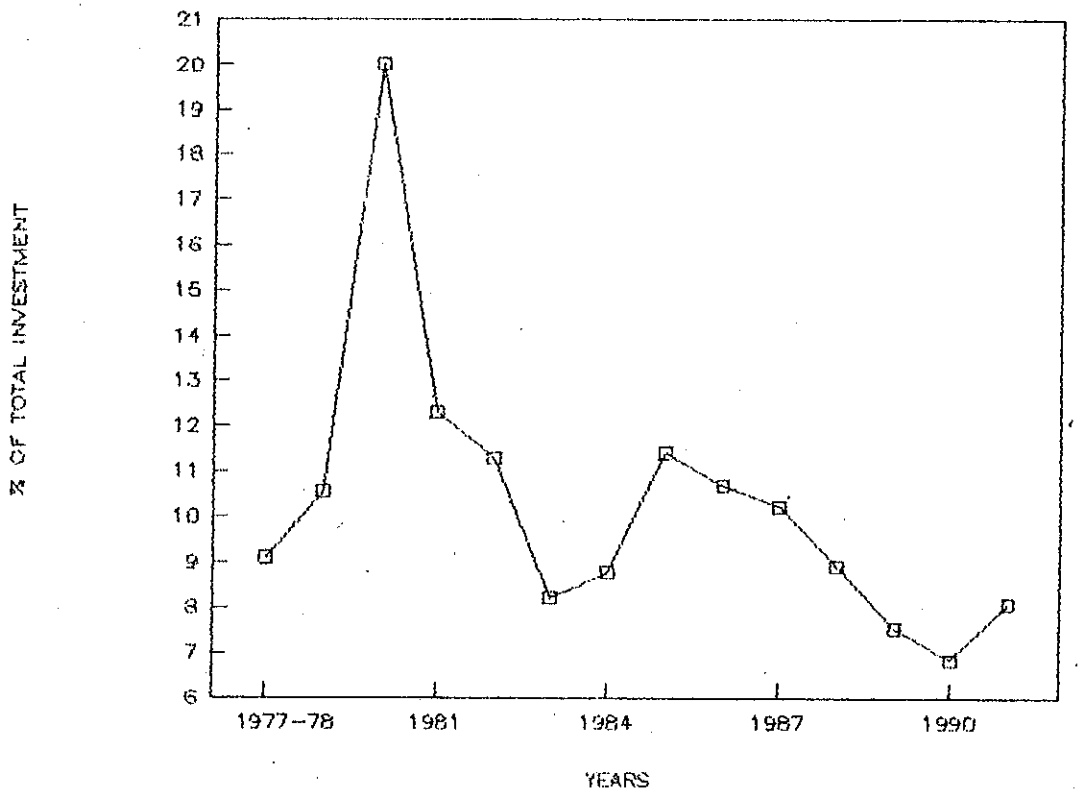
Y E A R	PERCENT
1977-78	9.1
1979	10.5
1980	20.0
1981	12.3
1982	11.3
1983	8.2
1984	8.8
1985	11.5
1986	10.7
1987	10.2
1988	8.9
1989	7.5
1990	6.8
1991	8.1

In real terms (3) the investment in transport sector is following some what a cyclical pattern (see Figure 3.2). This implicitly indicates that current level of investment, among other things, is also affected by the previous level of investment. At present the trend is clearly upward.

An important phenomenon of investment in transport sector, which is not given adequate consideration, is the replacement of depreciated stock. If depreciation is accounted for the net addition to the total capital stock, some time, is only a fraction of total investment. For example during the year 1989-90 net investment was only about 18% of gross capital formation. A yearly comparison of gross versus net capital formation in the transport sector is provided in Table 3.4 (also see Figure 3.3).

FIG–3.2 SHARE OF TRANSPORT INVESTMENT

[PERCENT]



FIG–3.3 GROSS AND NET CAPITAL FORMATION

[CONSTANT 1980–81 PRICES]

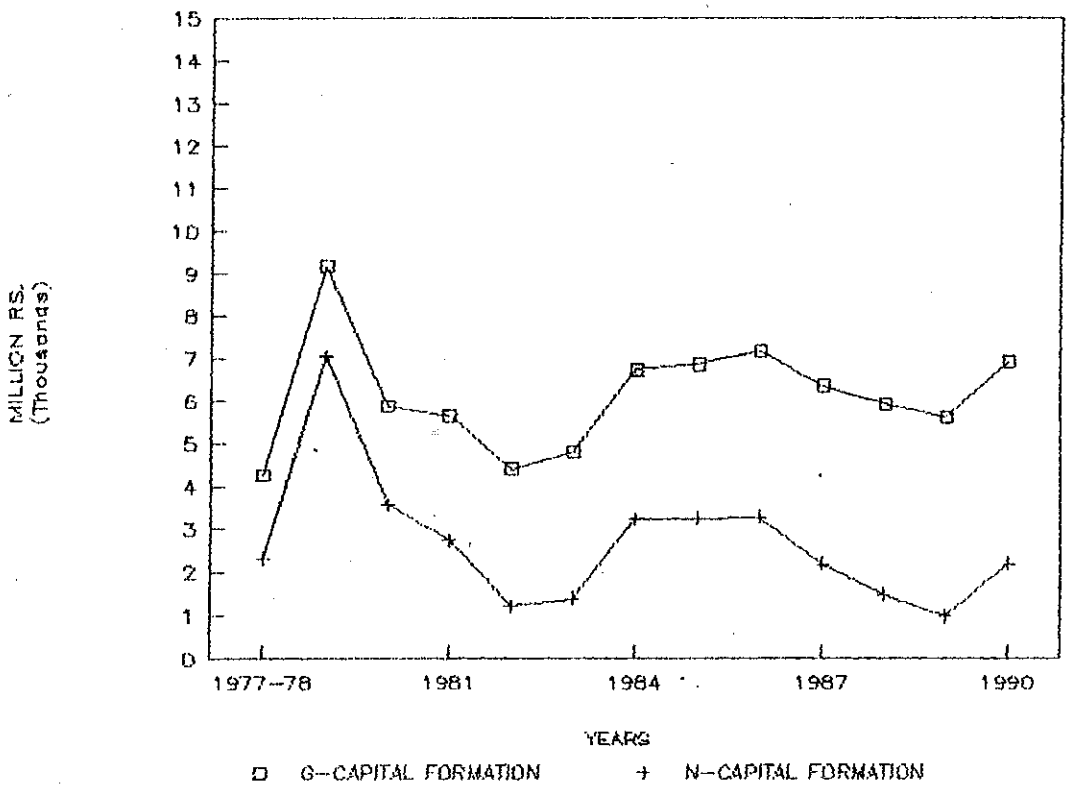


Table 3.4

GROSS INVESTMENT, DEPRECIATION AND NET INVESTMENT
(Constant 1980-81 Prices)

Million Rs.

YEAR	Gross Capital Formation	Depre-ciation	Net Capital Formation	Net As % Gross Investment
1977-78	3,584	-	-	-
1979	4,272	1,959	2,321	54.3%
1980	9,163	2,106	7,057	77.0%
1981	5,875	2,300	3,575	60.8%
1982	5,639	2,918	2,721	48.2%
1983	4,407	3,184	1,223	27.7%
1984	4,812	3,405	1,407	29.2%
1985	6,731	3,495	3,236	48.1%
1986	6,860	3,616	3,244	47.3%
1987	7,177	3,894	3,283	45.7%
1988	6,345	4,161	2,184	34.4%
1989	5,924	4,433	1,491	25.2%
1990	5,616	4,605	1,011	18.0%
1991	6,908	4,723	2,185	31.6%

Note: Figures slightly differ from table 3.2 because of rounding.

Investment for the economy has been regularly growing over past several decades. The average annual growth rate of total investment, in real terms, has been about 7.1 percent per annum for the period 1978-79 to 1990-91. During the same period investment in transport sector has increased only at a rate of 2.4 percent per annum. The growth equations estimated with semi-log method, for total investment and investment in transport sector are as following :-

$$i = 9.87 + 0.071 \text{ TREND} \qquad [3.13]$$
$$iT = 8.48 + 0.024 \text{ TREND} \qquad [3.14]$$

Where 'i' and 'iT' stand respectively for natural logs of investment (1980-81 prices) for the economy as a whole and transport sector.

Though there is some growth in gross investment, the net investment (after deducting depreciation) has even declined in real terms. The over all trend for net investment is negative as following :-

$$Ni = 8.2 - 0.06\ TREND \qquad [3.15]$$

(Ni stands for natural log of net investment).

There is a significant change in the pattern of investment of various sub-transport sectors. Table 3.5 (also presented in Figure 3.4), shows the share in investment of various sub-sectors.

Table 3.5

SHARE IN TRANSPORT INVESTMENT

YEAR	PRIVATE	RAILWAY	OTHER	TOTAL
1977-78	44.2	23.6	32.2	100.0
1979	39.7	16.7	43.7	100.0
1980	25.4	10.7	63.9	100.0
1981	31.5	18.9	49.6	100.0
1982	28.8	22.6	48.6	100.0
1983	38.2	26.6	35.2	100.0
1984	39.3	16.3	44.3	100.0
1985	35.5	15.3	49.2	100.0
1986	39.3	19.1	41.6	100.0
1987	42.8	17.0	40.3	100.0
1988	52.4	14.2	33.3	100.0
1989	63.4	2.0	34.7	100.0
1990	60.3	5.6	34.0	100.0
1991	61.9	8.9	29.2	100.0

The share of private sector has continuously increased in total transport sector investment. The share of private sector which was fluctuating between 37% to 40% is above 60% since 1989. On the other hand there is significant fall in the share of railways and was only 2% during 1989. However, the situation of investment in railways has reversed during 1989-90 and 1990-91. Since 1978-79 only private sector has shown an upward trend in real investment. For railways and other sub-sectors the position is almost stagnant. The semi-log growth equations of various sub-sectors are as following :-

In view of data limitation in developing countries most often a more restricted equation as :-

$$dy = adk \qquad [3.21]$$

is estimated where only capital is assumed to be productive factor. The equation [3.19] is thus less restricted (4).

The estimated equation for Pakistan is as following :-

$$dyT + = 707.6 + 0.25\ dkT \qquad [3.22]$$

(dyT and dkT stand for change in value added and capital stock of transport sector).

The Incremental Output Capital Ratio (IOCR) of 0.25:1, or the ICOR of 4:1 indicates that efficiency of capital for transport sector (i.e ICOR) is relatively high compared to total economy which is estimated to be 3:1.

The important point is that the Average Capital Output Ratio of 1.82 (Output Capital Ratio is 0.55), estimated in equation [3.7] is significantly lower than ICOR. This implicity suggests that over the years capital deepening is taking place in the transport sector as a result of which the productivity of capital has declined. The capital deepening implicitly suggests that labour is being continuously replaced by capital in transport sector. Thus, it is equally important to investigate the relationship of capital and labour and the labour productivity.

3.3.1 Capital Intensity and Labour Productivity

Capital is most often considered to be the limiting factor for growth and development of developing countries. Most of the growth theories of 1950s and 1960s have been developed on this paradigm. A choice between capital intensive and labour intensive techniques, in the context of developing countries, has therefore received extensive attention in order to ensure optimal utilization of limited capital resources. Howard (1980), has empirically demonstrated that how substantial private and social benefits can be obtained by systematically adopting appropriate technology (5).

The overall capital intensity of an economy is the average capital intensity of various sectors. The evaluation of capital intensity of various sectors is thus of special significance. The change in capital intensity of the transport sector vis-a-vis rest of the economy (and its effects on the

labour productivity) has, therefore, been examined in this section.

