STRUCTURE OF PUBLIC INVESTMENT AND INDUSTRIAL DECELERATION IN INDIA

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I hereby affirm that the research for this dissertation titled "Structure of Public Investment and Industrial Deceleration in India" being submitted to the Jawaharlal Nehru University for the award of the Degree of Master of Philosophy was carried out entirely by me at the Centre for Development Studies, Trivandrum.

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Certified that this dissertation is the bonafide work of Sri Haseeb A. Drabu and has not been considered for the award of any other degree by any other University. The dissertation may be forwarded for evaluation.

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Chapter 1

PUBLIC INVESTMENT BASED EXPLANATIONS OF DECELERATION: A THEORETICAL CRITIQUE

This study is placed in the context of the analysis of macroeconomic growth in the Indian economy during the seventies, which consequent upon the empirical observations of a relative decline in the growth of industrial production since the mid sixties has been variously characterised as stagnation, deceleration and structural retrogression.[1/]

The fact of deceleration has been established at an aggregative as well as a disaggregative level. Even a cursory look at the data on a number of macro indicators reveals that after the third plan, a deceleration in the economy, which appears to be secular, has set in. Most economists would agree that the economy certainly did not maintain the rate of growth achieved prior to the plan holiday, though there does not seem to be a consensus on the factors underlying this phenomenon and less so on the policy prescriptions forwarded. However, recently this deceleration argument, which rests implicitly on a linear conception of growth, has been questioned. Even though the argument that the growth path traversed by the economy is cyclical, as put forth by Raj[2/], does not get substantiated by the available empirical evidence, the merit of the contribution lies else where - in breaking away from the rather simplistic conception of the linearity of growth and replacing it by a non-linear understanding of the growth process.

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1. Chakravarty, (1974), Raj (1976), Vaidyanathan (1977), Patnaik and Rao (1977), Shetty (1978), Ahluwalia (1984).

2. Raj (1984)

We, for the purpose of this study, take deceleration in the economy in general and industrial sector in particular, an empirically well established fact that has been documented in detail.[3] We shall, however, very briefly recapitulate the salient features of deceleration as brought out in various studies on this issue.

To explore the quantitative dimensions of the growth process, over the years and across industries, three sets of data have been used in the literature. Most of the studies documenting the long term trends in the industrial growth rate have made use of the data on Industrial Production Indices, while the analysis of others is based on National Accounts Statistics or the Annual Survey of Industries or a synthesis of these two sources.[4]

The answers to the question of industrial slow down have come out quite differently depending on which set of data is used. For those who analyse the data relating to index of industrial production the slow down appears to be across the board, whereas with the National Accounts and Annual Survey of Industries data (on real value added) the slow down is concentrated in heavy industries, essentially the capital goods and basic goods industries. However though numbers may vary both sets of data do lend support to the slowdown in the growth of the industrial sector.

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3. Shetty (1978), Ahluwalia (1984)

4. This synthesis of NAS and ASI which has been attempted by Ahluwalia (op.cit) seems to be of a dubious nature. Dividing value added for each industry group as given by NAS by the value added for the corresponding industry group as provided by ASI, both at current prices, Ahluwalia arrives at her "correction factor" for each industry group which is used to correct ASI figure for non-response and coverage. The need for such a "correction" is questionable for the period 1964-65 onwards in view of the fact that CSO itself correct ASI figures for response variation problem to arrive at NAS figures. Apart from this, one fails to understand why this "correction factor" is computed at current prices when it could have been done at constant prices and thereby avoided all problems of 'weighting' and double deflation associated with deflation of value of output and value added. As to how her method is an improvement or is even of the same accuracy as that of NAS is not clear since the precise method of deflation has not be on spelled out.

Looking at the indices of production in the industrial sector a distinct slackening of the growth is discernible.[5] During the decade 1955 to 1965 the total industrial production increased at an average annual rate of 7.8% while manufacturing output increased at 7.6%. In the following decade 1965 to 1975 the rates dropped to 3.6% and 3.1% respectively. The phenomenon of deceleration is further substantiated if the industrial production data is examined at a disaggregated level - two digit classification. A comparison of the average annual growth rates during the period 1965 to 1975 with the corresponding ones in 1955 to 1965 shows that the slow down in growth occurred across the board in the industrial sector though it was more pronounced in some industries (e.g. Beverages and Tobacco, Basic Metals, non-electrical machinery, transport equipment) than in other (e.g. Food Products, chemicals, mining and quarrying See Table 1.2). Working out the use-based and Input-based industrial classification on the basis of the same data shows that there is a dramatic deceleration in the capital goods sector and the intermediate goods sector though the decline in the latter was not as steep as in the former. In the case of consumer goods industry, which had been throughout growing at a rate significantly below the average for industrial sector maintained its slow growth during the period 1965-70 primarily because of a rapid expansion in consumer durables. And once the pace of expansion in consumer durables declined, consumer goods industry as a whole slackened markedly.

Going by the National Accounts Statistics and/or Annual Survey of Industries data there is a clear evidence of a slowdown in the growth of value added in the industrial sector as a whole from 7.6% per annum in the period 1959-60 to 1965-66 to 5.5% per annum during the period 1966-67 to 1978-79. Within manufacturing the

5. See Table 1.1 (Tables relating to each chapter are given in the statistical annexure at the end of the chapter).

industry groups which show a statistically significant deceleration are basic metals, metal products, machinery and transport equipment. Altogether the industries that experienced significant deceleration accounted for about 47% of the value added in manufacturing. These findings are also corroborated by the results of the use based categories which show that the deceleration in the growth of value added plagued mostly the basic and capital goods industries. The other two categories viz. the intermediate and consumer goods industry did not share the phenomenon of deceleration. The consumer oriented industry (especially food manufacturing and cotton textile) were amongst the slowest growing industry groups over the entire period (See Table 1.3).

The National Accounts Statistics and Annual Survey of Industries data based studies are relatively more reliable than the ones which rely exclusively on index of industrial production data. The index of industrial production which is based on the voluntary response of producers suffers from problems of coverage, (which for e.g. is as low as 18% value of output in beverages, 20-25% for basic metal industries) bias against changing structure of production, different base periods and unrepresentativeness. The Annual Survey of Industries also is not free from problems. One severe handicap which limits the reliability of this data series is the deflation of real value added. None of the data sources, however, capture satisfactorily the unregistered sector.

A number of alternative hypothesis have been advanced to 'explian' the deceleration in industrial growth since the mid-sixties. These hypothesis put forth are neither mutually exclusive nor are they collectively exhaustive and attempts towards a unified hypothesis are rare. Each of the explanations have emphasized a specific factor or a set of factors as being central to the cause of industrial stagnation and while some hypothesis postulate mechanisms through

which the industrial sector as a whole has been affected, there are others that relate to specific segments of the industrial sectors.

The principal explanatory hypotheses put forth in order to explain the phenomenon of deceleration relate it to:

i. Performance of Agriculture[6/]

ii. Exhaustion of Import Substitution.[7/]

iii. Slow down in Public Investment[8/]

iv. Income Distribution[9/]

v. Inefficient Industrial System[10/]

vi. Factor Inefficiency.[11/]

We shall not attempt to review all these explanations here primarily because we are specifically concerned with the investment based hypothesis and also a number of detailed reviews have been carried out. However to the extent that public investment based explanations overlap with others (which they do) our empirical analysis will have a bearing on them.

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6. Raj (1976), Vaidyanathan (1977), Chakravarty (1979) Rangarajan (1982), Patnaik (1972)

7. Bhagwati and Srinivasan (1975),

8. Patnaik and Rao (1977), Patnaik (1979) Srinivasan and Narayana (1977), Ahluwalia (1984)

9. Bagchi (1970), Mitra (1977), Chakravarty (op.cit.)

10. Bhagwati and Desai (1970), Bhagwati and Srinivasan (1975), Ahluwalia (1984)

11. Ahluwalia (1984)

A careful read. g of the debate suggests that many explanations forwarded are based on apriori arguments making inferential statements which warrant empirical support. And amongst the explanations listed above the demand based hypotheses in general and the public investment hypothesis in particular seem to predominate. Of late the increasing inefficiency hypothesis, especially that of capital investment in the also public sector, also seems to be gaining recognition as a possible explanation of the industrial deceleration after the third plan particularly amongst the official circles.

Under Investment Hypothesis

One set of demand side explanations with which we are concerned emphasizes the significance of government for rapid accumulation in the context of a mixed economy like India. Consequent upon this mode of reasoning the basic cause of industrial deceleration is located in the decline in public investment. We refer to these explanations as under investment hypotheses. There are two variants of the underinvestment hypotheses:

One of the variants was put forth by Srinivasan and Narayana[12]. Observing after mid sixties a declining real investment, particularly pronounced in the public sector and a deceleration in the rate of industrial growth, Srinivasan and Narayana somewhat simplistically related the two. Seeing this as a marked departure from the trends established prior to the third plan, they argue that the slackening of public investment is among the principle causes of industrial deceleration. Logically following from their arguements, they advocate a vigorous expansion of public investment in order to surmount the crises. This, they go on to argue, can

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12. op.cit.

be defecit financed as there exist enormous reserves of food and foreign exchange.

The authors donot make any attempt to understand as to why did public investment decelerate and how this slackening precisely affected industrial sector. As Nayyar puts it, "Reading between the lines, one can discern an implicit view that large net inflow of aid until 1965 sustained high levels of public investment, which, in turn had complimentarities with the private investment". One is still, however, left guessing about the nature and forms of these complimentarities with private sector. Consequent upon the foreign aid reduction after the third plan, the aid fostered investment plan of the government also declined leading to a slackening in public investment and finally growth.

As we shall see in the course of this dissertation this hypothesis is far from valid - analytically as well as empirically.

The second variant of under investment as put forth by Patnaik and Rao[13] is much more perceptive and detailed. Operating in a framework of political economy, it has been argued that in an economy like India public investment provides the main exogenous stimulus governing the rate of growth of the economy. The state, however, is unable to maintain the tempo of its investment activity and consequent upon a fall in it, the economy's growth rate is lowered.

We shall discuss this hypothesis in detail.

Following Kalecki, Patnaik[14] formulated a dualistic, agriculture-industry model incorporating government expenditure and investment in an underdeveloped mixed economy like India. In his model, Patnaik brings out the implications of

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13. Op.cit. Also, Patnaik (1979, 1984)

14. Patnaik (1972)

a disproportionality between agriculture and the non-agriculture investment demand, particularly public investment -- a slow growing agriculture impinging on the rate of growth of investment through a rise in food prices which, self evidently, reduces real wage. The reduced real wages mean a fall in the workers consumption of industrial necessaries and along with this a forced reduction in public investment, which is sensitive to political implication of a continued inflation in food prices, reducing capacity utilisation. This in turn affects private investment which spirals down causing a slump. The upward movement is restored with a reduced inflation which offers scope for public investment and as public investment picks up once again, so does private investment.

Though a supply oriented disproportionality argument underlies the model of Patnaik summarised above, in his later contributions on industrial deceleration in India, a public investment based endogenously determined demand constraint has been emphasized. Based on Kaleckian understanding of advanced capitalist countries Patnaik and Rao concieve the economy to be dominated by monopolies such that there is a rise in the shar- of surplus accruing to them. This rise which the state is 'constrained' to increase through the mechanism of price and budgetary policies, has had two impacts: a reduction in the economic surplus available to the state for its investment and expenditure (as a proportion of output) and a curtailment in the share of workers consequent upon a relative shift in income from the 'bulk of the people' to the propertied classes. Added to this, the assertion that if increased private economic surplus does not per se lead to increased productive investment (being channelised into speculation, luxury consumption, and the like), makes growth inconceviable without inflation. The state's attempt to protect the interests of the politically vocal section of workers and fixed income earners coupled with the resource constraint discussed above implies a fall in public investment which leads to a retardation in growth.

Patnaik goes on to argue that the economy had to inevitably face such inbuilt barriers to growth primarily because of "top heavy" character of the industrialisation pursued, which "kept the market for mass consumption goods continuously restricted". He goes on to say:

"The fact that the industrialisation strategy was undertaken without substantial asset redistribution, in particular land distribution, not only determined its specific features but also made it inevitably transitory. The secular boom of the late fifties has been succeeded by a secular stagnation since mid sixties".[15/]

It is amply obvious that Patnaik finds the genesis of the problem in the inequitious distribution of assets and income since independence. Thus arguing against the "top-heavy" character of industrialisation, he implies that had there been an egalitarian shift in the pattern of asset and income distribution the problem of restricted market for consumer goods and consequently growth would not have arisen.

Patnaik draws his theoretical underpinning from the Marxist theorising on the subject of crises in the post depression period for advanced capitalist countries[16/] which is principally in terms of the limited purchasing power of the masses, referred to in the literature as underconsumption thepry.[17/]

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15. Patnaik (1979) Page. 12

16. See Sweezy (1952), Kalecki (1971), Baran and Sweezy (1966), Stiendl (1976)

17. Following Wright (1978), the basic propositions of under consumptionist thesis can be summarised as:
    There is an intrinsic contradiction in a capitalist society between the conditions of production of surplus value and the conditions of realisation of surplus value. This is consequent upon the functioning of the capitalist system where individual capitalist always try to minimise their wage bill thereby restricting the development of 'effective' demand on the part of the workers. The manifestation of the inability to realise the full value of the produced surplus is a fall in the actual rate of profit. In otherwords, an extreme disproportionality between the spheres of production and circulation leading to a consideration of circulation as a limiting cause of production is postulated.

Apart from the fact that Patnaik uses an aggregate static Kaleckian framework as was discussed above, this lineage can be established by arguing that theoretically underinvestment is a finer version of underconsumption and that underinvestment as a category independent of underconsumption is not sustainable. Although Patnaik would like to disassociate himself from the underconsumptionists[18] our summary of his (and Rao's) thesis would make it obvious that it has strong underconsumptionist undertone.

Eventhough a crucial role has been accorded to public investment the central argument of their thesis does remain the restricted consuming power of the population, primarily the working class. Arguing that the problem of crises at least to a certain extent could be resolved by an equitable distribution of income, draws them closer to the underconsumptionist thesis of crisis.

While in the typical underconsumptionist mode of reasoning the "effective demand" of the workers is seen to be restricted by the attempts of the individual capitalists to minimise their wage bill, in Patnaik and Rao's thesis specific to the Indian situation this comes about by a rise in the foodgrain prices which reduces the real wages of the worker. The problematic essentially remains the same.

In fact the role of investment which becomes an important part of their argument follows from the restricted consuming power of the masses which leaves a "demand gap" and other forms of expenditure (in their case, public investment) have to be brought in to fill this gap. This is what lies at the heart of the underconsumptionist argument also.

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18. Patnaik (1984)

At a theoretical level also, underinvestment as a category independent of underconsumption cannot be sustained because:

a. Capitalist expenditure includes variable capital and under investment would automatically tend to lead to underconsumption. In other words, consumption comes from wages which are themselves a necessary part of investment.

b. as in the Baran-Sweezy-Kalecki general crisis theory, underconsumption, over accumulation, unused productive capacity and a strong tendency to underinvestment are all linked up in a causal sequence.

Locating the problem in the poverty of the masses and thereby ascribing the cause of the crises to the inability to realise surplus value is tantamount to rejecting the classical Marxist argument. The logic of this argument, following Engels is[19] that all societies divided into classes have been and are characterised by the poverty of masses. This only describes class societies and capitalism in <u>this</u> regard is not unique. But only under capitalism crises are taking the form of over production inherent in its economic system. What follows therefore is that this poverty cannot explains why crisis occur only under capitalism and not under precapitalist modes of production. To explain crisis, therefore on has to locate the differentia specifica of capitalism which does not lie in the underconsumption of masses but in value form and commodity form.

The solution to the crisis which is sought in a "radical egalitarian shift in the pattern of asset and income distribution",[20] so, that demand either

19. Anti During (1947)

20. Patnaik (1979) p. 6

adjusts to supply or reallocates production, seems to us to be logically indeterminate. On the one hand it can be argued that greater inequality is consistent with higher rate of accumulation through higher level of saving and on the other hand a lack of purchasing power among masses results in the deficiency of effective demand. Is therefore one arguing for some "desirable" level of inequality which is consistent with both accumulation as well as creation of demand?

Further these arguments seem to proceed without investigating in detail the relationship of the relevant distributive variables - the real wage and the rate of profit to the rate of accumulation. Consequently they seem to ignore the mechanism that beyond a point an increase in the share of wages which means a corresponding decline in the rate of profitability via a decline in the rate of exploitation may lead to a collapse of investment. That a higher rate of accumulation can proceed with a decline in the share of wages can be inferred from empirical evidence relating to India. Shetty, documented a decline in the share of wages in the industrial sector, whereas Mundle, and Sau showed that the per capita consumption declined during the period 1950-51 to 1964-65 - the period associated with a high rate of fixed capital formation.[21] The association of a high rate of accumulation with a declining share of wages can be shown with the help of a two sector model also.[22]

The larger theoretical question, whether underconsumption theory (and its variants) is an adequate explanatory thesis for explaining crises in a capitalist economy is itself open to question[23] and so

21. Shetty (1973), Mundle (1975), Sau (1974)
22. See Dixon
23. For a summary of the criticisms levelled against underconsumption theories See Shaikh (1978) and for detailed discussion See Bleaney(1976). For a synthesis of the different Marxist perspectives on Crises theories See Weisskopf. (1978)

is its relevance for a country where a large portion of the means of consumption especially wage goods is produced under precapitalist social relations, such that the socially necessary labour time is to a greater or lesser extent determined outside the capitalist sector of the economy.

Without going into such questions in detail, since such an analysis, amounts to developing a theory of crises for the third world, one can question the factual observations, the empirical basis and the presumptions content of the under-investment hypothesis.

Apart from Patnaik and Rao, and Srinivasan and Narayana, who attribute the phenomenon of deceleration to public investment, (for radically different reasons), most of the other economists have also given it at least a partial explanatory status. In fact, one common factor to most of the hypothesis seems to be the recognition of the impact of public investment on the industrial deceleration in India. Even though there is some consensus on the bearing of public investment on the economic growth in general and industrial growth in particular there is no consensus on either the causalities or the mechanism of operation of these impacts and less so on the policy prescription's forwarded. The impacts of public investment on industrial deceleration that have been postulated vary from supply side infrastructure bottlenecks to demand side constraints. The earliest hypothesis regarding the performance of agriculture slowing down the growth in the industrial sector incorporates public investment either by arguing that a low performance of agriculture leads to erosion of government saving and hence public investment or reversing the causality by arguing that a decline in agriculture was a consequence rather than the cause of decline in public investment.

Similarly, the inefficiency, based argument finds the genesis of the problem in the growing inefficiencies in public sector investment as is reflected by increasing incremental capital output ratios. Furthermore the primacy is given

to supply side impacts by arguing that the investment famine faced by the infrastructural sector had a growth choking effect on the economy as a whole. Consequently a step up only in the infrastructural sectors is prescribed. The reason for a decline in public investment in the post mid sixties is seen in the "conservative attitude towards deficit financing".[24/]

Thus, there is, in the literature, a general recognition of public investment as an explanatory variable in industrial deceleration, for whatever reasons, and also therefore the significant influence of the state over the accumulation process in particular and the level of macroeconomic activity in general. Ofcourse, Patnaik, by explicitly (recognising the role of the state and) trying to explore the nexus between accumulation process and the state has made an undeniable advance. This is so because a great deal can be learned about crisis - its origin, nature and form - by seeing it through the spectrum of the state. On the other hand, given the response of the state to a situation of crisis, it can also serve as a starting point for an enquiry regarding the nature and character of the state[25/] and provide some insights into the various forms of interventions and assistance to capital in the latters valorization process..

Several aspects of State intervention and assistance to capital have not been recognised in the Indian debate on deceleration. For it seems, from the way the growth and stability of the economy prior to the mid sixties have been explained by the role of state investment and also the alleviation of the crisis through an increased state expenditure and investment, that the underlying assumptions are

24. Ahluwalia (1984) page 169

25. It needs to be clarified that we are not adopting a reductionist approach and suggesting that a complete theory of the State can be derived from a theory of accumulation crisis which would mean subsuming the state under its accumulation function.

a. public investment per se leads to growth of output in the private sector

b. public investment is 'exogenous' to the system such that it bears little or no relation to either its own profitability or the accumulation requirements of capital.

The first assumption seems to overlook the complex relationship between state and capital. It needs to emphasized that public investment, is but one of the forms of state's assistance to capital. While it might be true that public investment was instrumental in the pre 1965 period of growth, it does not follow that it would have continued to foster growth in the later period also. The requirements of capital change in form, content and magnitude depending on the stage of development and so do the forms of state's assistance.

Given this kind of an understanding the "proliferation of subsidies and grants to placate ....with consequent reduction in available surplus for public capital formation"[26] need not be considered as a "waste". It can be better understood as another form of State's assistance consistent with the capitals present requirements.

What is essentially being argued is that it is possible that the requirements of the Indian private capital changed after mid sixties such that a direct and overt intervention like, public investment, was no longer essential but what was perhaps required was assistance in the form of subsidies, for example, to exploit external markets.[27]

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26. Bardhan (1984) p.61

27. c.f Sen, S. (1982) From Import Substitution to Export Promotion. Policy planning in India's Foreign Trade Sector "Economic and Political Weekly Annual Number 1982".

It is arguable, further, that what was required by the private capital, after a large capital goods sector was already created prior to the plan holiday which was in some sense 'sufficient' for that level of accumulation, was the allocative type of intervention which creates economic condition suitable for accumulation and in addition to this some physical inputs in certain specific areas[28] which are more of the nature of making accumulation process "smooth" rather than of "restoring accumulation".

Given this type of reasoning aggregate public investment as a "homogenous magnitude" does not remain the only relevant variable for explaining deceleration as it has been treated in the literature. For, what matters apart from its growth is its composition across different sectors, which have diverse roles to play in the process of economic growth and while the role of certain sectors increases that of others diminishes.

Going beyond the notion of aggregate public investment one can visualise a changing pattern overtime within public investment - in terms of its structure. A shift in public investment may occur, for example, in favour of the sectors which through their stimulation of private sector may increase the rate of investment in the economy even when the growth rate of aggregate public investment is declining. and vice versa. Such a situation may, of course, in turn change the composition of the aggregate investment in the economy to the extent public investment differs from private investment. This may even lead to a change in the sources of growth.

Such are the kinds of empirical and analytical issues that deserve to be looked at carefully if one were to comment on the role of public investment in deceleration rather than remain preoccupied with aggregate public investment.

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28. Like infrastructure, as suggested by Ahluwalia (1984)

This, so far, remains to be done and has been attempted in this study.

Apart from the unscientific handling of data on even the most crucical magnitudes in some of the most influential writings[29], the focus of whatever fragmentary evidence that has been analysed is almost exclusively in terms of the rate of growth of public investment. "A proper view of the trend in capital formation and it major components" as Kuznets writes "requires a comparison with national product, (i.e. rate of investment) from which the savings embodied in capital formation are drawn, and for the production of which capital investment is made"[30] implying thereby that apart from the rate of growth of investment it is the rate of investment which is equally, if not, more important.

More importantly public investment has often been treated as if it were a homogenous entity, at a point of time and remained so over time such that no matter where it was invested, the growth generating effects would remain the same. In other words, the composition of public investment - in terms of its distribution across sectors and asset structure - has been totally neglected. No enquiry regarding the structure of investment, the changes in it and the consequent impact of such shifts on growth has been carried out. Consequently one feels that the analysis conducted has been based on inferences, and implication and the policy alternative suggested are based on presumptions rather than empirical facts. The point we are trying to make can be illustrated with an

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29. Here we are referring to Patnaik (1984) who draws inferences about the rate of growth of public investment from a series on public investment at 1970-71 price, which has been computed (not by him) by using implicit deflators of the whole economy capital formation. Which has led to estimational errors to the extent of 30% in the series. For details see Appendix 1 of Chapter 3 below.

30. Kuznet (1981) p.4.

example: generalised argumentation like, "deceleration in the rate of growth of public investment from the mid sixties onwards implied that capacity could not be fully utilised in certain capital goods" abound in the literature. Such an implication need not follow if one considers the possibility of increased "capital goods intensity" of public investment such that an underutilisation of capital goods industry resulting from a decline in the rate of growth of aggregate public investment is compensated adequately (or more than adequately) by the rise in the "capital goods intensity" (per unit) of public investment.[31] What is being argued is that a proper understanding of the demand generated by public investment cannot be achieved by looking at the aggregate public investment but by examining the movements of its components and their behavioural pattern over time.

Having critically summarised in this chapter, the theoretical content and the empirical approach of the under-investment hypotheses, we shall in the chapters that follow analyse the growth pattern and instability of public investment at a disaggregated level.

Chapter 2 provides an over-view of the aggregate public investment vis-a-vis the aggregate investment in the economy.

Chapter 3 discusses the sources of data available for a disaggregated study on public investment and points out their limitations and sources of error.

Chapter 4 lays out the theoretical framework of our study. It is devoted to establishing theoretically the importance of the structure of investment in determining the rate of growth of output.

Chapter 5 takes up for detailed analysis, in terms of growth, instability and compositional shift, public investment by Industry of use and explores the

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31. This argument has been taken up in detail in Chapter 4.

relationship, at the same level of disaggregation, between public investment and private investment.

Chapter 6 is an extension of Chapter 5 as it goes on to analyse public investment at a further level of disaggregation. This chapter analyses the components of public investment (i.e. asset structure) within each industry of use.

Chapter 7 relates investment and incremental output in public sector by Industry of use to complete the discussion on the structure of public investment. A decomposition exercise is carried out to assess the contribution of public sector to the economy's incremental capital output ratios.

Chapter 8 summarises the main arguments and evidences to present some tentative conclusions and implications of the study.