The transport sector at the moment is providing employment to about 1.6 million labour force which is 4.9% of total labour employed in Pakistan. This relative share is more or less constant over past two decades. However, the capital requirements for labour, in real terms, have increased gradually over years. The capital labour ratio, for example, has increased in real terms (1980-81 prices) from rupees 20,157 during 1978-79 to about rupees 34,226 (i.e by about 70%) during 1990-91 per worker as compared to rupees 12,704 and rupees 18,356 for the economy as a whole for the same period. There is, thus, a clear further deepening of capital in the transport sector, which was already higher than the national average.

In absolute terms the gap of capital requirement for employing one worker in the transport sector has substantially increased to Rs.15,870 during 1990-91 which was only 7,453 per worker during 1978-79. In relative terms, capital labour ratio has also subtantially increased from national average. During 1990-91 it is 86% higher than the national average as compared to 59% during 1978-79. In total, while transport sector is providing employment to 4.9% of total labour force its capital stock is about 8.8% of capital stock for the whole economy (6).

The deepening of capital is most often associated with the increase in labour productivity. In transport sector too, this has happened. A close association between capital-labour ratio and output-labour ratio can be seen in Figure 3.5. The co-efficient of correlation for these variables is 0.94. Assuming that output-labour ratio is dependent upon the capital-labour ratio, the regression co-efficient (with natural logs of both variables) is as following :-

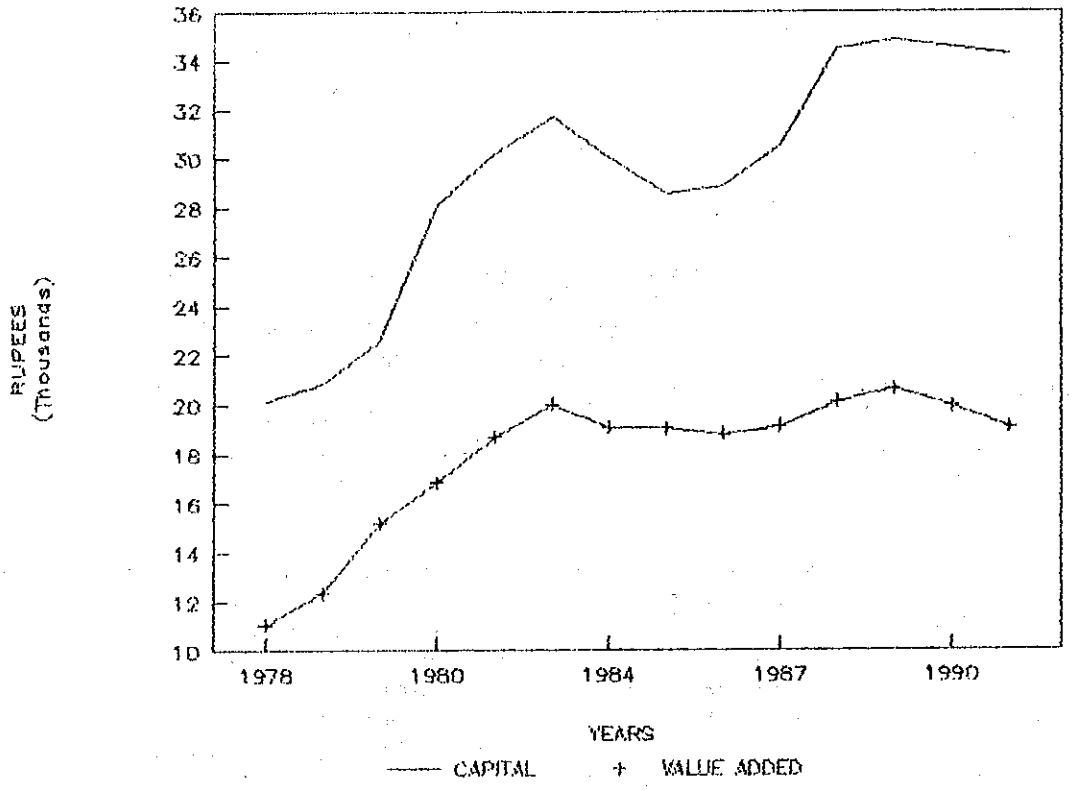
$$\underset{(-4.2)\ (9.9)}{l/o = (-).285 + 0.98\ k/l} \qquad [3.22]$$

Where l/o and k/l stand for the natural logs of labour-out put ratio and capital-labour ratio respectively. (Figures in parenthesis are 't' ratios which are significant at 1%).

It may be noted that elasticity of response of increase in productivity to capital deepening is close to 100% and statistically highly significant. This clearly shows that technological advancement in transport sector is quite fast in the economy and has also significantly improved the labour productivity. The value added in real terms (1980-81 prices) per

FIG–3.5 V–ADDED AND CAPITAL PER LABOUR

[1980–81 PRICES]



worker in the transport sector, which was rupees 11,086 during 1977-78, has increased to rupees 19,100 by the year 1990-91 i.e. by about 72.3%.

The productivity in the transport sector is also higher than the national average. The average productivity per labour for the economy was only rupees 8,679 during 1977-78 (compared to rupees 11,086 in the transport sector) and has increased to rupees 12,791 during 1990-91 (compared to rupees 19,101 in the transport sector). The improvement in productivity for the economy as a whole during 1978-91 is only 47.4%, (as compared to 72.3% in transport sector). Table 3.6 provides the yearly changes in capital-labour and output-labour ratio for the economy and transport sector.

Table 3.6

CAPITAL-LABOUR AND OUTPUT-LABOUR RATIOS

	TOTAL ECONOMY		TRANSPORT SECTOR	
YEAR	K/L RUPEES	Q/L RUPEES	K/L RUPEES	Q/L RUPEES
1978	12704	8679	20157	11086
1979	13533	8958	20868	12334
1980	14372	9400	22582	15188
1981	15337	9808	28138	16843
1982	16005	10322	20161	18698
1983	16600	10622	31694	20016
1984	17133	10661	29993	19089
1985	18112	11328	28558	19049
1986	18234	11150	28909	18815
1987	18843	11324	30473	19147
1988	18743	11654	34510	20120
1989	18642	12191	34856	20615
1990	18298	12281	34558	19921
1991	18356	12791	34226	19101

Note: K/L and Q/L stand for capital-labour and output-labour ratios.

The discussion in the preceeding paragraphs clearly suggests that development in transport sector, in terms of capital deepening and increase in productivity, is relatively faster than rest of the economy. This aspect needs further investigation with sub-sector analysis to identify the reasons

which are responsible for this behaviour. The internal structure of the transport sector is complicated and diversified and the mode of transport in itself dictates the intensity of capital. The pipeline transport, for example, is highly capital intensive while road transport is relatively labour intensive. However, the possibilities of substitution between labour and capital and vice-versa in road construction, goods handling, automation of various activities at ports, in railways and airports are always there. It is not possible to make a judgement that whether the extent of capital intensity in various sub-sectors (and ultimately micro projects) is balanced and desirable. The reliance on capital intensive methods could be because of one or combination of following reasons :-

(i) The technology selected may be the most efficient and selected on its own financial, economic and technical merits.

(ii) The government interest rate, exchange rate, fiscal, and minimum wage (including all kinds of benefits for workers) policies make it more convenient and financially attractive to select capital intensive techniques though they may not be economically or socially desirable (7).

CHAPTER - 4

FREIGHT AND PASSENGER TRAFFIC

4.1 Traffic Intensity

The contribution of transport sector to GDP and productivity has been discussed in detail in Chapter 3. The transport sector was found to be capital intensive than rest of the economy. The traffic intensity i.e. ratio of traffic to gross national product (GNP) is also very high. Table 4.1 shows the passenger and freight intensities.

Table 4.1

FREIGHT AND PASSENGER TRAFFIC INTENSITIES

YEAR (1)	PKM/GNP (pkm) (GNP IN RUPEES)	TKM/GNP (tkm) (GNP IN RUPEES)	TRAFFIC UNIT IN RUPEES	PKM/GNP$ (pkm) (GNP IN US $)	TKM/GNP$ (tkm) (GNP IN US $)	TRAFFIC UNIT IN $ @
1971-1972	0.29	0.10	0.39	5.01	1.71	6.72
1973	0.31	0.10	0.41	8.79	2.93	11.72
1974	0.32	0.10	0.42	6.99	2.11	9.10
1975	0.33	0.10	0.44	5.94	1.85	7.78
1976	0.32	0.10	0.42	5.08	1.57	6.64
1977	0.32	0.09	0.42	4.61	1.35	5.96
1978	0.31	0.09	0.41	4.09	1.20	5.29
1979	0.31	0.10	0.41	3.86	1.25	5.11
1980	0.31	0.10	0.41	3.44	1.11	4.56
1981	0.31	0.10	0.41	3.06	0.96	4.02
1982	0.31	0.09	0.41	3.02	0.89	3.92
1983	0.31	0.09	0.40	3.42	0.99	4.40
1984	0.31	0.09	0.41	3.36	0.98	4.35
1985	0.31	0.09	0.40	3.58	1.03	4.60
1986	0.31	0.09	0.40	3.68	1.12	4.80
1987	0.31	0.09	0.40	3.78	1.11	4.90
1988	0.32	0.09	0.41	3.61	1.04	4.64
1989	0.33	0.09	0.42	3.69	1.04	4.74
1990	0.33	0.09	0.42	3.45	0.95	4.40
1991	0.33	0.09	0.42	3.20	0.87	4.07

@"Traffic Unit=tkm+pkm"{as defined by Yenny and Lily (1985 P/12)}

Note: Calculations are based on data given in the Report of the Working Group on "Traffic Forecast for the Eighth Five Year Plan 1993-98" and Economic Survey of Pakistan (1991-92).

GNP has been converted into $ at official exchange rate (deflated by implicit GNP deflator) of corresponding year.

The traffic intensity is fairly stable if GNP is measured in rupees and slightly declines in $ terms.

If compared with other countries, Pakistan is highly traffic intensive. Traffic intensity for some countries, estimated by Yenny and Lily (1985) are produced in Table 4.2.

Table 4.2

TRANSPORT INTENSITY

	pkm	tkm	Traffic Unit
China (81)	0.91	3.10	4.01
USSR (80)	0.64	4.32	4.96
USA (81d)	0.98	1.81	2.79
India (81)	3.41	1.67	5.08
Korea (81)	0.87	0.47	1.34
Japan (80)	0.59	0.41	1.00

Source: Yenny and Lily (1985) P/2.

Transport intensity is affected by a number of factors, such as country size, location of resources, total and regional distribution of population, composition of GDP, extent of processing industry etc. Country size is the most important factor affecting the transport intensity for freight traffic. For example for Japan and USA freight transport lead i.e. average distance per ton Km compares as following :-

Table 4.3

AVERAGE FREIGHT DISTANCE IN JAPAN AND USA
(1980)

Country	Area (Million sq.km)	Ton (Million)	Ton km. (Billion)	Average Distance per one Ton (km.)
JAPAN	0.38	5985	439	73
USA	9.36	5501	4827	877

Source: Yenny and Lily (1985 p/8).

Total area of Pakistan is 796095 sq. km. The freight traffic in ton and ton-km for 1990-91 is as in Table 4.4.

Table 4.4

AVERAGE FREIGHT DISTANCE IN PAKISTAN

	Ton (Mill.)	Ton-km (Mill.)	Average Distance for one ton (km.)
(1) Rail	7.72	5709	740
(2) Road	157.44	35211	224
Total	165.16	40920	248

@ Figures rounded.