STATISTICAL ANNEXURE

TO

CHAPTER 1

Table 1.1: Index Numbers of Industrial Production

Year	Series 'A': 1956=100		Series 'B': 1960 =100		Series 'C' 1970 =100	
	General Index	Manufacturing	General Index	Manufacturing	General Index	Manufacturing
1955	91.9	91.6	(72.7)	73.8		
1956	100.0	100.0	(78.4)	79.6		
1957	104.2	103.3	(82.7)	83.4		
1958	107.7	106.2	(84.4)	84.8		
1959	116.8	114.9	(90.3)	90.5		
1960	130.2	127.9	100.3	100.0		
1961	141.0	137.9	109.2	109.2		
1962	152.9	149.2	119.8	119.6		
1963	167.3	162.9	129.7	129.1		
1964	177.8	173.6	140.8	141.2		
1965	187.7	182.3	153.8	154.0		
1966	192.6	186.0	153.2	151.7		
1967			152.6	149.6		
1968			163.0	158.7		
1969			175.0	170.6		
1970			184.3	178.9	100.0	100.0
1971			186.1	178.9	104.2	104.2
1972			199.4	191.4	110.2	110.1
1973			220.7	193.4	112.0	112.2
1974			(210.7)	(202.2)	114.3	113.0
1975			(219.9)	(207.7)	119.3	116.1
1976					131.6	127.7

Note: For Series B, the figure given in brackets are derived from series A and C respectively

Source: Nayyar, D (1978) p.1266

Table 1.2: Composition and time profile of Industrial Growth in India

Industry Group	Weights 1960=100	Index Number of Production 1960 = 100			Average growth rate per annum	
		1955	1965	1975	1955-65	1965-75
Food Products	12.09	75.9	122.2	171.2	4.9	3.4
Beverages and Tobacco	2.22	61.7	147.6	200.9	9.1	3.1
Textiles	27.06	94.1	114.8	112.0	2.0	-0.5
Chemicals	7.26	60.1	152.6	306.9	9.8	7.2
Non-metallic minerals	3.85	53.7	149.1	243.3	10.8	5.0
Basic Metals	7.38	53.3	180.9	242.3	13.0	3.0
Metal Products	2.51	54.1	205.6	310.0	14.3	4.2
Machinery -non electrical	3.38	35.5	320.9	623.6	24.6	6.9
Electrical machinery	3.05	49.0	208.2	443.8	15.6	8.0
Transport	7.77	99.2	265.3	149.4	7.6	-3.2
All manufacturing	84.91	73.8	154.0	207.7	7.6	3.1
Mining and Quarry	9.72	74.6	131.7	189.8	5.9	3.7
Electricity	5.37	51.5	190.9	461.8	14.0	9.2
Total Industrial Production	100.00	72.7	153.8	219.9	7.8	3.6

Source: op.cit p.1267

Table 1.3: Growth rates of sub periods and tests of Deceleration (at 1970-71 prices)

	Net Value added		Percent per annum Net value of output	
	I	II	I	II
A. Use Based Classification:				
Total	8.0	5.7	8.8	6.6
1. Basic Goods	11.0	5.9	12.2	7.3
2. Intermediate Goods	5.7	4.5*	9.4	6.2
3. Capital Goods	15.4	6.6	15.8	7.4
4. Consumer Goods	4.7	5.6*	5.9	6.2
a. Durables	11.5	10.8*	12.3	11.9
b. Non-Durables	4.2	5.0*	5.7	5.7
B. Input Based Classification				
1. Agrobased	3.7	4.4*	5.9	5.0
2. Metal Based	14.1	6.5	14.6	7.2
3. Chemical based	8.2	8.1*	11.3	11.2

Note: Form of equation: $\text{Log } Y = a + a'D + bt + b'Dt$ where

$D = 0$ upto 1965-66 and 1 thereafter

* Statistically not significantly different from the earlier period.

Source: Ahluwalia (1985) p.21

Chapter 2

GROWTH AND INSTABILITY OF PUBLIC INVESTMENT

As was argued in the preceeding chapter, the inter relationship between the State and capital operates at different levels and is expressed in diverse forms. However it cannot be denied that given the dirigistic development strategy pursued in India through a policy of State accumulation, public investment is necessarily one of the major policy instruments capable of regulating the rate of investment and forcing the pace of economic growth.

The domain of the public sector in India before independence was confined largely to public utilities like post and telegraph, railway and road transport, and ports. The political independence of India considerably enlarged the possibilities for the utilisation of the State for accelerating the process of economic development, though it needs to be noted that a realisation of these possibilities and the degree to which it could be achieved depended on the socio political structure and nature of the newly formed state and the society.

The emergence and establishment of t/ Public Sector in independent India can be associated with three processes:

a. transfer of property of the colonial government and that of princely states to the national state

b. Nationalisation

c. Public Investment

Though the first process is generally associated with the formation of public sector, in India it did not contribute significantly because its role in the process of emergence and development of the public sector was conditioned by the entrepreneurial activities of the colonial governments and the former princely states. Since their activities were extremely limited, they determined the limitations of its role. This can be bstantiated by taking a brief look at the history of development of the state interest in the economy.[1/] From 1830 till 1913 the state intervention was minimal and restricted to public utilities, essentially posts and telegraph. Between 1914 to 1938 the state started getting more involved by levying protective tariffs, and granting financial aid and assistance to industries. During this period the government began to recognize its responsibility in the matters of industrial development and adopted certain policies, with this end in view, of which the policy of protection was perhaps the most significant. In the third phase, 1939 to 1950, the strategic dangers created by the War led to the liberalization of the industrial policy essentially in the field of defence and strategic establishments. But by the end of the War in 1945, the Government of India announced an industrial policy declaring that "a vigorous and sustained effort is necessary in which the state no less than private industry take part and that Government have to decide to take positive steps to encourage and promote rapid industrialization of the country, to the fullest possible extent". Though there were some policy formulations and deliberation, the state's involvement was not substantial in any way and India inherited at best, a myopic public sector.

After political independence the second process i.e. Nationalisation

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1. For details, refer: Khera S S (1977), Mukherji K (1965)

operated. Nationalisation contributed to the 'emergence' of public sector in India. Though nationalisation of private capital was carried out with a payment of compensation[2] its impact on the evolution of the socio economic structure was considerable due to the transfer of Reserve Bank of India, Insurance companies and largest commercial banks into the state sector which enabled the state to regulate money circulation conducive to its overall economic and social policy.

However in the productive sphere nationalization played a rather limited role in a way of forming the public sector. It affected mainly transport (especially air-transport), transport engineering, power industries and mining. In fact, nationalisation was pursued in a way which was governed primarily by political considerations. Nationalisation was resorted in order to prevent a fall in production and mostly affected the most worn out and inefficient enterprises with very low capacity utilization and equipped with obselete technology.[3] This, undoubtedly had an adverse effect on the production structure, profitability and the overall economic efficiency of the state sector.

If nationalisation contributed to the 'emergence' of the public sector, the main and by far the most significant way of forming, consolidating and developing the state sector in India is state capital investment. The size and structure of the public sector was drastically changed in the post independence period, particularly after 1955, mainly through state investment.

In order to assess the significance of state investment in the economy we will first discuss the aggregate level of total investment in the economy and then

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2. Strictly speaking, this is not genuine nationalisation but as the French Communists term it, it is "etatisation".

3. For details, refer: Malayarov O.V (1983).

discuss the development of public sector in comparison with the rest of the economy.

Contrary to what is being argued that the rate of gross domestic capital formation as a proportion of gross domestic product i.e. rate of capital formation has "dramatically improved"[4] after the mid seventies we would like to propose that the rate of capital formation has been consistently high given the structure of the Indian economy. The rate of investment was 19.40% way back in 1956-57 and by the mid sixties it was already above 22%. What has actually been achieved in the post 1975 period is the stabilisation of this rate at such a high level - since 1974-75 it has consistently been around 23% (See Table 2.1)

Given this rate of investment which is comparable with that of some of the high income countries output should hav registered a much higher growth rate. But output has only grown at a compound annual growth rate of 3.53% during the fifties, 3.12% during the sixties and 3.48% during the seventies. This disjuncture between the rate of growth of output and the rate of investment has led to a major debate covering methodological, conceptual and empirical issues.[5]

Periodising on the basis of the five year plans we find that except during the plan holiday, the rate of growth of capital formation has throughout been higher than the rate of growth of output the divergence having increased after the third plan. The compound annual rate of growth of gross domestic capital formation over the plans has been fluctuating. While the second plan and the plan holiday were

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4. Shetty, S.L. and Menon, K.A(1980)

5. Raj (1979), Shetty and Menon (1980), Majumdar et al (1980), Ghosh et al (1981), Report of Working on Savings (1982) Rakshit (1982, 1983)

periods of slow and negative growth respectively, the highest rate of growth was registered during the fifth plan.

Though the rate of growth of fixed capital formation follows the same pattern, as is evident from Table 2.3, it might noted that the decline during the plan holiday of the magnitude of 7.38% was disproportionately borne by inventory investment. This becomes obvious by looking at the decline in gross domestic fixed capital formation, which declined by only 2% during the same period. It is also worth pointing out here that while in the earlier period the rate of growth of capital formation was higher than the rate of growth of fixed capital formation, this pattern has been reversed during the fifth and sixth plan.

During the period 1950-51 to 1981-82 gross domestic capital formation in the economy increased at a compound annual rate of 5.54% having grown at a faster rate of 6.85% per annum till 1965-66 as compared to a rate of 5.11% per annum in the post 1965 period. As against this, gross domestic product maintained a growt-rate of about 3.5% throughout the period, as well as the sub periods.

Since we are analysing capital formation in the context of growth it is necessary to enquire whether there has been as substantial an increase, as depicted by the rate of gross domestic capital formation, in the other forms of capital formation, like gross fixed capital formation, net fixed capital formation which are more relevant for assessing the impact of capital formation on growth.

On making an allowance for depreication it is found that the rate of net domestic capital formation is not as impressive as that of gross domestic capital formation. As Table 2.2 shows the rate of net domestic capital formation (i.e. net domestic capital formation as a percentage of net domestic product at factor cost) has hardly registered an increase in the third plan. While the rate of net

capital formation was 17.77% in 1966-67, in 1981-82 it was 18%.

Capital formation in the context of national accounts includes changes in the stocks which do not directly add to the productive capacity of the economy. It is, therefore, desirable to exclude the changes in stocks while analysing the growth performance correspond ng to a change in the rate of investment.

Estimates of gross fixed capital formation as a proportion of gross domestic product reveal that there has not been a perceptible increase in the rate of gross fixed capital formation.

Further, when one focusses on the rate of net fixed capital formation we find that the rate far from increasing appears to have decelerated. There has been a persistent decline in the rate of net fixed capital formation from 1965-66 to 1977-78 as can be seen from Table 2.2 . The rate of net fixed capital formation may be seen to have attained a level of 14.84% as early as 1965-66, though this rate was not sustained and remained below it for all the subsequent years till 1978-79. As against the impressive figure of 24% rate of gross domestic fixed capital formation, the rate of net fixed capital formation for the same year was just 13.02%. As the tables 2.1 and 2.2 show the same pattern is observed when one considers capital formation as a proportion of domestic product at market prices.

From the brief discussion abve, what emerges is that, different forms of capital formation need to be considered before one can make conclusive assertions regarding its increase.

It has been observed that the rate of gross domestic capital formation was much higher at current prices as compare to that at constant prices. This, along with the finding that the rate of net fixed capital formation was considerably

lower than the rate of gross capital formation suggests that the sharp rise in the proportion of gross domestic capital formation to gross domestic product since the mid sixties is essential attributable to factors like the rise in the level of inventories (inventories increased at a compound annual rate of 6% between 1950-51 1964-65 and 13.45% between 1965-66 1981-82) and a relatively faster rise in the price of capital goods.[6/]

However, not withstanding the fact that the increase in the rate of capital formation (particularly in net terms) has stagnated in the period after the third plan, there has been an appreciable increase when one considers the whole period i.e. 1950-51 to 1981-82. As against 7% at the beginning of the period the rate of net fixed capital formation is currently around 14%, which is not negligible Even though this level of capital formation would not justify any complacence, a doubling of the rate of net fixed capital should have generated a corresponding rise in the rate of growth of output.

Growth of Public Investment

Given this background about the capital formation in the economy, let us now examine the importance of public sector in the overall capital formation.

At the inception of planning, public sector gross capital formation was less than a quarter of the economy's capital formation. This share has now risen to around half. From 23% in 1950-51, the share of public sector increased to 53% in 1976-77; thereafter it has fluctuated around 46-48%. This share apart, the importance of public sector capital formation lies in its distribution across sectors and industry groups, which we shall discuss in detail in Chapter 5 & 6.

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6. Report of the Working Group on Savings (1982)

In absolute magnitude, capital formation in public sector, at constant prices, increased from 530 crores in 1950-51 to 6,123 crores in 1981-82 at a compound annual rate of growth of 7.32%.

If one periodises on the basis of the now standard periodisation of pre 1965 and post 1965, it is observed that in the earlier period gross domestic capital formation increased at a compound annual rate of 12% whereas in the later period the rate of growth was 6.57% per annum (Table 2.5).

A plan based periodisation, in the other hand, shows that the rates of growth though higher during the first three plans, there was no secular decline in the rate of growth of gross domestic capital formation as suggested by the pre and post 1965 periodisation -- a empirically determined periodisation for which there is no uniquely acceptable reason that would make it an automatic and rational choice'.[7] As the Table 2,5, shows, it was only during the plan holiday that there was a severe cutback in public investment leading to a negative growth rate of 3.56% per annum.

This argument is further substantiated by focussing on the rate of growth of gross domestic fixed capital formation given in Table 2.5, column 2. While gross domestic capital formation in the public sector grew at a compound annual rate of 6.5% during the fifth plan, gross fixed capital formation increased at a rate of 12.8% during the same plan, at constant prices. This would suggest that the component which was slow growing during this period was inventory investment rather than fixed investment. The same pattern is evident in the case of net domestic capital formation.

On the basis of the empirical evidence presented in Table 2.5 it can be argued that there does not seem to be a persistent decline in the rate of growth of capital formation in the public sector, especially in fixed capital formation.

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8. Shetty (1978) p.45.

Moreover, while comparing these growth rates, which admittedly were higher in the pre 1965 period, it needs to be noted that the rate of growth is not independent of the level of capital formation, i.e. the very high rates of growth can be partly because of a small initial base -- while a 15% growth rate in the first plan meant an increase of about 382 crores, during the fifth plan, a rate of growth of 6% would mean an increase of about 1500 crores, both at 1970-71 prices.

Whether public investment had to maintain the same pace for growth to proceed unfettered is debatable in view of the fact that "....the economy could probably achieve any of the desired objectives with lower investment, as substantial installed capacities were already created in a wide spectrum of basic and capital goods industries....",[8] and also for the reasons discussed in Chapter 1 above.

In evaluating the performance of the economy with regard to public investment (or investment in general) the emphasis should not be exclusively on the rate of growth. The relevant way of analysing investment requires a comparison with national product for the production of which investment is made -- which for our purpose would mean public investment as a percentage of the domestic product i.e. the rate of public investment. That, it is the rate of investment and not the rate of growth of investment which determines the rate of growth of output shall be discussed, in detail, in Chapter 4.

As against the decline in the rate of growth of gross doemstic capital formation, there has not been a decline in the rate of public investment. On the contrary it has increased consistently from 3.02% to 11.5% over the period 1950-51 to 1981-82. As Table 2.6 would show, whether one looks at rate of

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8. Shetty (1978) p.45

fixed capital formation in the public sector -- gross or net, there has not been any secular decline except for a period of four years during the plan holiday. Even this decline is of no substantial magnitude and the earlier rate is attained by 1972-73. The rate of gross fixed capital formation has increased more than four-fold over the last three decades. Net fixed Capital formation rate, though lower, understandably so, follows the same pattern.

Though we shall be relating capital formation in public sector with its output in Cahpter 7 it might be worth noting here that the gross domestic capital formation as a percentage of the gross domestic product in public sector has been declining secularly from 77.83% in 1960-61 to 49% in 1981-82. Between 1965-66 and 1969-70 this ratio declined by 27.2 percentage points.

Juxtaposing the rate of public investment (i.e. Gross domestic capital formation in public sector as a percentage of the total gross domestic product of the economy), which we observed was increasing, with the proportion of gross domestic capital formation to output in public sector which has been declining, it can be inferred that the output of the public sector has been growing at a much faster rate than the economy's output.

Instability of Public Investment:

Though, it would seem to be obvious that the growth performance of the economy would depend not only on the level, size and the rate of growth of investment but also on the nature and pattern of instability this aspect has been neglected thus far in the analysis of public investment.

Growth and instability bear a close relationship with each other, as any historical account of the growth process would show. Be it rapid growth or slow growth it will be characterised by some degree of instability. However the causalities may differ i.e. in the case of rapid growth being accompanied by a

high degree of instability, slow growth may be result of instability.[9] Latter is a type of a relationship which we would visualise the growth and instability in public investment bear with each other.

An unstable growth of public investment can have two types of consequences a statistical effect and a general growth retarding effect.

By the statistical effect of instability what we mean is that, if public investment grows at a fluctuating rate, say, r_t and attains a reached I_y after 'y' years, then it can shown that I_y will be less than I_y, which it would have attained had it grown steadily at the average rate of growth of m instead of the fluctuating rates. The difference between the actual and potential, in ourcase I_y and I_y, has been shown to depend on the instability of the actual growth rates as follows.[10]

$$I_y = I_y\left[1 - \frac{y}{2}\left(\frac{m}{1+m}\right)\right]^2 (CV)^2$$

where CV is the coefficient of variation of the actual annual growth rates.

Apart from this statistical effect, instability in public investment will affect growth by Transmitting its instability to other related segments of the economy which will get amplified because of the multiplier effect and will thereby create imbalances in the economy which may in turn have a growth choking effect.

Measuring the magnitude of instability is extremely difficult as it

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9. Sundrum (1983) finds such a relationship existing in the case of export instability.

10. Sundrum op.cit.

is beset with numerous conceptual and methodological problems.[11] We have used two methods for measuring instability:

a. Deviations from trend method

b. Coefficient of Variation of the annual growth rates.

Instead of using the standard trend method, where in the deviations from the trend value are computed and their standard deviations estimated to arrive at the magnitude of instability we have used a variatnt of this method.

Growth rates were calculated by fitting the following regression:

$$\text{Log}_e I_t = a + rt + e_t$$

where I_t = Public Investment

t = time

ℓ_t = error term

r = growth rate

The following simple variant of the trend method has been used to measure, 'F', the instability around the fitted trend:

$$F = (\text{Error sum squares}/n)^{\frac{1}{2}} \times 100$$

where n = number of years.

The advantage thus method has over the trend method is that it is scale independent.

The basic drawback with the trend method is that the magnitude of instability

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11. See: Indian Journal of Agricultural Economics, "Seminar on Data Base and Methodology for the Study of Growth Rates in Agriculture, Vol.XXXV, No.2, 1980 and Ray, S.K. Growth and Instability in Indian Agriculture; Institute of Economic Growth 1983. Though both are exclusively concerned with instability in agriculture general methodological problems relating to instability have been discussed.

arrived at will depend directly on the trend fitted. Since there is no aprori reason that advocates the fitting of a particular trend and two different trend lines can be fitted equally well, giving two different magnitudes of instability for the same period, this method is suspect. Moreover it is not a very reliable method for comparing instability between periods, because the trends might be different in the two periods and instability measured around two different trends is not, strictly speaking, comparable.

Another simple method for arriving at the magnitude of instability is to calculate the coefficient of variation of the annual growth rates. This method is quite satisfactory unless there is a strong trend increase or decrease in the variable under measurement, and in which case even if there are no fluctuations the coefficient of variation method will show that there is instability. As such it is not the ideal method for measuring instability over longer time periods but can be used for short time periods where it is unlikely to get distorted by a strong trend.

Tables 2.7 and 2.8 provide the estimates of instability in public investment as obtained by the above discussed trend and coefficient of variation method. On the basis of both these methods it can be concluded that the magnitude of instability has been increasing over time. The instability of gross domestic capital formation has almost doubled - while it was 1.11 during the period 1950-51 to 1965-66, it increased to 2.04 during 1966-67 to 1981-82, as shown by the coefficient of variation of the growth rates. The instability has increased even more sharply in the case of net domestic fixed capital formation, from 0.69 to 2.47 over the same period. That the magnitude of instability in gross domestic capital formation is lower than that of net fixed capital formation in the period 1966-67 to 1981-82, as are generally associates a higher degree of instability with inventory investment.

As to whether inventory investment has instability inducing or instability dampening effects can be only enquired through a disaggregated analysis of public investment by type of assets, which is the subject matter of our Chapter 7.

The results of the trend method substantiate the conclusions arrived at on the basis of the coefficient of variation method. The instability in gross domestic fixed capital formation has increased from 7.3 to 8.90 and that in net domestic fixed capital formation from 8.9 to 9.3 over the two sub-periods.

One cannot infer or draw conclusions about the causes (and consequences) of instability in public investment at an aggregate level such as above. This is so because instability in public investment will depend on the relative movements of its components -- in terms of assets and also by industrial categories. A synchronised movement in the components, for example, may increase the instability whereas it may decrease if their pattern of movement become dissimilar. Thus a disaggregated study of instability of public investment is warranted for analysing the causes and consequence of instability and has been carried out in Chapters 5 and 6 below.

Relationship between Public Investment and Private Investment:

The relationship between public and private investment is, as we discussed in the preceeding chapter, one of the main elements of the public investment based explanations of deceleration. The role of public investment as an instrument of stabilisation and growth policy is to a large extent, sought in its stimulation of private investment. Though varying channels of influence through which public investment bears upon private investment have been postulated, the actual relationship that exists between the two has not been empirically explored.

Briefly stated, underlying the logic of complimentarity and stimulation of private investment by public invest are the followings channels of influence:

a. Public Investment creates infrastructure and raises the productivity of private capital stock, thereby reducing the requirements of private investment per unit of output.

b. Public Investment raises the demand for output of the private sector thereby influencing output expectation and investment requirements of the private sector.

c. Public Investment raises aggregate output and savings hence supplementing the economy's physical and financial resources.

Essentially therefore two sets of linkages, operating on the demand side and the supply side, are postulated. On the demand side the influence operates via the demand public investment creates for heavy industries and through generation of employment and income. On the supply side public investment encourages private investment by providing critical inputs and infrastructural facilities.

As against this view of complementarity "crowding out" relationship can also be postulated. Public sector having a primacy over resources by the very nature of its role in the developing countries, public investment can therefore exert a negative influence on private investment as both sectors compete for scarce physical and financial resources.

Though the relationship between public and private investment, as generally postulated, is determined by the composition of public investment this has not be recognised adequately. The underlying reasoning, in the above summarised channels of influence, seems to be that public investment per se bears a consistent and positive relationship with private investment.

This misunderstanding follows directly from the neglect of the composition of public investment, and thereby the changes in it, while analysing the relationship between public and private investment. For, what determines the nature and pattern of this relationship is the composition of public investment. For example,

a large proportion of public investment in industrial categories like agriculture, and electricity, gas and water may tend to strengthen its relationship with private investment, whereas a shift in favour of manufacturing, finance community and personal services may tend to weaken the relationship.

Further, if the relationship between public and private investment is viewed from this perspective, it would follow that the relationship need not be consistent but will change with a changing structure of public investment. An analysis along disaggregated analysis will not help in postulating a more specific form of relationship that exists between the two but could also help in understanding and explaining the dynamics of the relationship.

While a disaggregated relationship between public and private investment has been explored in Chapter 5 (try industry of use) and in Chapter 6 (by type of assets) after a discussion on the structure of public investment, here we shall briefly look at the relationship that exists between the two at the aggregate level.

A preliminary view of the relationship can be provided by plotting the two time series gross domestic capital formation in public sector and private sector in absolute terms as well as a proportions of gross domestic product.[12/] From the Graph 1 overleaf it can be seen that, a generally synchronised movement in the same direction (between gross domestic capital formation in the public and private sector) existed till 1965-66, giving way to fairly divergent movements thereafter. The decline during the late sixties and early seventies in the rate of growth of aggregate public investment, which is the basis for explaining industrial deceleration, saw an acceleration in private investment as can be seen from the graph. During the mid 1970's when rate of growth of public investment was high private investment appears to have stagnated.

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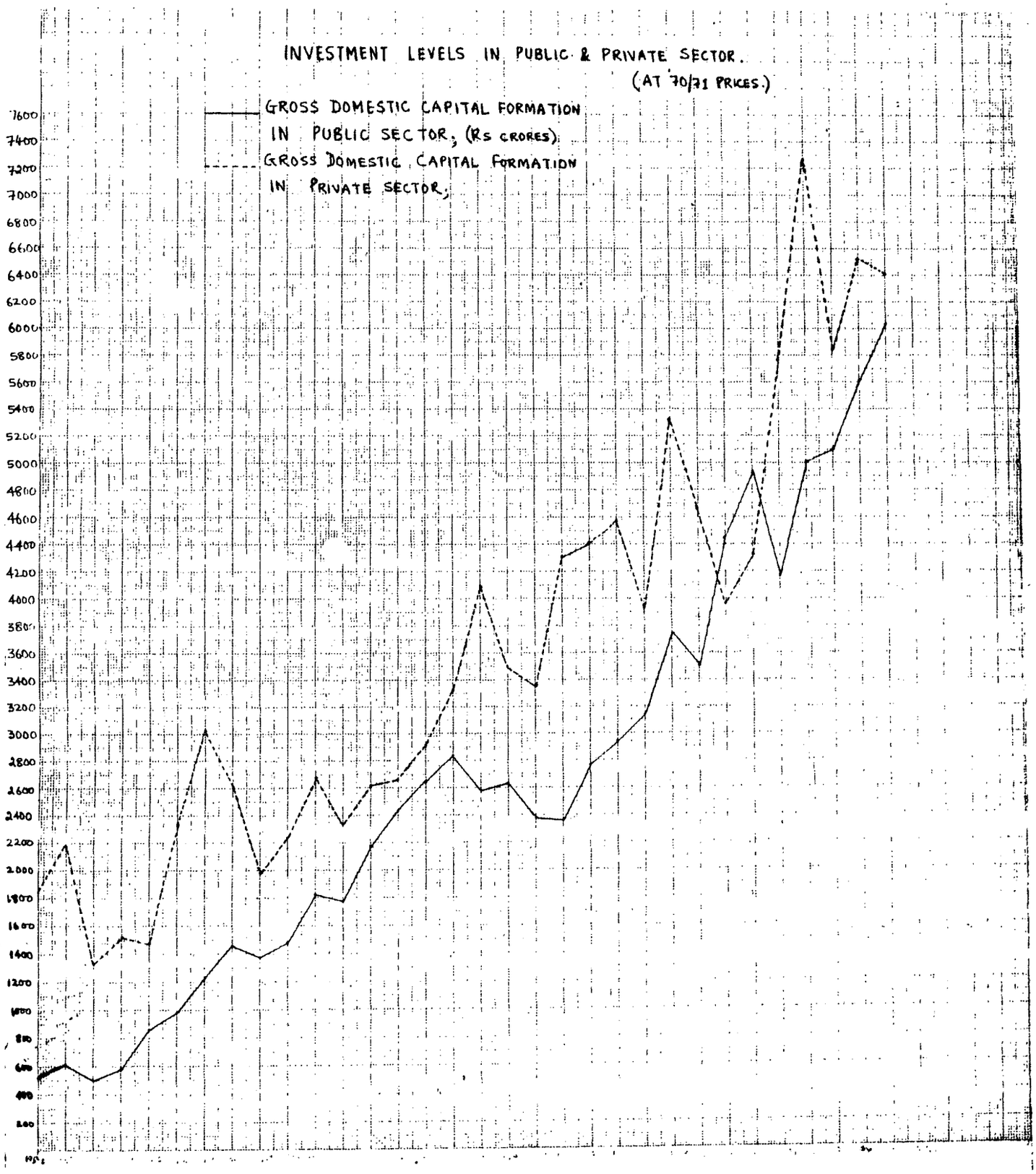
12. Sundarajan and Thakur (1980)