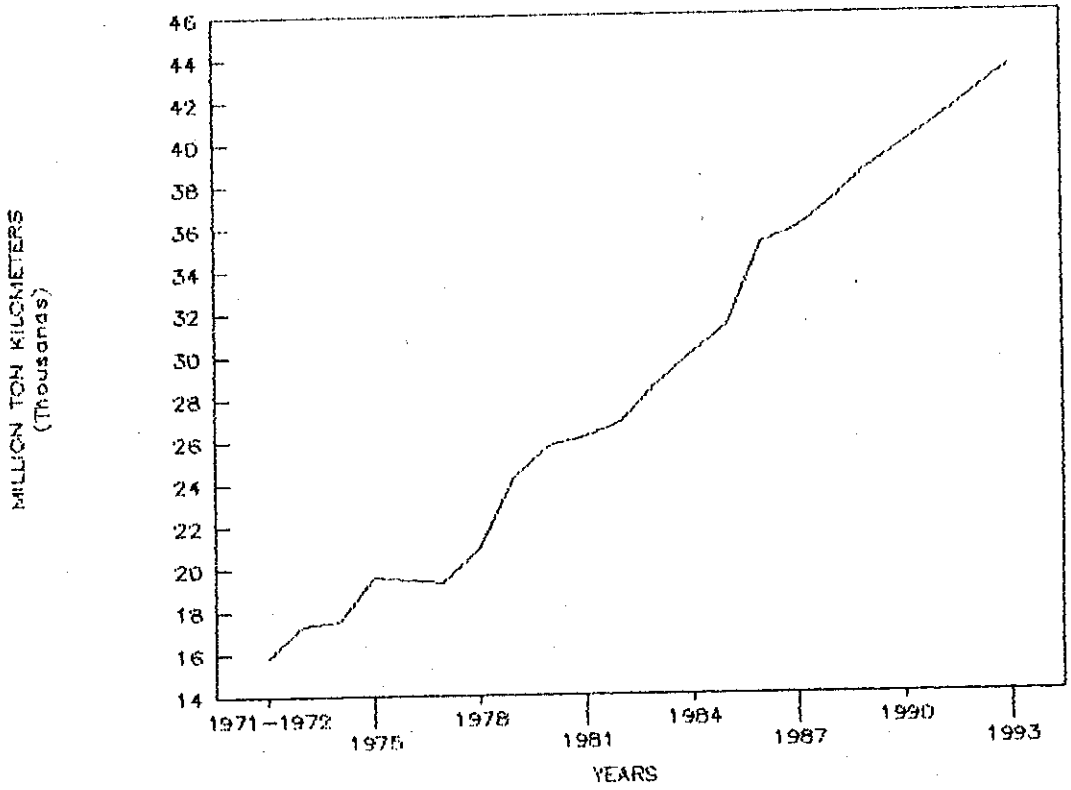
As expected per ton average distance for railways is higher than roads. During 1970-71 the average distance per ton for railways was 574 km. It appears that during past two decades road transport has taken mostly the short distance freight from railways and as a result average distance per ton for railways has increased.

4.2 Freight Growth

Domestic freight transported during 1990-1991 by means of rail, road and air reached to about 41 billion ton kilometre (TKM) from a level of 15.8 billion TKM during 1971-72. The average compound growth rate for the period 1971-91 is thus about 5.1% per annum. (Figure 4.1 shows the rapid rising trend). The modal split of freight traffic is given in Table 4.5.

FIG—4.1 FREIGHT TRAFFIC

[RAIL, ROADS AND AIR]



FIG—4.2 FREIGHT TRAFFIC

[RAIL]

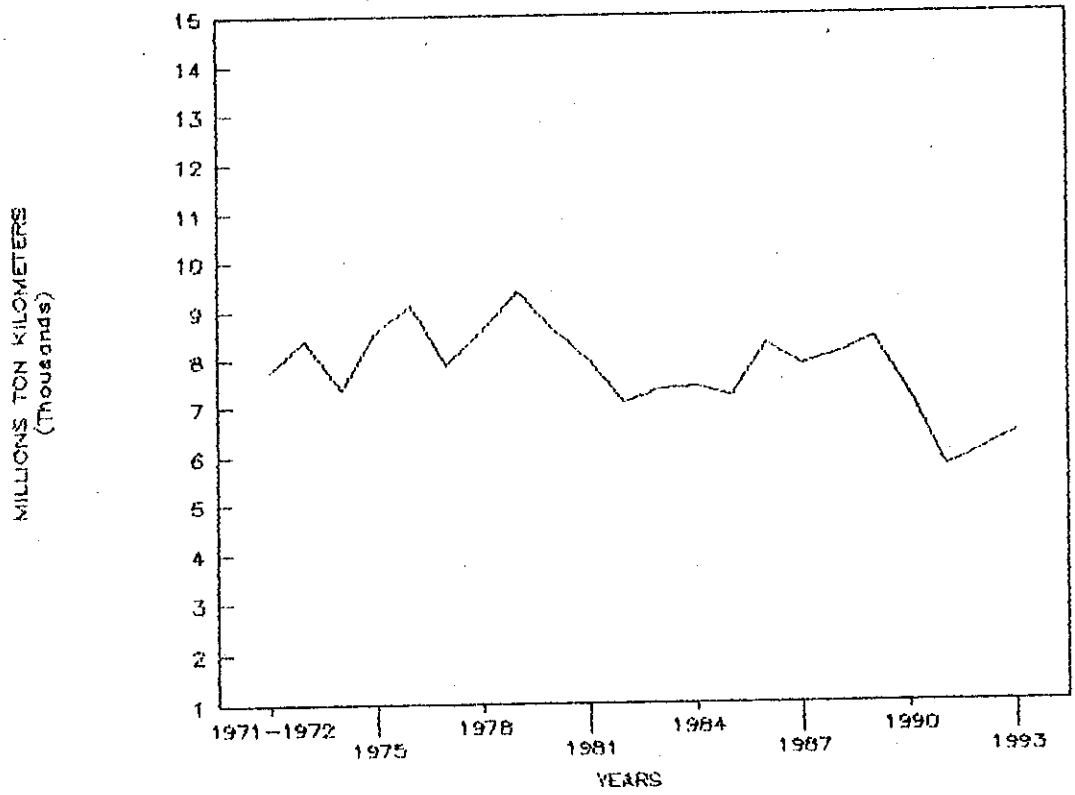


Table-4.5

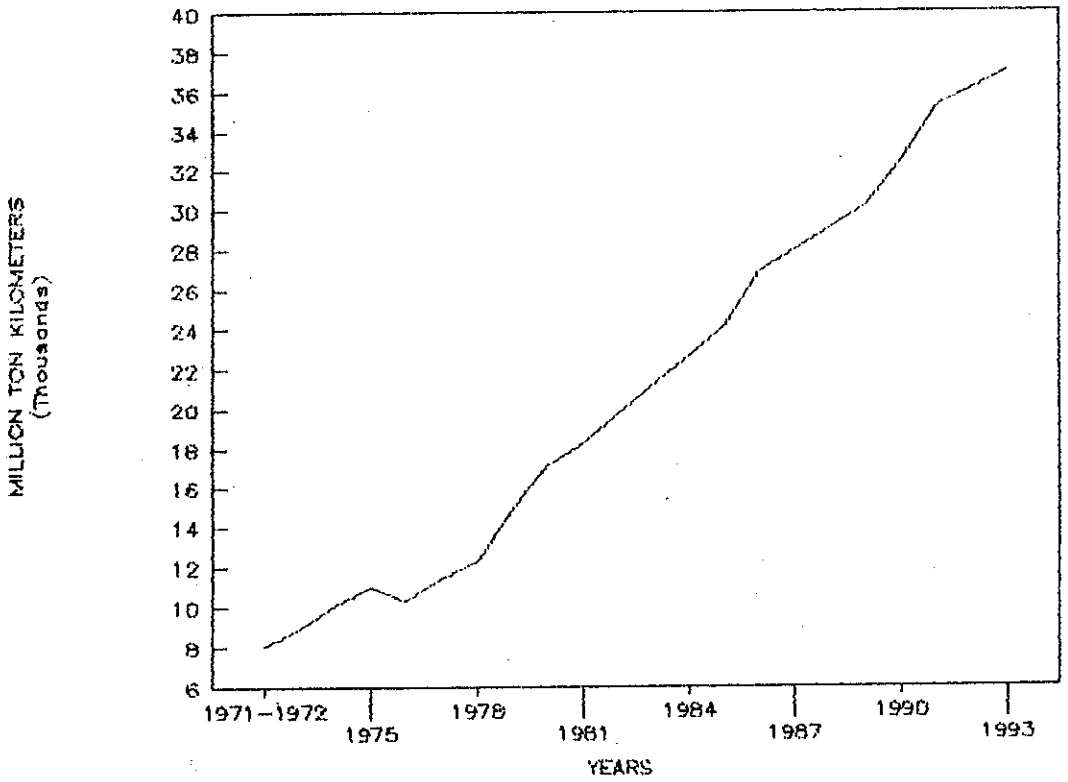
DOMESTIC TRAFFIC

YEAR	MILLION TON KILOMETERS			
	RAIL	ROAD	AIR	TOTAL
1971-1972	7756	8047	6	15809
1973	8363	8940	6	17309
1974	7370	10129	10	17509
1975	8544	11001	11	19556
1976	9097	10327	11	19435
1977	7857	11438	15	19310
1978	8557	12319	14	20890
1979	9375	14904	15	24294
1980	8598	17085	14	25697
1981	7918	18207	16	26141
1982	7066	19704	17	26787
1983	7323	21200	19	28542
1984	7385	22620	19	30024
1985	7203	24126	23	31352
1986	8270	26888	25	35183
1987	7820	27953	25	35798
1988	8033	29060	26	37119
1989	8364	30210	29	38603
1990	7226	32450	32	39708
1991	5009	35211	32	40952

Source:- Traffic Forecast for the Eighth Five Year Plan 1993-98 Report of the Working Group. NTRC - Govt. of Pakistan (April-1992).

It would be seen that while road and air traffic have sharply increased during 1971-1992, rail freight has declined in absolute terms. Figures 4.2 to 4.4 show the different trends. The yearly growth rates for total transport sector, as well as subsectors, are highly erratic with wide fluctuation as can be seen in Table 4.6.