INVESTMENT LEVELS IN PUBLIC & PRIVATE SECTOR.
(AT 70/71 PRICES.)
GROSS DOMESTIC CAPITAL FORMATION IN PUBLIC SECTOR, (Rs CRORES)
GROSS DOMESTIC CAPITAL FORMATION IN PRIVATE SECTOR,
7600
7400
7200
7000
6800
6600
6400
6200
6000
5800
5600
5400
5200
5000
4800
4600
4400
4200
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200

On regressing private sector gross domestic capital formation on public sector gross domestic capital formation we find that for the period 1950-51 to 1981-82 there is no statistically significant relationship between the two with or without a time lag (See Table overleaf).

Dividing the period 1950-51 to 1981-82 into two sub-periods - 1950-51 to 1965-66 and 1966-67 to 1981-82, it is found that in the pre 1965-66 period the regression coefficient of public investment is positive and significant (at 1% level). The strength of the relationship as shown by the partial correlation coefficient, is 0.657. This would mean that public investment explains 43.16% [13/] of the variation in private investment when both variables are taken net of the time trend. It would be interesting to note that the significant positive relationship is of an unlagged nature, and it does not hold when time lags are introduced. This would indicate that the relationship between public sector investment and private sector investment operates on the supply side rather than the demand side which ought to have been of a lagged nature.

During the second sub-period, 1966-67 to 1981-82, the positive relationship that existed in the first period breaks down completely and is negative, though not statistically significant. This negative relationship apart from being statistically insignificant (which could be due to multicollinearity, for the common time trend is very significant in this case) is also weak, (having a partial correlation coefficient of -0.035 without a time lag and -0.225 with a 1 year time lag) therefore no firm conclusions can be drawn. It can, however, be said that there does not seem to be any relationship between public and private gross domestic capital formation in the period 1966-67 to 1981-82.

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13. i.e. square of the partial correlation coefficient.

Regression Results

Private Investment regressed on Public Investment

Period Lag	Gross Domestic Capital Formation				
	Correlation Coefficient	Regression Coefficient	Partial Correlation Coefficient	T Value	R^2
1950-51 to 1965-66	0.752	1.852	0.657	3.19	0.691
Lag 0					
Lag 1	0.793	0.324	0.135	0.47	.389
1966-67 to 1981-82					
Lag 0	0.781	-0.089	-0.035	.1537	.704
Lag 1	0.755	-0/435	-0.225	.8076	.683
1950-51 to 1981-82					
Lag 0	0.919	0.2936	0.216	1.17	.721
Lag 1	0.913	0.1913	0.122	0.691	.687

Form of the equation: $\text{Log } Y = a + bx + cT + e$

Note: Lag 0 means there is no time lag in response
Lag 1 means there is 1 year time lag in response

Net Domestic Capital Formation

Period/Lag	Correlation Coefficient	Regression Coefficient	Partial Correlation Coefficient	T Value	R^2
1950-51 to 1965-66					
Lag 0	0.514	1.497	0.505	2.13	0.400
Lag 1	0.439	0.2720	0.087	0.299	0.192
1966-67 to 1981-82					
Lag 0	0.633	-0.221	-0.1166	0.416	0.485
Lag 1	0.600	-0.157	-0.099	0.356	0.483
1950-51 to 1981-82					
Lag 0	0.826	0.1650	0.117	0.609	0.7133
Lag 1	0.811	0.023	0.011	0.757	0.7100

Consider net domestic capital formation. In the first sub period 1950-51 to 1965-66 the relationship between net domestic capital formation in private sector and that in public sector is significantly positive as can be seen from the table above. As in the case of gross domestic capital formation, here also the relationship breaks down in the second sub period The coefficient of public investment changes from positive in the first sub period to negative in the second sub period. However the negative relationship during the period 1966-67 to 1981-82 is not statistically significant.

On the basis of the preliminary empirical evidence presented above it could be argued that there does not seem to be a significantly positive relationship between private and public investment which would indicate complimentarity between the two. While in the period 1950-51 to 1965-66 there did exist a significant positive relationship no such relatioship would appear to hold after 1966-67. That there does not exist a positive relationship between public investment and private investment especially in the post 1965-66 period, is consistent with our earlier finding that when the rate of growth of public investment declined during the mid sixties, the rate of investment in the economy increased from 16.4% in 1963-64 to 21% in 1966-67.

If, because of a negative relationship between public and private investment, a decline in public investment is compensated by a rise in the private sector investment, as it appears to have, there will be a change in the composition

of aggregate investment depending on the difference in the investment mix of the two sectors.

Whether a decline in public investment gets compensated by a rise in the investment in private sector and to what extent will there result a shift in the composition of aggregate investment can be more furitfully discussed at the disaggregated level. What are needs to discuss, in this context, is the sectoral composition of public investment and identify the sectors where a fall in investment has been registered and then explore its relationship with private sector at that (sectoral and industrial category) level. Discussion along such lines have been carried out in Chapter 5 and 6.

STATISTICAL ANNEXURE

TO

CHAPTER 2

Note: The source for all data, unless otherwise specified, is: National Accounts Statistics, C.S.O.(Various issues).

Table 2.1: Gross Domestic Capital Formation in the Economy

At 1970-71 prices

Year	GDCF	GFCF	GDP	Rate of GDCF (% of GDP)*	Rate of GFCF (% of GDP)*	Rate of GDCF (% of GDP)**
1950-51	2379	2045	17536	13.56	11.66	12.9
1951-52	2804	2413	17883	15.67	13.49	14.8
1952-53	1838	1911	18517	9.92	10.32	9.4
1953-54	2127	2205	19688	10.80	11.19	10.2
1954-55	2363	2212	20233	11.67	10.93	11.0
1955-56	3323	3004	20870	15.92	14.39	14.9
1956-57	4271	3710	22013	19.40	16.85	18.2
1957-58	4088	3560	21631	18.89	16.45	17.5
1958-59	3382	3335	23465	14.41	14.21	13.4
1959-60	3741	3272	23894	15.65	13.69	14.5
1960-61	4523	3754	25534	17.71	14.70	16.7
1961-62	4140	3657	26440	15.65	13.83	14.6
1962-63	4808	4162	27003	17.79	15.41	16.5
1963-64	5080	4475	28380	17.89	15.76	16.4
1964-65	5581	4970	30617	18.22	16.23	16.8
1965-66	6170	5746	29023	21.25	19.79	19.3
1966-67	6675	5812	29307	22,77	19.83	20.9
1967-68	6139	5495	31868	19.26	17.24	17.8
1968-69	5758	5575	37725	17.59	17.03	16.1
1969-70	6677	6082	34802	19.18	17.47	17.6
1970-71	7177	6138	36736	19.53	16.70	17.8
1971-72	7547	6274	37313	20.22	16.81	18.8
1972-73	7075	6655	36910	19.16	18.03	17.3
1973-74	9072	7393	38646	23.47	19.13	21.4
1974-75	8205	6114	38979	21.04	15.68	20.1
1975-76	8422	6548	42662	19.74	15.34	18.5
1976-77	9249	7887	42986	21.51	18.34	20.1
1977-78	9958	9178	46773	21.29	19.62	21.1
1978-79	12280	10056	49463	24.82	20.33	22.5
1979-80	11135	8684	46854	23.76	18.53	21.5
1980-81	12141	9680	50526	24.02	19.15	22.0
1981-82	12525	10069	53229	23.53	18.91	21.4

Notes: 1. GDCF: Gross Domestic Capital Formation
GFCF: Gross Domestic Fixed Capital Formation
GDP : Gross Domestic Product

2. All capital formation figures are adjusted for "errors and omissions"

3. *: Gross domestic product at factor cost
**: Gross domestic product at market prices

4. The source of all the data is: National Accounts Statistics (C.S.O) Various Issues, unless otherwise specified.

Table 2.2: Net Domestic Capital Formation in the Economy

At 1970-71 Prices

Year	NDCF	NFCF	NDP	Rate of NDCF (% of NDP)*	Rate of NFCF (% of NDP)*	Rate of NDCF (% of NDP)**	Rate of NFCF (% of NDP)**
1950-51	1641	1307	16798	9.76	7.78	9.3	7.4
1951-52	2049	1658	17128	11.96	9.68	11.3	9.1
1952-53	1054	1127	17733	5.94	6.35	5.6	6.0
1953-54	1321	1399	18882	6.99	7.40	6.6	7.0
1954-55	1501	1350	19371	7.74	6.96	7.3	6.6
1955-56	2422	2103	19969	12.12	10.53	11.3	9.8
1956-57	3329	2768	21071	15.79	13.13	14.7	12.2
1957-58	3082	2554	20625	14.94	12.38	13.8	11.4
1958-59	2298	2251	22381	10.26	10.05	9.5	9.3
1959-60	2615	2146	22768	11.48	9.42	10.6	8.7
1960-61	3349	2580	24360	13.74	10.59	12.9	9.9
1961-62	2886	2403	25186	11.45	9.54	10.7	8.9
1962-63	3388	2472	25583	13.24	9.66	12.2	9.9
1963-64	3616	3011	26916	13.43	11.18	12.3	10.2
1964-65	3990	3379	29026	13.74	11.64	12.6	10.7
1965-66	4482	4058	27335	16.39	14.84	14.8	13.4
1966-67	4892	4029	27524	17.77	14.63	16.3	13.4
1967-68	4264	3620	29993	14.21	12.06	13.0	11.1
1968-69	3811	3628	30778	12.38	11.78	11.3	10.7
1969-70	4567	3972	32692	13.96	12.14	12.7	11.0
1970-71	4960	3921	34519	14.36	11.35	13.0	10.3
1971-72	52652	3989	35028	15.02	11.38	13.5	10.2
1972-73	4667	4247	34502	13.52	12.30	12.1	11.0
1973-74	6629	4950	36203	18.31	13.67	16.6	12.4
1974-75	5850	3759	36624	15.97	10.26	15.3	9.6
1975-76	5915	4041	40155	14.73	10.06	13.9	9.5
1976-77	6618	5256	40355	16.39	13.02	15.4	12.3
1977-78	7198	6417	44012	16.35	14.58	16.6	14.2
1978-79	9275	7051	46458	18.42	12.82	16.62	11.5
1979-80	8069	5618	43788	18.42	12.82	16.62	11.5
1980-81	8850	6389	47235	18.73	13.52	17.08	12.3
1981-82	8937	6481	49641	18.00	13.05	16.32	11.8

Note: 1. NDCF: Net Domestic Capital Formation
NFCF: Net Domestic Fixed Capital Formation
NDP : Net Domestic Production

2. All Capital Formation figures are adjusted for errors and omissions

3. * : Net Domestic Product at factor cost
** : Net Domestic Product at market Prices.

Table 2.3: Plan Wise Compound Annual Rate of Growth of Capital Formation in the Economy

At Constant Prices

Period	Gross domestic capital formation	Gross domestic fixed capital formation	Gross domestic product
First Plan	5.90	5.84	3.97
Second Plan	0.25	0.06	3.96
Third Plan	9.47	10.81	3.12
Plan Holiday	-7.38	-2.08	5.51
Fourth Plan	5.98	4.71	2.14
Fifth Plan	9.73	13.32	5.68
Sixth Plan	5.88	7.39	6.37

Note: In this study, growth rates have been calculated on the basis of fitting the following regression to the annual data:

$$\text{Log}_e Y_T = a + rT + e$$

where Y_T = Value in year T

r = compound growth rate

e = Error term

under standard assumptions.

Table 2.4: Capital Formation in the Public Sector

Year	Gross Domestic Capital Formation	Gross Domestic Fixed Capital Formation	Net Domestic Capital Formation	Net Domestic Fixed Capital Formation
1950-51	530	459	438	367
1951-52	614	531	521	438
1952-53	506	555	415	464
1953-54	588	658	491	561
1954-55	868	785	766	683
1955-56	996	1063	860	927
1956-57	1239	1114	1109	1014
1957-58	1464	1130	1336	1002
1958-59	1395	1200	1270	1075
1959-60	1498	1471	1373	1346
1960-61	1826	1686	1646	1506
1961-62	1797	1735	1599	1537
1962-63	2181	1983	1948	1750
1963-64	2421	2249	2177	2005
1964-65	2665	2493	2383	2211
1965-66	2846	2624	2568	2346
1966-67	2574	2467	2263	2156
1967-68	2635	2271	2286	1922
1968-69	2397	2334	2026	1963
1969-70	2373	2300	1962	1889
1970-71	2773	2394	2320	1941
1971-72	2957	2618	2467	2128
1972-73	3135	3146	2556	2567
1973-74	3738	3133	3128	2503
1974-75	3517	2652	3253	2388
1975-76	4433	3234	3844	2645
1976-77	4920	4073	4326	3479
1977-78	4184	4323	3511	3650
1978-79	5012	4351	4306	3645
1979-80	5309	4481	4584	3756
1980-81	5609	4685	4806	3882
1981-82	6123	5086	5197	4160

Table 2.5: Plan Wise Compound Annual Rates of Growth in Public Sector Capital Formation

Period	Gross Domestic Capital Formation	Gross Domestic Fixed Capital Formation	Net Domestic Capital Formation	Net Domestic Fixed Capital Formation
First Plan	15.07	17.34	16.15	18.86
Second Plan	7.98	10.92	8.17	10.86
Third Plan	11.20	10.56	11.49	10.79
Plan Holiday	-3.56	-2.77	-5.53	-4.68
Fourth Plan	10.31	8.91	10.29	8.42
Fifth Plan	6.50	12.80	4.70	11.67
Sixth Plan	7.13	6.33	6.27	5.10
1950-51 to 1981-82	7.32	6.89	7.27	6.74
1950-51 to 1965-66	12.05	11.81	12.63	12.38
1966-67 to 1981-82	6.57	5.80	6.64	5.73

Share of Public Sector Capital Formation in the Economy

(in percentage)

At Constant Prices

Year	Share	Year	Share	Year	
1950-51	22.27	1963-64	47.65	1976-77	53.19
1951-52	21.89	1964-65	47.75	1977-78	42.01
1952-53	27.52	1965-66	46.12	1978-79	40.81
1953-54	27.64	1966-67	38.6	1979-80	47.67
1954-55	36.73	1967-68	42.92	1980-81	46.19
1955-56	29.97	1968-69	41.62	1981-82	48.88
1956-57	29.00	1969-70	35.73		
1957-58	35.81	1970-71	38.63		
1958-59	41.24	1971-72	39.18		
1959-60	40.04	1972-73	44.31		
1960-61	40.37	1973-74	41.20		
1961-62	43.40	1974-75	42.86		
1962-63	45.36	1975-76	52.63		

Table 2.6: Rate of Capital Formation in Public Sector

Year	Rate of GDCF (% of GDP)	Rate of GFCF (% of GDP)	Rate of NDCF (% of NDP)	Rate of NFCF (% of NDP)
1950-51	3.02	2.09	2.60	2.18
1951-52	3.43	3.43	3.04	2.55
1952-53	2.73	2.99	2.34	2.61
1953-54	2.98	3.34	2.60	2.97
1954-55	4.29	3.87	3.95	3.52
1955-56	4.77	5.09	4.30	4.64
1956-57	5.62	5.06	5.26	4.81
1957-58	6.76	5.22	6.47	4.85
1958-59	5.94	5.11	5.67	4.80
1959-60	6.26	6.15	6.03	5.91
1960-61	7.15	6.60	6.75	6.18
1961-62	6.79	6.51	6.34	6.10
1962-63	8.07	7.34	7.61	6.84
1963-64	8.53	7.92	8.08	7.45
1964-65	8.70	8.14	8.20	7.61
1965-66	9.80	9.04	9.39	8.58
1966-67	8.78	8.41	8.22	7.83
1967-68	8.26	7.13	7.62	6.40
1968-69	7.32	7.13	6.58	6.37
1969-70	6.81	6.61	6.00	5.77
1970-71	7.54	6.51	6.72	5.62
1971-72	7.92	7.02	7.04	6.07
1972-73	8.49	8.52	7.41	7.44
1973-74	9.67	8.05	8.64	6.91
1974-75	9.02	6.80	8.88	6.52
1975-76	10.39	7.58	9.57	6.58
1976-77	11.44	9.47	10.71	8.62
1977-78	8.94	9.24	7.97	8.29
1978-79	10.13	9.36	9.27	7.84
1979-80	11.33	10.23	10.46	8.57
1980-81	11.10	9.27	10.17	8.21
1981-82	11.50	9.55	10.47	8.38

Table 2.7: Instability in Public Sector Capital Formation

Coefficient of Variation Method

At 1970-71 prices

Period	Gross Domestic Capital Formation			Net Domestic Fixed Capital Formation		
First Plan	20.62	15.36	1.34	9.45	20.72	0.451
Second Plan	10.76	13.42	0.802	8.55	10.51	0.812
Third Plan	7.39	9.52	0.77	4.736	9.368	0.505
Plan Holiday	5.49	-5.40	-1.01	5.58	-5.60	-0.996
Fourth Plan	7.47	9.54	0.78	8.97	5.35	1.677
Fifth Plan	15.42	7.18	2.14	12.56	8.54	1.469
1950-51 to 1965-66	14.30	12.77	1.11	9.36	13.52	0.692
1966-67 to 1981-82	11.25	5.51	2.04	10.26	4.13	2.47
1950-51 to 1981-82	13.32	9.02	1.47	10.90	8.68	1.25

Notes: : Standard deviation of the annual growth rates

: Mean of the annual growth rates

: Coefficient of Variation of the annual growth rates

Table 2.8: Instability in Public Sector Capital Formation

Trend Method

Period	Gross Domestic fixed Capital Formation		Net Domestic Fixed Capital Formation	
	R^2	I	R^2	I
1950-51 to 1965-66	.9225	7.30	.9402	8.9
1966-67 to 1981-82	.9337	8.90	.8983	9.36
1950-51 to 1981-82	.9167	19.00	.8829	21.70
First Plan		6.39		6.13
Second Plan		5.17		5.83
Third Plan		2.32		2.24
Plan Holiday		2.59		3.20
Fourth Plan		3.7		4.32
Fifth Plan		6.95		6.78

Notes: I, the measure of instability, $= \left(\frac{\text{Error sum of squares}}{n}\right)^{\frac{1}{2}} \times 100$

Trend fitted: $\text{Log } I_t = a + rt + e_t$

Chapter 3

DATA BASE

The focus of our study, as indicated earlier is to study the structure of public investment. Consequently we are primarily concerned with the growth and composition of public sector capital formation and its impact on the capital formation in the economy.

In order to understand and interpret the data relating to capital formation presented in this study, it is essential to keep in mind the basic steps adopted by the Central Statistical Organisation in the estimation of capital formation, its scope, limitations and possible sources of error.

The Central Statistical Organisation (hereafter, CSO) entrusted with the job of estimation of National Income and related macro economic aggregates divides the economy, for the purpose of capital formation estimation, into three sectors:

i. the public sector	organised
ii. the private corporate sector	organised
iii. the household sector	Unorganised

The first two belong to what is called the organised sector of the economy, whereas the third is the unorganised segment. Estimates provided by the CSO for capital formation in the organised segment at current prices are derived from the published government reports, budgets and company accounts. In case all relevant documents are available, the data should be free from estimational errors, at least in principle. The unorganised sector (which includes farm households engaged in agricultural production in addition to all unincorporated enterprises engaged in

industry, trade, transport,) does not have such a data base and consequently the data on capital formation are generated by commodity flow method and expenditure method.[1] To start with, for estimating capital formation in the economy three forms in which physical assets can be accumulated are identified. These are construction, machinery and equipment, and inventories. This is done partly by the commodity flow method and partly by the expenditure method. Having done this the second step is to estimate capital formation in the public sector and in the private corporate sector independently from published sources. Having estimated the capital formation in public and private corporate sector, independently, these two are subtracted from the overall capital formation figures estimated in the first step, to arrive at the capital formation in the unorganised sector as a residual. In doing this all the possible error in estimation of aggregate capital formation are inadvertently carried over to the estimates of capital formation in the unorganised sector.[2]

Sources and Estimation:

Our source of data is the annual publication of CSO entitled National Accounts Statistics (NAS), and Public Sector Transactions 1960-61 to 1979-80 also brought out by the CSO. The CSO first brought out a publication in 1967 called "Revised Series of National Product for 1960-61 to 1964-67" simultaneously with the revision of estimates of national product, due attention was paid to the preparation of related macro aggregates, like capital formation. In 1969 CSO brought out brochures on capital formation spelling out the methodology of estimation as well as estimates for the years 1960-61 to 1965-66. However, NAS, in its

1. For methodological details See National Accounts Statistics -- Sources and Methods (1980)

2. Report of the Working Group on Savings (1982) p.4.

present form was first brought out in March 1975, the coverage has been gradually extended and since 1976 NAS devotes a seperate section to public sector transactions.

In NAS Public sector is divided into two subsectors, namely, administrative departments, and public enterprises. Administrative departments comprise governmeng agencies of central government, state government and local bodies whose function is to organise for the community but not normally sell those services which are otherwise available. Thus administrative departments undertake activities like general administration, education, health, defence, law, social security etc.

Public enterprises are further divided into departmental and non-departmental undertakings. Departmental enterprises are unincorporated enterprises owned, controlled and run directly by public authorities. These enterprises in normally do not hold or manage financial assets. This distinction is due to differences in organisational set up and is of importance; as in many cases, it is not possible to segregate the activities of departmentally run enterprises from those of other administrative departments from the accounting point of view. The criteria followed by CSO for distinguishing such departmental activities from other administrative ones are:

i. use of commercial accounting method

ii. use and control of productive goods

The departmental enterprises thus cover activities relating to posts and telegraph, overseas communication, railway, multipurpose river schemes, irrigation, electricity, forestry and logging etc.

The non-departmental enterprises, on the other hand, are statutory corporations set up under a special enactmant of the parliament or state legislature and government companies set up under Companies Act. These include ONGC, Damodar

Valley Corporation, Food Corporation of India, Airport Authority of India; Road Transport Corporation etc. These enterprise have a seperate board of directors and present profit and loss accounts and balance sheets as in the case of other private sector companies.

Non departmental enterprises can be further subdivided into financial and non-financial. The non-departmental financial enterprises include banking department of RBI, public sector banks, financial corporations, insurance saving and lending institutions.

This break up of public sector into departmental, non department and administrative departments is extremely useful, as the activities of these three undertakings differ widely in their objective, cost structure, and source of finance and, therefore, their impact on the economy also differs.

Industry of Use:

Consequent upon the above distinction within Public Sector, based on the System of National Accounts, we have two disaggregated series for domestic product and capital formation, viz., the type of assets and industry of use.

The disaggregation of capital formation by the. Industry of use means that public sector is divided into basically four industry groups. Primary, Secondary, Transport, Communication and trade, and Finance, Community and personal services. These four subsectors are further subdivided into 11 industrial categories in all. Primary sector consisting of agriculture, forestry, and mining; secondary of manufacturing, construction and Electricity / Gas and water. Transport, Communication and Trade comprises of transport, storage and communication and trade, restaurant, and hotels. Transport storage and communication is further subdivided into railway, communication and transport by other means.

The procedure of calculating capital formation by industry of use involves the calculation of fixed capital formation and to it are added the changes in stocks of that industry.

As we indicated earlier the sources for calculation of capital formation in public sector are basically budget documents of Central and State governments, railways, posts and telegraphs and defence services. In addition to these sources the text of finance ministers speech; demands for grants, company accounts, departmental reports, profit and loss accounts and balance sheets of non departmental undertakings are also used.

In case of agriculture the estimates of fixed capital formation are based on data on improvement of land, irrigation work, and flood control projects, purchase of agricultural implements and machinery, laying of new orchards and plantations, derived from the budget documents, and annual reports. For forestry and logging the budget document details are supplemented by statistics on forest ownership provided by State governments, and Indian Forest Statistics. Mining and Quarry being a non-departmental activity, capital formation figures are available from their reports.

In manufacturing, the non-departmental enterprise capital formation is obtained from an analysis of the account of these establishments. The estimates of electricity, gas and water capital formation are based on data available in the budget documents and annual reports of the electricity board. In the case of water supply, the estimates of expenditure on new capital in the public sector are adopted for the whole industry.

Estimates for railway and communication are obtained from the data contained in the budget documents, the railway ministers speech, budget of the Railway Revenue and Expenditure of the Central Government. Works, Machinery and Rolling Stock

Programme of Railways, Appropriation Accounts of railways and Annual Reports of Indian Railways. In case of air transport, the estimates of capital formation are compiled from the balance sheet of Air India, and Indian Airlines Corporation. For capital employed in aerodromes, civil aviation the data are obtained from budgets.

Estimates of capital formation in respect of commercial banks and corperative societies are compiled from the "Statistical Tables relating to Banks in India", Statistical Statements relating to Cooperative Movement in India. Estimates for RBI are culled out from the Annual Report of the RBI.