FIG—4.3. FREIGHT TRAFFIC
[ROADS]



FIG—4.4 FREIGHT TRAFFIC
[AIR]

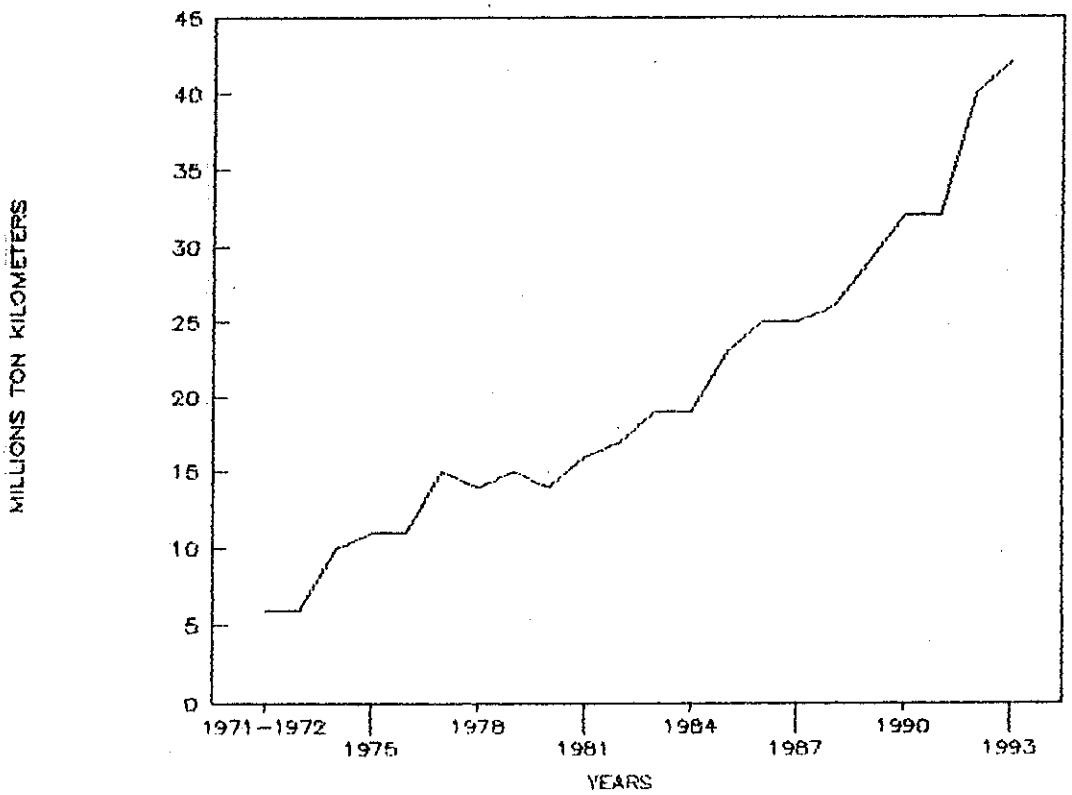


Table 4.6

DOMESTIC TRAFFIC GROWTH

YEAR	RAIL	ROAD	AIR	TOTAL
1971-1972				
1973	7.5%	10.5%	0.0%	9.1%
1974	-12.6%	12.5%	51.1%	1.1%
1975	14.8%	8.3%	9.5%	11.1%
1976	6.3%	-6.3%	0.0%	-0.6%
1977	-14.7%	10.2%	31.0%	-0.6%
1978	8.5%	7.4%	-6.9%	7.9%
1979	9.1%	19.0%	6.9%	15.1%
1980	-8.7%	13.7%	-6.9%	5.6%
1981	-8.2%	6.4%	13.4%	1.7%
1982	-11.4%	7.9%	6.1%	2.4%
1983	3.6%	7.3%	11.1%	6.3%
1984	0.8%	6.5%	0.0%	5.1%
1985	-2.5%	6.4%	19.1%	4.3%
1986	13.8%	10.8%	8.3%	11.5%
1987	-5.6%	3.9%	0.0%	1.7%
1988	2.7%	3.9%	3.9%	3.6%
1989	4.0%	3.9%	10.9%	3.9%
1990	-14.6%	7.2%	9.8%	3.9%
1991	-23.6%	8.2%	0.0%	3.1%
1992	5.7%	2.5%	22.3%	2.9%
1993	5.7%	2.5%	4.9%	2.9%

Source: Table 4.5.

The trend growth rates of freight traffic, estimated with semi-log method, for various modes of transport are as following :

tkm-TOTAL = 9.65+0.049 TREND [4.1]
tkm-Rail = 9.08-0.012 TREND [4.2]
tkm-Road = 8.90+0.076 TREND [4.3]
tkm-Air = 1.95+0.081 TREND [4.4]
(tkm stands for natural log of million TKM)

The highest growth of 8.1% has been for air freight which is closely followed by road transport with an annual compound growth rate of 7.6%. The base line figure for air freight is very low and as a result, probably, the growth rate is so high. The trend for railways is clearly negative.

The difference in growth rates of railways, roads and air has brought a significant change in the share of freight traffic for various modes of transport which is shown in Table 4.7.

Table 4.7

PERCENT SHARE IN DOMESTIC TRAFFIC

YEAR	RAIL	ROAD	AIR	TOTAL
1971-1972	49.1	50.9	0.04	100
1973	48.3	51.6	0.03	100
1974	42.1	57.9	0.06	100
1975	43.7	56.3	0.06	100
1976	46.8	53.1	0.06	100
1977	40.7	59.2	0.08	100
1978	41.0	59.0	0.07	100
1979	38.6	61.3	0.06	100
1980	33.5	66.5	0.05	100
1981	30.3	69.6	0.06	100
1982	26.4	73.6	0.06	100
1983	25.7	74.3	0.07	100
1984	24.6	75.3	0.06	100
1985	23.0	77.0	0.07	100
1986	23.5	76.4	0.07	100
1987	21.8	78.1	0.07	100
1988	21.6	78.3	0.07	100
1989	21.7	78.3	0.08	100
1990	18.2	81.7	0.08	100
1991	13.9	86.0	0.08	100

Source: Table 4.5.
Note:- (Because of rounding figures may not add up to 100).

The share of railways, which was about 50% during 1971-72, has declined to only about 14% during 1990-91. The shift is clearly towards the road transport. Air freight has also slightly increased its share in relative terms.

4.3 Freight Elasticity

The increase in traffic is normally associated with the overall economic activity in the economy. In the earlier stage of development, other things being equal, the elasticity of traffic, relative to Gross National Product (GNP), is expected to be greater than one and declines as economy moves to higher stages of development. Yenny and Lily (1985) have reported following elasticities with respect to GNP for various countries for freight traffic.

Table 4.8

(1)

FREIGHT ELASTICITIES

Country	Years	Elasticities
China	1965-1981	1.034
USA	1960-1981	0.941
India	1960-1981	0.921
Brazil	1960-1981	1.109
Japan	1960-1980	0.756
Korea	1961-1981	1.218

Source:- Yenny and Lily (1985 Table-2.1, p/42).

They have observed significant variations in elasticities for different sub periods (except for Japan). For India, for example, during 1960-81 the elasticities with respect to GNP have varied between 0.519 and 1.122.

The elasticity of freight traffic with respect to GNP is greater than 1 for the developing countries (except India). For unexplained reasons the elasticity has been very low (i.e 0.519) for the period 1976-81 and as a result the overall elasticity has declined to 0.921. For USA and Japan it is less than one. Korea, which has experienced a very rapid growth in the past, has the highest elasticity of 1.218. This implicitly suggests that in order to maintain a high rate of economic growth, transport sector has to develop very rapidly.

For Pakistan the total and subsector elasticities are described below :

The elasticities of air and road freight with respect to GNP {Equations 4.9 and 4.10} are very high. These elasticities are in conformity to the trend growth of these two subsectors which are higher than the growth rate of GNP. For roads, as discussed above, the shift of freight traffic from railways, is another reason of high elasticity.

4.4 Growth of Passenger Traffic

The passenger traffic in Pakistan reached to about 15 billion passenger kilometer (PKM) during 1990-91 from 4.6 billion PKM since 1971-72 - a more than three fold increase which gives an average annual compound growth rate of 6.4%. The trend growth rate, with semi log method, is as following :-

$$pkm = 10.76 + 0.058 \text{ Trend} \qquad [4.12]$$

The growth of passenger traffic has ben less erratic as compared to freight traffic. Table 4.9 gives the yearly growth rates for total and various sub-sectors. As in case of freight traffic the overall trend growth is higher for road and air.

Table 4.9

DOMESTIC PASSENGER TRAFFIC GROWTH

YEAR	PERCENT GROWTH			
	RAIL	ROAD	AIR	TOTAL
1971-1972				
1973	15.1%	10.5%	27.0%	11.6%
1974	5.5%	12.5%	32.3%	11.2%
1975	5.5%	8.1%	21.9%	7.7%
1976	4.8%	-1.2%	21.3%	0.3%
1977	1.9%	4.9%	20.4%	4.5%
1978	15.3%	5.5%	18.9%	7.7%
1979	8.3%	4.6%	6.3%	5.4%
1980	3.5%	6.5%	4.4%	5.8%
1981	-5.5%	7.8%	5.4%	5.0%
1982	0.7%	9.8%	3.3%	7.9%
1983	8.9%	8.9%	7.4%	8.9%
1984	1.4%	4.7%	8.8%	4.2%
1985	-2.7%	7.6%	9.9%	5.9%
1986	-5.5%	7.7%	10.2%	5.7%
1987	0.4%	5.5%	7.3%	4.8%
1988	9.1%	5.5%	8.2%	6.1%
1989	6.2%	5.5%	8.1%	5.7%
1990	3.2%	5.5%	-0.8%	5.1%
1991	-2.0%	5.5%	-1.9%	4.4%

The shift from railways to road is relatively at lower scale as compared to freight traffic. The trend growth equations, with semi-log method, for various modes of transport are as following :-

pkm-Rail = 9.32 + 0.03 TREND [4.13]
pkm-Road = 10.50 + 0.06 TREND [4.14]
pkm-Air = 8.30 + 0.06 TREND [4.15]

As a result of positive trend growth rates for all modes of transport (see also Figures 4.5 to 4.8), as against freight traffic, there is relatively smaller change in modal split of passenger traffic. The share in passenger traffic, which was 20.6%, 78.9% and 0.5% during 1971-72 has gradually changed to 13.3%, 85.2% and 1.5% for rail, road and air during 1990-91 respectively. Full details of modal split for the years1970-71 to 1990-91 are provided in Table 4.10.

FIG-4.5 PASSENGER TRAFFIC
[RAIL, ROADS, AND AIR (DOMESTIC)]