In case of Public Administration and defence estimates cover capital formation in roads, bridges, vehicles, and public buildings. All these are based on budget documents. Estimates of capital formation in other services are prepared for medical services and education. Estimates of fixed capital formation are prepared on the basis of data contained in Education in India and Economic and Purpose classification of Expenditure of Central Government.

The same sources, as stated above, for fixed capital formation are used for preparing the estimates of change in stocks for all economic activities. In sectors like "other services" in the absence of any reliable data, change in stocks is assumed to be negligible.

Given these sources industry wise, the capital formation is estimated as follows for each industry and then aggregated to arive at the overall public sector capital formation:

$$K_i = C_i + M_i + S_i$$

where K_i = Capital formation in the i^{th} industry of use

C_i = Construction Component of capital formation

M_i = Machinery and Equipment component of capital formation

S_i = Change in inventories

Aggregating for all industries of use,

$$\sum_{i=1}^{11} K_i = \hat{K} = \sum_{i=1}^{11} (C_i + M_i + S_i)$$

where, $\hat{K}$ = Capital formation in public sector

All the data collected and hence estimates made are at current prices. In order to arrive at constant price estimates, these are deflated seperately for each industry group. To the extent data are available each component of capital formation is deflated separately by the relevant index number of prices. In cases where it is not possible to use independent indices of prices for each component of capital formation e.g. in manufacturing, the total capital formation in this sector is deflated by a composite index constructed using the proportions of capital formation in construction and machinery and equipment at current prices in the bench mark year.

The estimates of capital form in construction at current prices in all industry groups are deflated by the index of cost of pucca construction prepared by using prices of different building materials and wage rates of rural and urban construction workers. Data on price indices of public sector purchases in respect of cement, steel, electrical goods as available from Index numbers of Purchase Prices (DGS & D) are used.

Thus the estimates of gross capital formation at constant prices are arrived at.

Depreciation

The N.A.S also provides estimates on Net Capital Formation in Public Sector.

These are arrived at by taking account of the consumption of fixed capital in each industry and deducting it from gross capital formation figures.

Depreciation in N.A.S. is a type of a constructed variable having the form:

$$Q = \beta P$$

where, P is some variable, in this case gross capital formation, which is known, but there is not much empirical observation on the basis of which the ratio β, here the parameter of depreication, could be assumed to be constant or take any particular numerical value. Evidently errors are uncontrollable. While the magnitude of gross capital formation can in principle be ascertained objectively by collecting the relevant information, any estimate of capital consumption involves necessarily a process of imputations, as there is no way of determining what is the extent of wear and tear in capital stock each year and how much therefore is the appropriate rate of depreciation.

In theory, in the Indian System of National Accounts, the concept of depreciation which is used to derive estimates of Net Capital Formation from estimates of gross capital formation takes account of the expected life of assets and anticipated obsolescence of equipment. In actual computation, to what extent these elements are concerned is not clear. Looking at the existing methods of estimation in India, it is found that in respect of agricultural machinery and equipment. 11% of the value of stock of such assets, calculated on Perpetual Inventory Method basis is estimated as capital consumption. For farm houses it is 2%. These proportions are based on the age structure of the concerned asset. However such inventory of capital assets and their age structure is restricted to agricultural and residential construction, in case of construction in agriculture and allied activities the All India Debt and Investment Survey estimates for capital consumption for the year 1971-72 have been adjusted to 1970-71 and moved ahead by

adding 10% of Net Capital Formation as capital consumption. For forestry 1% of the major forest produce is assessed as capital consumption, and for construction it is taken to be 5.04% of the gross value added in construction.

For departmental and non departmental undertakings the provisions for capital consumption are based on those made in the enterprises accounts. However in departmental enterprises like Railway, depreciation is assumed to be equal to works expenditure met from depreciation fund less expenditures on improvement of assets replaced. In sectors like trade, hotel and restaurant since the original source, National Sample Survey, does not provide information on depreciation, the ratio of gross value added to Net Value added for the registered trade is used. In other sectors like public administration and defence data on capital consumption are not estimated at all due to practical difficulties though in public administration and defence estimates of capital consumption are provided which are "based on hardly any information"[3/] does not go beyond what has been mentioned above regarding the computation of capital consumption and it is not clear how far these estimates are at all related to the age structure and other essential elements for calculation of depreciation.

The method of estimating is the same as discussed above the disaggregation by type of assets.

All the estimates of capital formation arrived at from the above discussed sources and methods are at current prices. Apart from these current price estimates, in order to knew the magnitude of capital formation in real terms, constant price estimates are required. Currently, the constant prices ate at base 1970-71.

Constant Price Estimates:

The estimates of gross capital formation at 1970-71 prices in the public sector are compiled seperately for (i) construction (ii) machinery and equipment

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3. C.S.O (1980)

(iii) net purchase of second hand physical assets and (iv) change in stocks, for each industry. The method consists of deflation of current price estimates by relevant price indices.

The estimates of capital formation at current prices in all industry groups are deflated by the index of cost of pucca construction prepared by using prices of different building materials and wage rates of rural and urban construction workers. Data on price indices of public sector purchases in respect of cement, steel, electrical goods etc. as available from Index Numbers of Purchase Price (provided by Director General of Supplies and Disposal) are used. For deflating capital formation in Machinery and Equipment two sets of indices are prepared. First is an overall, price index of purchases of machinery items by Public Sector and the second the second pertains to purchase price of transport equipment. Both indices are based on Index Numbers of Purchase Price. The value of purchases in base year, 197-71 are used as weights. The current price estimates of net purchases of 2nd hand physical assets in all the industry groups are deflated by the average implicit cost of investment index prepared from public sector figures.

The current price estimates of changes in stocks in respect of mining, manufacture, construction, road and water transport, Banking and Insurance, are deflated using Index Number of Purchase Price of DGS & D, whereas, Economic Advisor's index of wholesale prices is used in case of air transport, trade hotel and restaurant, Public Administration and defence, and other services is used as the deflator.

Sources of Error, Problems and Limitations:

As we indicated above, the estimation of capital formation in public sector is based on the economic classification of budgets, annual accounts and balance

sheets. Thus in principle there do not seem to be any grounds for error except of course, errors on account of mistakes in measurement, omission etc. Such observed variables, like public sector capital formation which are the result of a direct measurement satisfy the relation:

$$X = X + e$$

Where X is the time value of X;

e is a non-random error

However, it needs to be looked into as to what is the form of data in these publications that is available to the CSO and on which the estimates are based and how far these data meet the requirements of N.A.S. The nearest the actual government accounts come to providing a measure of government capital formation is by means of a system of double accounts. The system of double accounts is the division of all receipts and payments between the two accounts, one current and the other capital, both of which are required to balance. The principle in which capital items are to be distinguished from current is hard to discern even in an idealsystem of double accounts. In the Indian National Accounts System the allocation of items between the two accounts follows no single clear cut principle. Consider for example the developmental schemes and programs initiated by the Central government like IRDP, NREP, DPAP, DDP and other large schemes numbering about 350 in 1981-82 alone and accounting for more than 150 crores. The statistics regarding these show a lumpsum amount under the scheme. It is not known in such cases whether the expenditure on the scheme is to be classified wholly under current expenditure, or wholly as a capital expenditure or treated partly as current and partly as capital. Even the breaking of expenditure into its economic categories like salaries and wages, purchases of goods and services, current transfer and subsidies is not available. Similarly, the grants in aid which can be categorised under two broad groups of namely, inter government grants and grants from public authorities to other sectors

of the economy. In most cases it is not clear whether the grants are of a current or capital nature and the latter are thus classified under the former. As a result the figures of current account are likely to be overestimated. Thus in the absence of such breakups, the CSO resorts to certain arbitrary proportions in deciding the breakup into capital and current.

As would have become evident while we discussed the methodology of estimating capital consumption, the basis on which CSO estimates depreciation is very weak and open to criticism. Although the concept underlying CSO's estimates is based on the SNA concept of capital consumption, the approach followed is not the same and is often guided by the availability of data. Thus in industry groups of Mining and Quarry, manufacturing electricity gas and water, transport, storage, and banking and insurance, the annual data on consumption of fixed capital received by CSO are enteries for depreciation allowance, which the producers make in their accounts. These accounts reflect the accounting concept of depreciation via amortization of capital expenditure rather than the replacement cost of assets which alone is relevant for economic analysis.

In case of assets used in producing government services viz. government buildings and offices, equipment of a durable nature no allowance for capital consumption is made although the system of National Accounts (United Nations) lays down procedures for imputing it. For construction assets like bridges, roads, dams, etc. no depreciation is calculated. Such problems arise because the budget documents of administrative departments do not make any provisions for depreciation and as such it is not possible for the CSO to present them.

Again, the available data in the budget documents do not permit estimation of change in stocks of even the essential commodities. Consider the procurement of food. Food procurement done by the State is an important item in the State

budget unlike in the Centre where the FCI undertakes the task. In case of State government the data on this item appear as:

YEAR 1979-80		(Rs. Crores)
Item	Maharashtra	Uttar Pradesh
Procurement and Supply		
1. Cost of Purchases	216.92	105.82
2. Recoveries	199.71	129.52
3. NET (1 - 2)	17.21	-18.70

This is the format of almost all state budgets. The scope of recoveries is not indicated. Does the latter mean that the value of the sales of all the stock was purchased during the year, nothing being left in stock or is it the value of sales including a part of the previous stock? If the former is the case, then the government has earned a profit on this transaction and change in stock is nil in case recoveries exceed purchase value; in the latter case there may be a profit or loss depending on the withdrawal of stocks. The point we are trying to make is that the information which would lend itself to estimation of changes in stock, profit or loss is not available from budget documents and thus the CSO has to perforce use some arbitrary method for estimation.

From the above examples we can conclude that it is not sufficient to say that "since all these data relate to the actual receipts and payments as reported by concerned authorities they offer as firm a basis as can be expected" as the Raj Committee does.[4/] The data made available to the CSO, as we shared above, is not always sufficient and in many cases forces CSO to make assumptions and use arbitrary methods whose validity is undoubtedly questionable. That there are problems in the public sector data also is evident from the fact that inspite of using the same data sources and methods in most cases, yet there is a striking difference in the estimates

4. Report of the Working Group on Savings (1981)

of different institutions like NCAER, RBI, and CSO. These discrepancies as Rudra would argue are that "the non probabilistic estimational techniques used by them, ... , offer a very large scope for individual variation". Thus one can say that the data on public sector capital formation are also subject to error and don't have as firm a basis as is made out to be. But as compared to the unorganised sector the public sector data base is much better and one is on surer ground while dealing with it.

Another very important point which needs to be noted in the context of data base provided by the NAS and is often missed is that different variables estimated in the NAS have different precision. Yet all of them are used with equal confidence and precise conclusions are drawn. In the table below, different variables have been listed and the relative precision that can possibly be attributed to their measures broadly is indicated:

As such it becomes difficult to draw concrete conclusions on some of the crucial indicators. As rightly pointed out by Gothaskar, "A Statistical system has to yield statistics which are (a) of required level of precision, commensurate with the purpose for which these statistics would be used (b) amenable to a behaviourist type of interpretation to provide an insight into the process being measured. On both these counts, our present system does not come up to the mark..."[4/]

Specific Problems Relating to Capital Formation in Public Sector:

Apart from these limitations and problems of the CSO data there are certain problems specific to public sector capital formation (See Appendix). For example, the public sector capital formation by type of assets covers Gross domestic fixed capital formation, both old and new, machinery and equipment, construction, stocks,

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4. Gothoskar, S.P. (1980) p.96

Important National Income Variables and Relative Precision of their Measures

Variable	Item	Proportion accounted in Total	Precision
1. Domestic Product	Organised Primary Sector	10	Average
	Unorganised Primary Sector	35	Unsatisfactory
	Organised Secondary Sector	15	Satisfactory
	Unorganised Secondary Sector	8	Unsatisfactory
	Organised tertiary sector	12	Satisfactory
	Unorganised	20	Unsatisfactory
2. Household Consumption	Principal Commodities	60	Average
	Other Commodities and Services	40	Unsatisfactory
3. Capital Formation	Organised Sector	70	Satisfactory
	Unorganised Sector	30	Unsatisfactory
4. Consumption of Fixed Capital		100	Unsatisfactory
5. Savings	Financial Saving	70	Satisfactory
	Physical Saving of HH's Sector	30	Unsatisfactory
6. External Transactions		100	Satisfactory

Source: Gothoskar, S.P. "Towards a More Purposeful National Accounting Information System" Journal of Income and Wealth, No.2. Vol.4 July 1980 p.99

Note : Data are considered satisfactory where formal published accounts are available and where cross checks are possible. Average precision is attributed to those data where bench mark estimates are moved with some related variable. Data are considered unsatisfactory when they are based on partial and outdated information or where data collection is not based on scientific procedures.