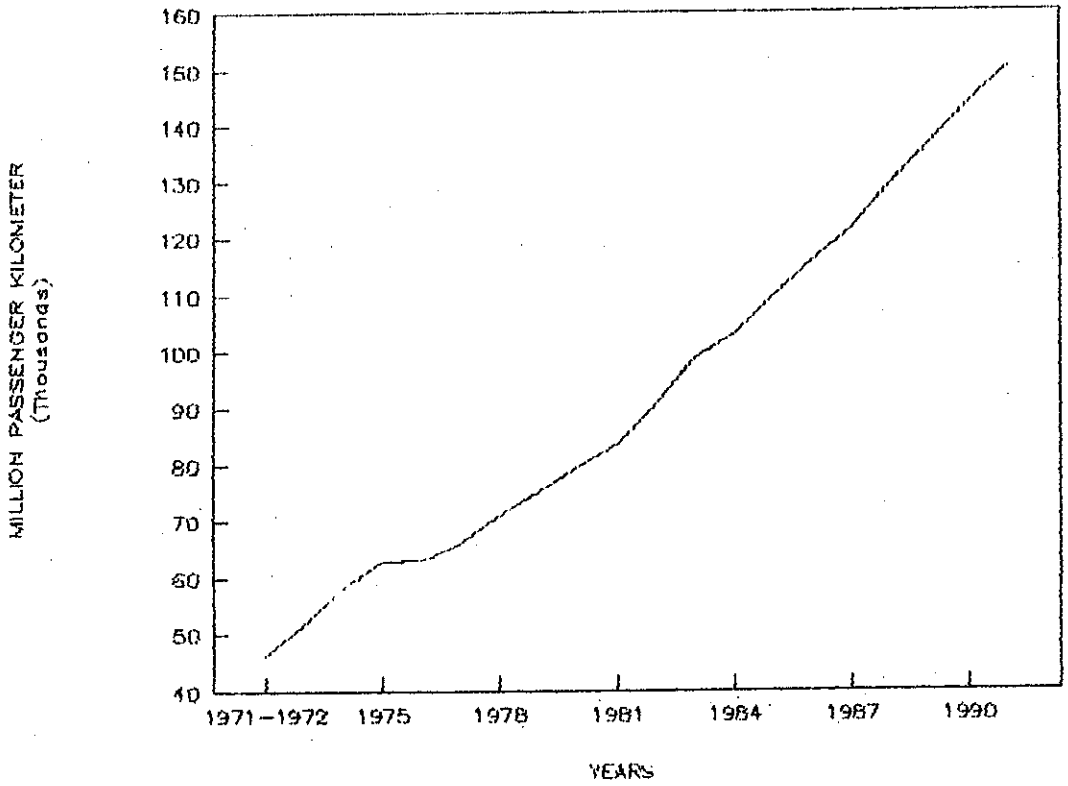
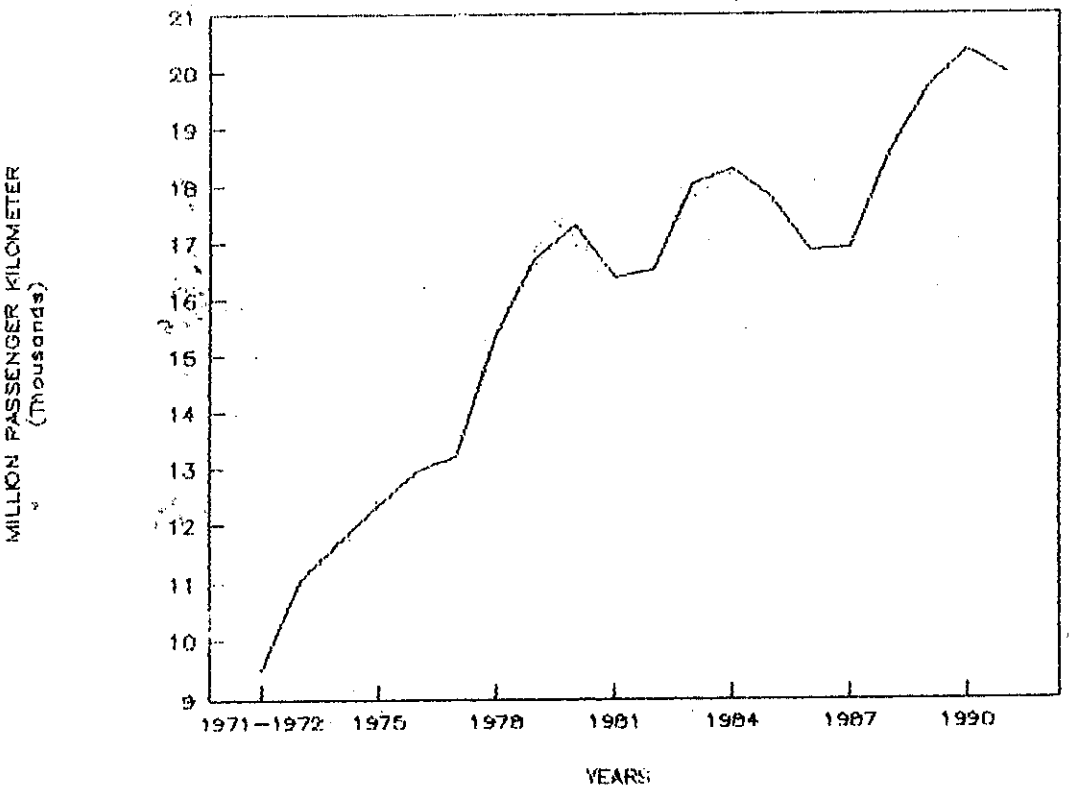
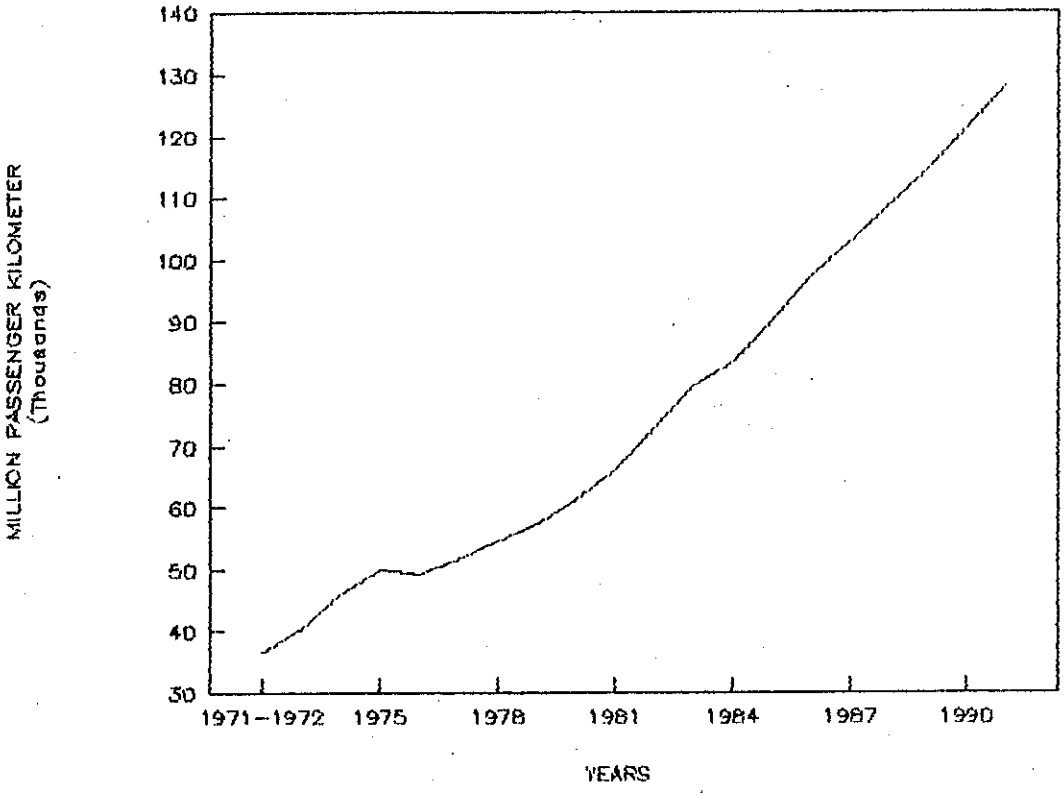


FIG-4.6 PASSENGER TRFFIC
[RAIL]



FIG–4.7 PASSENGER TRFFIC

[ROADS]



FIG–4.8 PASSENGER TRAFFIC

[PIA]

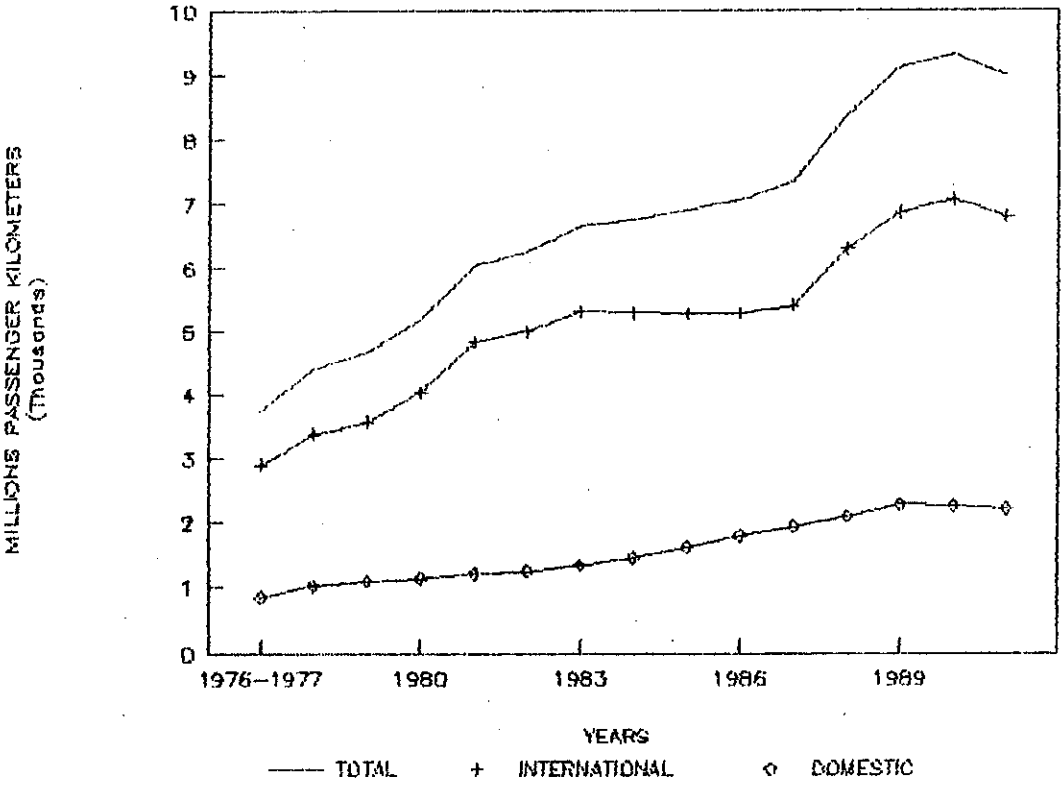


Table 4.10

DOMESTIC PASSENGER TRAFFIC

YEAR	PERCENT SHARE			
	RAIL	ROAD	AIR	TOTAL
1971-1972	20.6	78.9	0.5	100
1973	21.3	78.1	0.6	100
1974	20.1	79.1	0.8	100
1975	19.7	79.4	0.9	100
1976	20.6	78.3	1.1	100
1977	20.1	78.7	1.3	100
1978	21.6	76.9	1.4	100
1979	22.3	76.3	1.5	100
1980	21.8	76.8	1.4	100
1981	19.6	79.0	1.4	100
1982	18.2	80.4	1.4	100
1983	18.2	80.4	1.4	100
1984	17.7	80.8	1.4	100
1985	16.3	82.2	1.5	100
1986	14.5	83.2	1.5	100
1987	13.9	84.5	1.6	100
1988	14.4	84.0	1.6	100
1989	14.4	83.9	1.7	100
1990	14.2	84.3	1.6	100
1991	13.3	85.2	1.5	100

4.5 Elasticity of Passenger Traffic

The growth in passenger traffic, among other things, is mostly affected by the overall economic activity. Table 4.11 compares PKM per capita and GNP per capita for various countries.

Table 4.11

PKM PER CAPITA AND GNP PER CAPITA OF VARIOUS COUNTRIES

	PKM/Capita	GNP/Capita (US $)	(PKM/GNP)
China (1981)	252	278	0.90
India (1981)	785	232	3.38
Korea (1981)	1368	1576	0.87
Japan (1980)	5416	9173	0.59
USA (1981)	11193	11465	0.98
Pak. (1981)	997	326	3.06

Source: Yenny and Lily (1985 p/24), except Pakistan which is estimated.

It would be seen the only comparable country with Pakistan is India. The yearly historical values for Pakistan for the period 1971-91 are given in Table 4.12. The mobility in Pakistan is clearly very high.

The overall elasticity of passenger traffic with respect to GNP is slightly greater than 1 which is quite likely in view of the stable traffic intensity ratios (see Table 4.1). The elasticity equation is as following (1) :

$$\underset{\quad (-)\ 6.5}{pkm} = \underset{(-)\ 1.48}{} + \underset{(56.3)}{1.03\ gnp} \qquad [4.16]$$

R-SQR = 0.996 RSS = 0.0018 D.W 1.0

Table 4.12

GNP AND PKM PER CAPITA

YEAR	GNP PER CAPITA RUPEES	GNP PER CAPITA-$	PKM PER CAPITA	PKM/GNP RUPEES	PKM/GNP DOLLARS
			PKM/RUPEES/DOLLARS		
1971-1972	2485	146	731	0.29	5.0
1973	2559	90	789	0.31	8.8
1974	2668	122	856	0.32	7.0
1975	2693	151	897	0.33	5.9
1976	2727	172	873	0.32	5.1
1977	2757	192	885	0.32	4.6
1978	2960	227	928	0.31	4.1
1979	3046	246	950	0.31	3.9
1980	3164	284	977	0.31	3.4
1981	3227	326	997	0.31	3.1
1982	3349	347	1047	0.31	3.0
1983	3564	325	1110	0.31	3.4
1984	3566	334	1122	0.31	3.6
1985	3701	323	1155	0.31	3.7
1986	3824	322	1186	0.31	3.8
1987	3860	319	1207	0.31	3.8
1988	3877	345	1244	0.32	3.6
1989	3913	346	1277	0.33	3.7
1990	3987	378	1303	0.33	3.4
1991	4031	413	1320	0.33	3.2

Note: GNP per capita is in constant 1980-81 prices. For GNP in $, the exchange rate has also been deflated by implicit GNP deflator.

There is a significant variation in the elasticity for different periods. The elasticities of two sub sample periods 1972-1980 and 1980-1991 are as following :

$$\underline{(1972 - 1980)}$$
$$pkm = \underset{(-\ 1.7)}{(-)\ 1.6} + \underset{(13.0)}{1.04\ gnp} \qquad [4.17]$$

$$\underline{(1980 - 1991)}$$
$$pkm = \underset{(-1.8)}{(-)\ 2.40} + \underset{(51.9)}{1.10\ gnp} \qquad [4.18]$$

For the period 1980-1991 the elasticity is significantly greater than one. This implies that the mobility of population is rising more rapidly with the growth of GNP. In other words, in order to have a decent passenger transport service the investment in passenger transport has to be kept relatively at higher rate as compared to the other sectors (as GNP grows) or measures have to be taken to reduce the mobility.

The sub sector elasticities for passenger traffic are more or less according to the freight traffic. For railways the equation is as following :-

$$\underset{}{\text{pkm - RAIL}} = \underset{(3.5)}{2.4} + \underset{(10.3)}{0.58\ \text{gnp}} \qquad [4.19]$$

R-SQR = 0.813 RSS = 0.124 D.W 1.10
(All figures are in natural logs. Figures in parenthesis are 't' ratio and significant at 1%).

As in case of freight traffic, the elasticity of railway passenger traffic, with respect to GNP, is also less than one, (i.e 0.58). However, it is important to note that passenger traffic has shown statistically significant relationship with GNP which is not the case for freight traffic. The elasticity less than unity has the following possible two explanations :-

a) With the rising income level the demand for railways passenger service is not increasing because of its low quality of service; and /or

b) Railways are unable to take advantage of the rising level of income. As a result a major share of rising demand has been taken by road and air transport. The elasticities for road and air are, therefor, greater than one as following :

$$\text{pkm - ROAD} = \underset{(-\ 8.9)}{(-)\ 2.8} + \underset{(44.9)}{1.11\ \text{gnp}} \qquad [4.20]$$

R - SQR = 0.991 RSS 0.025 D.W 0.6

$$\text{pkm - AIR} = \underset{(-\ 8.2)}{(-)\ 15.6} + \underset{(11.52)}{1.80\ \text{gnp}} \qquad [4.21]$$

R-SQR = 0.911 RSS = 0.713 D.W 0.8
(Explanations are as per equation [4.19])

Despite different elasticities with respect to GNP there is not much change in the modal split for passenger traffic as it has happened for freight traffic. The share for railways, which was about 21% during 1971-72, has declined to 13.3% by 1990-91. However, there is a continuous and sustained increase in the share of road and air passenger traffic. Such a shift clearly warrants policy decisions for the future. Either the capacity and quality of railways, vis-a-vis its cost to the passengers, have to be improved significantly, to arrest the present trend, of the capacity of roads (both in terms of infrastructure and rolling stock) has to be increased at accelerated rate. It is important to note that it is more economical to use railways for distance above 500 km and road transport for less than 500-kms (2).

CHAPTER - 5

ENERGY CONSUMPTION

5.1 Introduction

We have observed in Chapter 3 that transport sector in Pakistan, has become increasingly capital intensive and labour is more productive as compared to rest of the economy. This is more or less, a universal phenomenon. Hooper (1987) has rightly pointed out that higher productivity in transport sector has happened at "increasing energy cost" and has thus become "less satisfactory" (1). The rising energy consumptions in transport sector has, therefore, promoted interest to investigate the matter and find out ways and means to make the transport sector more energy economical. The exceeding interest in looking for means to reduce the level of energy consumption in transport sector has assumed importance because of rising cost of fuel, to save precious fossil fuel (primary energy) and/or for environmental reasons.

The analysis of energy consumption in transport sector is a difficult and complicated phenomenon. Different modes of transport and the total environment under which a particular mode of transport operates determine the overall energy consumption in transport sector.

The demand for a particular mode of transport is not determined alone by the efficiency in energy consumption. A particular mode of transport, efficient in energy consumption, might not be efficient financially or economically as a whole which are ultimately important for demand. For example electrification of track is considered to be most energy economical in Pakistan (2) but it cannot be done because enough resources are not available to implement track electrification programme and generation of electricity in itself needs fossil fuel. In other words, if energy conservation is an objective then it has to be supported by a number of other policy measures.

5.2 Transport and Energy Consumption in Pakistan

The energy consumption in transport sector as percent of total energy consumption is more or less stable around 19% over several years as shown in Table 5.1. There is no clear pattern of energy consumption for developed and developing countries. It varies according to requirements, transport structure and characteristics of an individual country and a meaningful comparison, therefore, cannot be done.

Table 5.1

ENERGY CONSUMPTION

UNIT:TOE

YEAR	TOTAL	TRANSPORT	TRANSPORT AS % OF TOTAL
1983-84	16359365	3179644	19.4%
1985	17848759	3357539	18.8%
1986	19039716	3587583	18.8%
1987	20760978	4122889	19.9%
1988	23237018	4404964	19.0%
1989	24337920	4579694	18.8%

Source: Energy Year Book (1989). Ministry of Petroleum and Natural Resources.

As we have seen in Chapter 2, the contribution to GDP (current prices) of transport sector, during 1990-91, was only 8.4%. In other wards for 8.4% of GDP contribution transport sector is consuming about 19% of total energy resources. This clearly indicates that the transport sector is more energy intensive than rest of the economy. The over all stability in ratio of energy consumption for transport sector shows that growth rate of energy consumption in transport and rest of the economy is more or less the same. According to Energy Year Book (1989) about 99% energy consumed in transport is petroleum (3). The little balance of 1% represents the electricity consumed by electric trains.

The consumption of petroleum products in transport sector have risen at a rate faster than rest of the economy. The yearly details for the economy and transport sector are provided in Table 5.2.

Table 5.2

COMMERCIAL ENERGY DEMAND

OIL/petroleum(Tonnes)

YEAR	TOTAL	TRANSPORT SECTOR	OTHER SECTORS	TRAN. AS % OF TOTAL
1971-72	2782448	1116175	1666273	40.1%
1973	2865859	1182974	1682885	41.3%
1974	2985559	1258694	1699865	42.5%
1975	3413614	1416749	1996865	41.5%
1976	3242123	1536446	1705677	47.4%
1977	3386937	1617039	1769898	47.7%
1978	3600505	1907840	1692665	53.0%
1979	3890739	2223596	1667143	57.2%
1980	4151365	2291922	1859443	55.2%
1981	4300898	2487451	1813447	57.8%
1982	4847253	2745302	2101951	56.6%
1983	5514418	2890159	2624259	52.4%
1984	6100195	3066952	3033243	50.3%
1985	6615743	3240202	3375541	49.0%
1986	7056802	3410276	3646526	48.3%
1987	7728191	3922526	3805665	50.8%
1988	8528578	4185965	4342613	49.1%
1989	9059315	4352667	4706638	48.0%
1990	9972457	4683595	5288862	47.0%
1991	9961273	4841362	5119911	48.6%

Source: Economic Survey of Pakistan 1991-92.

It would be seen that share of transport sector in petroleum consumption has continuously increased and has declined after peaking during 1980-81. The trend growth equations, with semi log method, for transport sector and rest of the economy (excluding transport sector) are as following :-

$$P\text{-}Tran = 13.87 + 0.08\ TREND \qquad [5.1]$$
$$P\text{-}Other = 14.03 + 0.07\ TREND \qquad [5.2]$$

(P-Tran and P-Other stand for petroleum consumption in transport and rest of the economy).

According to equations [5.1] and [5.2] the growth of petroleum is slightly higher (8% per annum) as compared to rest of the economy (7% per annum), which has increased the share of transport sector for petroleum consumption over the years.

5.3 Internal Structure of Transport and Energy Consumption

Traffic volume or a unit of traffic volume is most often used as reference value for energy consumption (4). Abdullah has estimated the fuel efficiency for various modes of transport in Pakistan as in Table 5.3.

Table 5.3

MODE OF TRANSPORT AND FUEL CONSUMPTION

Mode of Transport	Fuel Consumption (Liters)
Passenger Train	4.50 per 1000 PKM
Bus (52 pass.)	4.75 "
Wagon (13 pass.)	8.90 "
Car	32.50 "
Aircraft	120.00 "
Goods Train	4.6 per 1000 TKM
Truck	21.50 "

Source: Abdullah p/144

According to Table 5.3 railways have a clear advantage over other modes of transport in terms of energy efficiency. However, as it has been discussed in detail in Chapter 4, there is a clear shift in both goods and passenger traffic from railways to other modes of transport. The air transport, which is the most energy intensive, has been found to be most rapidly growing mode of transport. In order to make the transport system in Pakistan energy efficient, a package of policies have to be evolved which could gradually shift the demand towards railways. At present the environment is not in favour of railways. Introduction of new/private air lines, an extensive highways improvement/construction programme and easy and extensive credit for road transport are further increasing demand for road and air transport rather than railways.

Besides the overall modal split, the internal composition and behaviour of each mode also affects the total demand for energy. For air transport, according to Wolf and Simon (1984 pp/168-169), the energy consumption per PKM/TKM, other things being equal, declines as distance and/or load factor increases. The rapid rise in demand for air transport in Pakistan has helped to improve the load factor for PIA (as shown in Table 5.4) and has thus made the air transport more energy efficient over time.

Table 5.4

LOAD FACTOR
(Per Cent)

Year	Passenger	Freight
1971-72	56.4	53.1
1980-81	59.5	52.0
1990-91	67.1	60.0

Source: Economic Survey of Pakistan 1991-92.

The introduction of new private air lines has, however, increased the air freight and passenger capacity. It is yet to be seen that the rate of creation of new capacity does not exceed the rising demand for air transport. If demand lags behind, then as a result of expansion in the air transport, the national average load factor is going to decline, unless road and rail traffic is diverted to air to fill the extra capacity.

Abdullah has examined the energy consumption in railways in sufficient detail. Following are his important findings with respect to energy consumption (5)

i) Electric trains consume relatively less energy than diesel locomotives.

ii) Rail cars have a much higher rate of energy consumption because of their low loading. The specific consumption for rail cars is 15.6 litres per 1000 Gross Ton Kilo Meters (GT-KM) as compared to only 4.25 litres per 1000 GT-KM for Express Train (estimated for Shalimar Express).

iii) For high speed trains the energy consumption is high but it is more or less compensated if stops for high speed trains are reduced along the route.

In the light of (i) to (iii) above if performance of Pakistan Railways is evaluated, the total picture is notsatisfactory. There is no extension in the electrified track. The use of electric locomotive has rather declined. During 1980-81 the total number of kilometers covered by electric railways were 2204000 km. It declined to 1695000 during 1990-91 (i.e by about 23%). As a result the use of electricity as fuel

has also declined from 44 GWH during 1980-81 to 33 GWH during 1990-91. During the same period the total number of kilometers covered by diesel trains have increased from 27,294000 kilometer to 32366000 kilometers (i.e by about 19%). The running of rail cars which are most energy intensive mode of transport within railways has, however, significantly declined (from 2716000 km during 1980-81 to only 753000 kilometers during 1990-91 i.e by about 72%). It appears that Pakistan Railways are gradually reducing the rail car service (6). The over all picture for railways with respect to energy consumption is thus mixed.

For road traffic, as noted in Table 5.3, the size of vehicle and capacity are crucial in energy consumption. The specific energy consumption is highest (i.e 32.50 litres per 1000 PKM) for the individual cars followed by wagons (8.9 litres per 1000 PKM) and bus (4.75 litres per 1000 PKM). The NTRC Bus Train Pilot Project which has been successfully operated in Karachi and Islamabad has demonstrated that how a long size bus train could reduce the specific energy consumption by a significant margin. The specific energy consumption for NTRC Bus Train, operated in peak hours, is 1.79 litres per 1000 PKM which is even less than railways. (7)

The analysis of growth rate of various types of vehicles depicts a highly unsatisfactory picture. Table 5.5 provides growth rates of various types of vehicles during 1971-91.

Table 5.5

VEHICLE GROWTH RATES

Year/Type of Vehicle	Motor Car	Taxi Cab	Station Wagon	Bus	Truck
1971	59200	6871	6041	6871	22741
1991	452953	33492	74984	33492	86872
Growth rate 1971-91 (Compound)	10.7%	8.2%	13.4%	8.2%	6.9%

Source: NTRC, Ministry of Communications.

The highest growth rate is for station wagons followed by private cars. Thus in the road transport service the energy intensity has increased over the years. The bus service appears to has been gradually replaced by station wagons and public transport by private car transport.

In road transport, in addition to types of vehicles, the type of roads available for these vehicles and the speed at which vehicles are operating also affect the energy consumption. Table 5.6 provides a comparison of fuel consumption for various kinds of vehicles at different speeds under different road conditions.

Table 5.6

FUEL CONSUMPTION PER 1000 KM
UNIT = LITRES

VEHICLE/ROAD TYPE

	SPEED Km/Hrs							AVERAGE CONS. @
	30	40	50	60	70	80	90	
(A) IMPROVED ROADS								
CAR	87.05	80.05	89.05	98.05	111.87	133.38	163.61	109.01
M-BUSES	120.17	108.17	100.17	108.17	119.17	132.23	141.29	118.48
BUSES	288.75	244.75	215.75	254.76	360.81	387.67	407.91	308.63
TRUCKS	445.74	304.75	277.75	249.71	282.27	460.47	N.A	336.78
(B) UN-IMPROVED ROADS								
CAR	106.7	100.7	108.7	117.7	132.43	155.25	190.21	130.24
M-BUSES	153.93	141.93	133.93	141.93	155.51	169.83	179.29	153.76
BUSES	343.69	299.25	269.96	309.34	422.47	459.62	494.08	371.20
TRUCKS	502.26	359.85	332.58	304.24	341.62	501.25	N.A	390.30
(C) SHINGLE ROADS								
CAR	109.14	103.44	111.15	120.15	134.87	157.69	192.95	132.77
M-BUSES	156.52	144.30	136.53	144.52	158.10	172.42	181.89	156.33
BUSES	347.11	302.67	273.38	312.76	425.89	463.04	497.5	374.62
TRUCKS	505.60	363.20	335.92	307.59	344.96	539.97	N.A	399.54

@ = i) The average speed for trucks and other vehicles is 55 and 60 Km/hr respectively.

ii) In view of newly developed energy efficient engines a fresh study is needed to update the fuel consumption estimates.

Source: Vehicle operating costs NTRC.79 (1985 pp 36-47)

The design parameters for improved, un-improved and shingle roads are in Table 5.7.

Table 5.7

DESIGN PARAMETERS

Type of Road	Gradient m/Km	Curvature Degrees/Km	Roughness m/Km
Improved	10	100	1.5
Un-Improved	20	200	3.5
Shingle	20	200	5.5

Source: Vehicle Operating Costs NTRC.79 (1985 P-8)

According to Table 5.7 the energy consumption in road transport is affected by various factors as described below :

i) A very low speed, because of congestion (a problem of urban areas) or poor quality of a road, increases the energy consumption.

ii) Improvement in road reduces the energy consumption. On shingle roads as compared to improved roads the energy consumption on average, for cars, mini-bus, bus and trucks is high by 22%, 32%, 21% and 19% respectively.

iii) Exceeding speed beyond a certain limit increases energy consumption (different for different types of vehicles).

How the variables (i to iii) are working in road transport system of Pakistan are briefly examined in the following paragraphs.

The problem of congestion could be solved by increasing the capacity or reducing (or keeping constant) the level of traffic. The expansion of capacity requires, most often, a lot of financial resources. In view of financial constraints such investments are lagging behind the demand posed by the system. In absence of a comprehensive policy package, any expansion is soon saturated by rapidly rising number of vehicles on roads. It has already been noted that the number of small vehicles (cars, station wagons etc.) is rising more rapidly than the bigger vehicles (bus, trucks etc.). Unless a very clear and comprehensive policy is formulated and implemented, as a result

of which private car owners and s.wagons/mini-bus passengers are provided with a standard alternate facility, to motivate them to shift to large size buses, the problem of congestion is likely to persist.

Traffic management is another way to increase the traffic capacity of existing network and solve the problem. According to Thomson (1968 p/30-31) in Central London, 1 percent increase in capacity (by traffic management) was worth one million pounds per annum (in 1968 prices). If traffic management increases the journey length or generates additional traffic (because of reduction in vehicle operating cost) these benefits are reduced. However, traffic management in developing countries "without supportive actions or effective enforcement has a slim chance of success" (8). The literacy rate, which is an important factor in success of a traffic management programme, is most often, exceedingly low in developing countries like Pakistan (9) and, therefore be compensated by a well conceived and rigorous enforcement policy. Unless a comprehensive package of traffic management is introduced, which particularly takes into account the problems associated with low level of literacy, the problem of congestion in the urban areas of Pakistan is likely to continue. In the near future improvements on this account are very limited.

As mentioned in Chapter-2, in the existing road network of 169502 km, about 48% are low type roads. The poor maintenance of high type roads have also substantially degraded them. Improvement of shingle and un-improved roads is thus another way to reduce the energy consumption. The existing road construction and improvement programme is, however, highly biased towards highways (which includes construction of a Motor Way). Highways/Motor Ways are by definition meant for high speed, and thus going to further increase the energy consumption. An appropriate policy is, therefore, needed to balance the whole road network.

5.4 Conclusion

The overall picture of energy consumption in transport sector is not satisfactory. Modal split as well the internal structure of various modes of transport (particularly road transport) are going to further increase energy intensity of transport system. In order to reverse this process a policy, which could deal adequately with all the important elements of national transport system, has to be devised in a co-ordinated fashion. Independent and piece meal actions are not going produce positive results.

CHAPTER - 6

CONCLUSIONS AND RECOMMENDATIONS

The transport sector in Pakistan has evolved around the special characteristics of the country and is dominated by North-South network. According to the national income statistics reported in Economic Survey of Pakistan (1991-92) the contribution of transport sector (including communication) towards GDP was about 8.4% during 1990-91 at constant 1980-81 prices. It seems that there are some problems in valuation of income generated by transport sector. For example, under two different methodologies, with base year 1959-60 and 1980-81 adopted by the Bureau of Statistics (and accepted by Economic Advisory Wing of Finance Division) the terms of trade of transport sector with rest of the economy are quite contradictory for the period before and after 1980-81. According to old methodology, transport sector is the net beneficiary because the general price rise in transport sector is high as compared to rest of the economy but reverse picture emerges when the terms of trade are analysed under new methodology (with base 1980-81).

Availability of data for capital stock and the average rate of depreciation of capital stock of a sector are of particular importance. Statistics for capital stock are most often not available in developing countries like Pakistan. The average rate of depreciation of capital stock might vary from country to country depending upon the structure of transport and climate of the country. On average the rate of depreciation for transport sector is about 10% per annum, for a country like Pakistan. The net addition to capital stock, which is ultimately important in continuously rising demand for transport service, is the gross investment less depreciation. But unless an estimate of capital stock is available the extent of investment needed for replacement (i.e. depreciation) cannot be estimated.

The total output (i.e GDP) depends upon the capital stock as following:

$$Qt = ao + aKt \qquad [7.1]$$

where Qt, 'a' and 'Kt' stand for output, output capital ratio and capital stock.

Over a short period the relationship between output and capital stock (i.e 'a') is stable. This relationship can therefore, be

used to estimate the capital stock for a particular year and develop capital stock series by inventory method as equation [7.2].

$$Kt = Kt\text{-}1 + NIt \qquad [7.2]$$

(where Kt stands for capital stock of particular year 't', NIt is investment after subtracting depreciation. 't-1' is for time lag of one year).

The capital stock for transport sector has been developed as per equations [7.1] and [7.2] and analyzed. The important findings are as following:

i) The net investment is always lower than the gross investment. However, it is significantly lower for some years in transport sector. For example the net investment during 1989-90 was only 18% of gross investment and appears to be negative for a number of years in sub-sector like Pakistan Railways.

ii) The capital intensity (i.e extent of capital required to produce one unit of output) has been increasing in the transport sector over time and is substantially higher than the national average. The average and marginal capital output ratios are 1.82:1 and the 4:1 respectively as compared to 1:1 and 3:1 for the economy as a whole.

iii) Capital labour ratio (CLR) for transport sector is also higher than rest of the economy and the difference is continuously increasing. More and more capital is, therefore, needed to employ each labour in transport sector. During 1978-79 Rs. 20157 (at constent 1980-81 prices) were required to employ one labour. This ratio increased to Rs. 34226 during 1990-91. The same ratios (for the same period) are Rs. 12704 and Rs. 18356 for the economy as a whole.

iv) Higher capital labour ratio has increased the labour productivity in transport sector and is significantly higher than rest of the economy. The labour productivity which was Rs.11086 (constant 1980-81 prices) per labour increased to Rs.19100 during 1990-91. For the economy as a whole the same ratios (for the same period) are Rs.8679 and Rs.12791.

The transport network in Pakistan has not been developing in an optimal way. The traffic intensity and mobility is very high. Different modes of transport are growing at

different rates. The domestic air and roads traffic is growing much faster than railways. The freight traffic of railways has even declined during past two decades. As a result the share of road freight transport has continuously increased and that of railways shrinked and a significant change in modal split has taken place during 1971-91. The share of Pakistan Railways has declined from about 50% during 1971 to only 14% during 1991. During the same period the change in modal split for passenger traffic is, however, relatively low.

The freight and passenger traffic are most often associated with the overall economic activity. In the earlier stages of development the elasticity of freight as well as passenger traffic with respect to GNP is expected to be greater than one (i.e the freight and passenger traffic grow faster than GNP). The railways freight traffic has shown no relationship with GNP. As a result the total elasticity of freight traffic for transport sector is less than one. The same elasticity is significantly high for road and air freight traffic. The lack of investment in Pakistan railways has, infact, affected its performance. In addition there is a clear empircial evidence of shift of freight traffic from railways to road.

The elasticity of passenger traffic with respect of GNP is slightly greater than one. However, the same elasticity is less then one for railways (though it is statistically significant which is not the case for freight traffic). The elasticities for air and road passenger traffic are significantly greater than one which implies that demand for these modes of transport is growing faster than the growth of GNP. In other words, if railways service could not be substantially upgraded, the road and air services are going to expand at accelerated pace.

The current modal split, growth rates and elasticity with respect to GNP of various modes of transport are not satisfactory. The performance of Pakistan railways needs to be improved both in qualitative and quantitative terms. The high traffic intensity and mobility may also be reduced by appropriate policy measures.

Transport sector in Pakistan is a major energy consumer. Its share is around 19% of total energy consumed in the economy and 50% in petroleum products. The GDP contribution of transport sector, on the other hand, is only about 8%. Thus for each one unit of GDP, transport sector is consuming more energy than rest of the economy. The high energy intensity is the direct result of current state of modal split and internal structure of each mode of transport. The road transport has been found to be particularly responsible for high energy consumption.

6.1 Policy Recommendations

In the light of the findings of this study following policy measure are recommended :-

(i) Improvement of basic statistics of transport sector is of vital importance. The transport sector should essentially be separated from communications with respect to data related to GDP, investment, etc. Bureau of Statistic should be approached in this respect.

(ii) Transport policy should clearly spell out the role of various modes of transport with appropriate short and long term policy measures and action programme.

(iii) The relative as well as absolute shrinking of Pakistan Railways need immediate attention. The poor response of railways to rising demand in the economy is particularly disturbing. The past and future investment programme of Pakistan Railways may, therefore, be examined and the management and organizational issues appropriately addressed.

(iv) In order to reduce the traffic intensity, mobility and energy consumption, a policy which could ensure an optimal modal split and also improve the internal structure of each mode of transport is essentially required. The existing fiscal, and monetary measures and investment programme are clearly favourable to road transport. Unrestricted increase in the smaller vehicles are increasing demand for extra capacity and energy consumption.

(v) Transport management should be an integral part of overall transport policy. Specific allocations should be made for transport management projects. The transport management should particularly give emphasis on educating general public and making improvements in enforcement.

6.2 Research Proposals.

In the light of present study following specific proposals are put forward for future research.

1. Road Transport and Energy Consumption : The current state of energy consumption has been found to be overloaded by total size as well as internal composition of road transport. This aspect needs further investigation under a separate study.

2. Impact of Private Air Lines on Air Traffic : Introduction of private airlines in Pakistan is a significant change in air transport. It is going to create new air passenger and freight capacity or replace capacity already available under national fleet of PIA. The former will affect the overall efficiency of air transport if the increase in demand does not match with the increase in capacity. In the later case, only the structure of air transport will change. In order to make a realistic assessment of this change a study is essentially needed.

3. A Critical review of Operational Efficiency of Pakistan Railways : The study is recommended with main objective to find the causes of decline in freight and passenger traffic over past two decades.

4. An Analysis of Investment Programme and Development of Pakistan Railways :

   Investment is crucial in creating new capacity. The past low level of investment, among possible other reasons, has ultimately reduced the share of railways in total transport system. An in-depth analysis of investment is essentially required in order to make more specific judgement and recommendations.

APPENDIX

TERMS AND CONCEPTS

CAPITAL AND CAPITAL STOCK ASSETS

As a factor of production, capital is a produced means for further production. In an economic entity capital stock accumulates over the years as a result of investment in that entity after adjusting the depreciation of capital stock before the investment. Capital stock thus grows to the extent new investment exceeds the depreciation of existing capital stock. This process of accumulation is also known as "capital formation".

CAPITAL DEEPENING

Increase in an economy's stock of capital at a faster rate than the growth of its labour force, thus expanding the volume of capital per worker and also normally raising average output per worker.

CAPITAL LABOUR RATIO

The volume of capital employing one worker.

CAPITAL OUTPUT RATIO

Capital output ratio is sometimes used in a "total" sense, and sometimes in a "marginal" sense. (a) The "total" capital output ratio is the ratio of an economy's or a sector of economy's total stock of real capital to the level of its income or output. (b) The marginal capital output ratio is the change in income or output resulting from a unit change in its stock of real capital. Thus a ratio of 3/1 means that three units of additional capital produce one unit of additional output. The output capital ratio, another most commonly used concept, is the inverse of capital output ratio.

CONSTANT PRICES

An expression reflecting the actual prices of a previous year or the average of actual prices of a previous period of years. Hence economic data are often quoted in constant prices or real terms (contrast with current prices or financial terms).

DEPRECIATION

Depreciation is the decline in the value of a fixed asset, such as plant or equipment or infrastructure, due to wear and tear, destruction, or obsolescence resulting from the development of new and better techniques. For an economy or sector as a whole the average depreciation is synonymous to capital consumption allowance.

ELASTICITY

In general, elasticity is the reponsiveness of changes in one variable to changes in another, where responsiveness is measured in terms of percentage changes. The elasticity(E) may take any of five forms :

Perfectly elastic	(E = infinite)
Relatively elastic	(E > 1)
Unit elastic	(E = 1)
Relatively inelastic	(E < 1)
Perfectly inelastic	(E = 0)

FISCAL POLICY

A deliberate exercise of the government's powers to tax and spend in order to bring the economy's different economic and social variables to desired levels.

GDP DEFLATOR

The weighted average of the price indexes used to deflate the GDP or components of GDP is known as GDP deflator. Thus for any given year :

$$\text{GDP in constant prices} = \frac{\text{GDP in current prices}}{\text{GDP Deflator}}$$

Therefore :

$$\text{GDP Deflator} = \frac{\text{GDP in current prices}}{\text{GDP in constant prices}}$$

Because of its comperehensiveness, the GDP deflator is one of the most useful measure of broad price movements in the economy.

INVESTMENT

Investment is spending by government or business firms in order to produce income-producing goods. It consists of replacements or additions to the nation's stock of capital such as plants, equipments, infrastructure, inventories etc.

LESS DEVELOPED (UNDERDEVELOPED) COUNTRY

A nation which, in comparison with the more advanced countries, tends to exhibit such characteristics as : (1) low level of income and hence little or no saving; (2) high rate of population growth; (3) substantial majority of its labour force employed in agriculture; (4) low proportion of adult literacy; (5) extensive disguised unemployment; and (6) heavy reliance on a few items for export etc.

GDP AT FACTOR COST

The GDP at factor cost is the total of all incomes earned by or ascribed to the factors of production - that is, the sum of wages, rent, interest and profit which accrues to the supplier of labour, land, capital and entrepreneurship. When this income is adjusted for transfer payments (i.e. indirect taxes and subsidies) it becomes equivalent to market value of goods and services, produced during a period of time and is known as GDP at market prices.

PRIVATE SECTOR

That segment of the total economy consisting of households and businesses, but excluding government.

SUBSIDY

Subsidy is a payment (usually by government) to businesses or households that enables them to produce or consume a product in larger quantities at lower prices than they would otherwise.

TERMS OF TRADE

Terms of trade means the number of units of goods that must be given up for one unit of goods received, by each party (e.g., a nation or a sector) in a transaction. In general, the terms of trade move in favour of the party that gives up fewer

units of goods for one unit of goods received and against the party that gives up more units of goods for one unit of goods received. In international economics, the concept of "terms of trade" plays an important role in evaluating exchange relationships between nations. Similarly the transaction among various sectors of an economy are also subject to certain "terms of trade". As price is value of a good or service expressed in terms of money, the "terms of trade" and change in "terms of trade" is meaured through price and price change rather than directly interms of units of good/services exchanged.

VALUE ADDED

The value added is an increment in value at each stage in the production of a good. The sum of the increments for all stages of production gives the total income - the aggregate of wages, rent, interest and profit - derived from the production of the good. At national level it is equal to GDP.

N O T E S

CHAPTER - 1

1. Farouk (1980) provides a good review of the role of transport in the economic development.

2. A choice among different modes of transport will depend upon their micro economic efficiency or the over all optimal programme (if any) of transport sector.

CHAPTER - 2

1. The aggregate statistics for National Income Accounts of Pakistan prepared by the Bureau of Statistics (reported in Survey of Pakistan and other publications of Bureau of Statistics) provide a consolidated figure for Transport, Communications and Storage. The actual contribution of Transport Sector to GDP is thus some what less than this figure.

2. According to Survey of Pakistan (1991-92) the National Income Accounting methodology, with base year 1959-60 for estimating GDP/GNP has been changed during 1988-89 (also shifting base to 1980-81). The new series takes care of recommendation of Kazi Committee on National Accounts with respect to coverage, improvements in methodology and data availablity. Under new methodology the economic activities covered in Transport and Communication sector are transportation by railway, road transport (mechanized and non-mechanized), water transport (coastal, ocean and domestic), air transport, storage and communication services rendered by Pakistan Post Office, Telegraph & Telephone, Pakistan Broadcasting and Pakistan Television Corporations.
   The estimates of value added are measured through income apparoch for which requisite data are collected from the source agencies. Initially the estimates are derived at current factor cost.
   To convert the current estimates into constant, unit value indices of passenger & tonnage kilometers for railway, passenger & tonnage - kilometers for air, and cargo handled at sea for sea transport are prepared. Similarly, unit value indices for post, telegraph and telephone services for communication and broadcasting and telecasting hours for radio and television are prepared and applied.

The estimates of mechanized road transport are based on the FBS surveys conducted in major cities, while the estimates of non-mechanized road transport are based on data collected from Town Committees.

3. The trend growth equation, with semi-log method for GDP (1980-81) Factor Cost) is as following :-

GDP = 11.22 + 0.05 TREND (i)
(GDP is in natural log)

CHAPTER - 3

1. Bureau of Statistics was approached for data about capital stock, gross and net capital formation and value added of various transport sub-sectors (i.e railways, road, aviation, shipping, pipeline etc.). The requisite time series data was not available with the Bureau.

2. Since the value added used in equation [3.11] is for the transport and communications sector (not alone for transport sector) the base year estimate of capital stock is on the higher side. However, this effect is kept constant for the subsequent period by excluding the investment in Post Office and T&T. The difference thus gradually declines in relative terms as the capital stock expands over the years.

3. As described in Chapter 2 (Section 2.3) there seems some problems with regard to valuation of output of transport sector under old and new methodology adopted by Bureau of Statistics (see Note 2 Chapter-2). It was, therefore, considered more appropriate to use the overall GDP deflator (Factor Cost 1980-81) instead of implict GDP deflator for Transport and Communication Sector for converting the current values into constant prices.

4. For some other formulation of productivity measures readers are refered to see Hooper (1987 pp 343-349). At micro level conventional cost-benefit analysis is the appropriate tool for estimating the productivity of investment.

5. Howard (1980) has investigated a number of industries in order to demonstrate the benefits of appropriate technology. His argument is equally applicable to transport sector. Keeping in view the scope of the study and limitations of data the matter has been examined in very broad and aggregate terms rather than going to micro project level, (though it is extremely desirable exercise to do).

6. Capital stock series for Pakistan have been estimated by Haq (1990) in his Phd Thesis (unpublished) "Foreign Capital Inflow and Debt Problem of Pakistan" Glasgow University using the methodology described in equations [3.1] to [3.4].

7. Readers are referred to see Howard (1980) for comparing capital intensive versus intermediate and labour intensive technologies.

CHAPTER - 4

1. Some time elasticity of PKM per capita with respect to GNP per capita is considered to be more appropriate indicator of mobility. But in view of common denominator (i.e population) there is a little difference in the two estimates. The estimated equation for Pakistan is as following :-

   pkm-p = (-) 1.53 + 1.05 gnp-p [i]
   R-SQR = 0.976 RSS = 0.0139)

   (where pkm-p and gnp-p stand for natural log of per capita PKM and GNP respectively).

2. See "The Study on the National Transport Plan (Final Report Part-II - 1988 p 66).

CHAPTER - 5

1. Hooper (1987 p 341).

2. See Abdullah (1980 p 133).

3. See Energy Year Book (1980) p-ix

4. See Wolf and Simon (1984) p 160

5. Abdullah (1981) pp 106-108.

6. All figures in this para have been derived from Survey of Pakistan (1991-92) and Pakistan Railways Year Book (1990-91).

7. For full details see Idris (1992)

8. Orikaye and Brown (1984 p 468)

9. See Ibid p 467.

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