Gross domestic capital formation consumption of fixed capital and net capital formation by the three types of enterprises in Administrative, Departmental and Non departmental. The Public Sector transaction (CSO 1983) goes further to give the same breakdam of capital formation by type of authority (enterprise) for each industry group. With such a disaggregation one can now arrive at estimates of fixed capital formation, machinery and equipment, construction for each industry. But the data on all these aggregates is at current prices. In order to arrive at the figures in real terms one needs to deflate the current price estimate by relevant price deflators. In the absence of any relevant deflators or information about their computation, we have to use some meaningful implicit deflators. In this context, we have two options

i. Use the overall economy GDFCF deflator by components - machinery and equipment and construction - to deflate the corresponding estimates for overall public sector and also apply the same deflators across administrative, departmental and non-departmental undertakings.

ii. Use the Public Sector GDCF deflator by industry of use for deflating GFCF. The deflated GFCF figure thus obtained is divided between construction and machinery and equipment by using the same proportion they bore to GFCF at current prices. Thus we obtain machinery and equipment and construction component of capital formation by industry of use at constant prices. Then aggregating for all industries machinery and equipment, and construction we arrive at total capital formation by type of asset for the public sector at constant prices.

We have used the second method because if we use the implicit GDFCF overall economy deflators the estimates will get distorted due to compositional problems. First the composition of aggregate capital formation in terms of different industry groups like agriculture, mining and manufacture etc. will be different in the whole

economy as compared to the Public sector. Secondly the composition of the components of capital formation i.e. machinery and equipment, and construction are different for different industry groups and also between the private sector and the public sector. As such the first method isn't accurate (See Appendix)

On the other hand the second method uses the relevant price deflators of capital formation. The only assumption made is that stocks have the same composition as capital formation and hence same deflator is applied. This is not an unrealistic assumption given the fact that the CSO data on stocks is very weak.

The method can be summarised as
We have

GDCF at current prices by industry of use, $GDCF_1$ (NAS)

GDCF at constant prices by industry of use, $GDCF_2$ (NAS)

GDFCF at current prices for industry of Use, by Type of Assets at current prices, $GDFCF_{I.O.U}$, (from CSO 1981) Also we have:

Machinery and Equipment component, ME_1 at current prices

Construction Component C_1 at current prices

$$\therefore \quad \frac{GDCF_2}{GDCF_1} \times GDFCF_{IOU} = GDFCF^{con}_{IOU}$$

where $GDFCF^{con}_{IOU}$ is Gross domestic fixed capital formation by industry of use at constant prices

Then to deflate machinery and equipment:

$$\frac{ME_1}{GDFCF^{con}_{IOU}} \times GDFCF = ME_2$$

where ME_2 machinery and equipment at constant prices by industry of use.

Similarly for construction component. Then aggregating, we arrive at total public sector capital formation by type of assets. Thus in this method both inter-industry and intra-industry compositional differences are taken care of.

The period of our study is 1960-61 to 1981-82. Ideally we would have liked to begin our analysis in 1950-51, the year in which planning for development was initiated. Even 1956-57 would have been better because coinciding with the second five year plan and the Industrial Policy resolution of 1956, it was in this year that planning strategy emphasized the need and laid out the framework and role of public sector in the overall economic development. However, since the N.A.S. started providing industry wise capital formation only for the period 1960-61 onwards our choice was restricted to that year. As for the choice of the terminal year we have used the latest year estimates available in N.A.S.

APPENDIX

"A NOTE ON THE USE OF IMPLICIT DEFLATORS"

Use of implicit deflators, in the absence of constant price estimates of a variable, is a standard practice but its mechanical use can give unsatisfactory results.

In the case of capital formation and domestic product, seperate price deflators for public sectors are not provided by the C.S.O so one has to use some implicit deflators in order to arrive at constant price estimates. Most often the whole economy deflators are used, based on the premise that since public sector is a part of the economy the economy's implicit deflators will not be significantly off the mark. However this is not correct.

Let us take the case of capital formation by type of assets in public sector for which no price deflators are provided. The use of overall (whole economy's) capital formation implicit deflator for arriving at constant price estimates of capital formation in public sector, assumes:

i. Price trends in public sector are the same as the corresponding price trends for all public and private undertakings taken together.

ii. The share of each industry (like Agriculture, Mining, Manufacturing etc.) in the public sector is the same as that for the whole economy

iii. The composition of capital formation <u>across</u> industries, and <u>within</u> industries is the same for public sector and the whole economy.

Strictly speaking none of the above made assumptions are correct. Whereas the whole economy's estimates are based on Economic Advisers price index, for the public sector DGTD price series is used. Regarding the second assumption, it is

only logical that the share of different industries in the aggregate capital formation will not be the same for the economy and the public sector. The share of basic and infrastructural industries, for example, will be higher in public sector as compared to private sector. Agriculture which had a weight of 9% in 1981-82 in public sector, accounted for 22% of the capital formation in the total private sector. Similarly the share of manufacturing in Public sector capital formation was 20% in 1981-82, while for private sector it was 38%. On the other hand, transport storage and communication accounted for 14% of public sector capital formation whereas for the private sector its share was 7%. Thus the implicit assumption of same share of industries for public sector and whole economy is not realistic.

The compositional differences not taken into account by using overall GDCF deflators for public sector are of two types:

The sectoral composition of capital formation by industry of use varies across industries. Obviously the machinery and equipment used that goes into agricultural capital formation is quite different from that what goes in manufacturing or other sectors. By deflating with an overall implicit deflators we are assuming away this fact, and deflating for uniform, homogenous capital formation across.

The second compositional problem comes up due to differential composition within the same industry, across public sector and whole economy.

Consider for example agriculture. The capital formation in agriculture by public sector is of the nature of infrastructure irrigation whereas for the private sector it is more of agricultural machinery and equipment that goes into agricultural capital formation.

The difference between the actual constant price estimates and the estimated constant price figure derived by means of overall implicit deflator can be seen from the table below:

Year	Current GDCF	Actual contact GDCF*	Estimated constant** GDCF	Estimation error
1960-61	1137	1826	2030.2	-204.2
1961-62	1169	1797	1947.7	-150.7
1962-63	1464	2181	2832.9	-651.9
1963-64	1671	2421	2614.7	193.7
1964-65	1920	2665	2910.9	-245.9
1965-66	2184	2846	3114.5	-268.5
1966-67	2114	2574	2620.9	- 46.9
1967-68	2311	2635	2682.7	- 47.7
1968-69	2146	2397	2440.3	- 43.3
1969-70	2234	2373	2400	- 27

* As provided by CSO

** Using whole economy implicit GDCF

Chapter 4

STRUCTURE OF INVESTMENT - A THEORETICAL FORMULATION

The process of capital formation essentially involves the creation, mobilisation and the utilisation of the economic surplus of an economy. It is the last part that we are specifically concerned with i.e. allocation of investment. Apart from the problems relating to the overall size of investment, the process of investment involves the distribution of this amount as between sectors and subsectors. It needs to be stressed here that our concern is not to discuss the criteria of this allocation, because this we take as a given distribution. Starting from this distribution of investment we shall attempt to analyse the structure of investment resulting from the given distribution.

In this chapter our concern is to establish theoretically that apart from the rate of investment, an equally important component in determining the rate of growth of output is the structure of investment which has not been appreciated sufficiently in the literature devoted to investment. There have been models like Feldman - Mahalanobis, and Raj - Sen model which have dealt with the structure of investment but their disaggregation of the economy into sectors has been motivated by finding such allocative parameters across sectors that would lead to specified increases in income and employment. The structure of investment in such models is therefore determined by the sectoral classification which is basically in terms of investment goods sectors and consumer goods sector. Such classification as used by Mahalanobis type of models is "....attractive but it is impossible to give it any but the roughest empirical meaning simply because the economy is not organised in this manner".[1/]

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1. Raj, K.N. "Growth Models and Indian Planning" in Wadhva (1977) P.36

In our theoretical formulation below we do not postulate any such classification, though one can, in principle, use the disaggregation done below in accordance with the specific purpose at hand, - including the Mahalanobis type of classification. The criteria of our classification of sectors is implicitly based on the actual organisation of the economy (e.g. Agriculture, Manufacturing or broad sectors like Primary, Secondary etc.) and explicitly on the assumption of varying capital-output ratios across these sectors and the qualitative differences in the investment in these sectors. One can, of-course, conceive of different patterns of disaggregation but the one postulated below is used because it is readily amenable to empirical verification and also provides us the theoretical backdrop within which to study the impact of a shift in the investment allocation on the growth performance of the economy.

In any closed economy, the components of national income can be classified into:

(i) those elements which serve as the means to increase the national income i.e. "productive accumulation", analogus to capital formation at an empirical level. Productive accumulation comprises of "productive investment", synonymous with fixed capital formation and increase in inventories.

(ii) those elements which are the aim of production of goods and services i.e. individual and collective consumption in a broad sense.

Both productive accumulation and consumption include government expenditures. We shall be concerned exclusively with productive accumulation.

Denoting the national income by Y, productive accumulation by I, and consumption by C, we have:

$$Y = C + I \qquad \ldots\ldots \quad (1)$$

If, Y represents the increment in national income. One can establish the relationship between the investment in national income on the one hand, with productive investment and level of national income on the other. Denoting the incremental capital-output ratio by, b, the productive effect of investment is:

$$\Delta Y = \frac{1}{b} \cdot I \qquad \ldots\ldots\ldots (2)$$

Taking account of obsolescence and the wear and tear which also affects the increment we have the element of depreciation:

$$\text{Depreciation} = aY$$

where a is the parameter of depreciation. Usually the depreciation parameter is applied to the capital stock but for the sake of convenience we are using output instead of capital stock. This should not make any difference since within output it is capital that depreciates[2/] Then, the increment in national income is related to investment and the level of national income as follows:

$$\Delta y = \frac{1}{b} \cdot I - aY \qquad \ldots\ldots\ldots (3)$$

or

$$\frac{\Delta y}{y} = \frac{1}{b} \cdot \frac{I}{Y} - a$$

$$r = \frac{1}{b} \cdot \frac{I}{Y} - a \qquad \ldots\ldots\ldots (4)$$

In this conventional Harrod Domar type of equation, the rate of investment, the depreciation rate and the capital-output ratio of the economy govern the rate of growth of output.

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2. Unless, of course, K/Y changes substantially which is unlikely in a short period

We shall now try to incorporate the structure of investment as a variable into this Keynesian framework and attempt to deal with the problems of changes in the structure of investment and its impact on output.

To start with, let us assume that the economy is divided into a number of sectors with different capital-output ratios, but without any gestation lag of investment, such that:

$Y_j(t)$ = output of sector j in time period t

where:

j = $(1,2,.....n)$

$$Y_j(t) = \sum_{j=1}^{n} Y_j(t) \qquad \ldots\ldots\ldots (5)$$

$K_j(t)$ = capital stock of the j^{th} sector in time period t

$K_j(t+1)$ = capital stock of the jth sector in time period $(t + 1)$

By definition then,

$$I(t) = K_j(t+1) - K_j(t) \qquad \ldots\ldots\ldots (6)$$

let:

b_j = incremental capital output ratio for the j^{th} sector

$\beta_j = 1/b_j$;

λ_j = proportion of total investment alloted to the j^{th} sector, such that:

$$\lambda_j = I_j/I \quad or \quad I_j = \lambda_j I$$

Recalling equation 3, we may write an equation similar to it, for sector j, $(j = 1,2,....n)$ as follows:[3/]

3. In order to focus sharply on the intersectoral structure of investment, and keep the formulation simple we are abstracting from input-output relationship between sectors.

$$\begin{aligned}
\Delta y_1(t) &= \beta_1 I_1(t) - a_1 y_1 \\
\Delta y_2(t) &= \beta_2 I_2(t) - a_2 y_2 \\
&\vdots \\
\Delta y_n(t) &= \beta_n I_n(t) - a_n y_n
\end{aligned}$$

Since:

$$\begin{aligned}
I_1(t) &= \lambda_1 I(t) \\
I_2(t) &= \lambda_2 I(t) \\
I_n(t) &= \lambda_n I(t)
\end{aligned} \qquad (7)$$

We have:

$$\begin{aligned}
\Delta y_1(t) &= \beta_1 \lambda_1 I(t) - a_1 y_1 \\
\Delta y_2(t) &= \beta_2 \lambda_2 I(t) - a_2 y_2 \\
\Delta y_n(t) &= \beta_n \lambda_n I(t) - a_n y_n
\end{aligned} \qquad (8)$$

From equation 5, we have:

$$\Delta y(t) = \sum_{j=1}^{n} y_j(t)$$

Assume for the time being that $a_1 = a_2 = \ldots\ldots\ldots a_n$

Summing up equation (8) and substituting it in equation (9) we get:

$$\Delta y(t) = \sum_{j=1}^{n} \Delta y_j(t) = \Big(\sum_{j=1}^{n} \beta_j \lambda_j\Big) I(t) - \sum_{j=1}^{n} a_j y_j$$

$$\text{or } \frac{\Delta Y(t)}{Y(t)} = \frac{\sum_{j=1}^{n} \Delta Y_j(t)}{\sum_{j=1}^{n} Y_j(t)} = \frac{I(t)}{Y(t)} \sum_{j=1}^{n} \beta_j \lambda_j \quad - \quad na$$

$$9 \ldots\ldots\ldots \quad r = \frac{\sum_{j=1}^{n} \Delta Y_j(t)}{\sum_{j=1}^{n} Y_j(t)} = \frac{I(t)}{Y(t)} \sum_{j=1}^{n} \beta_j \lambda_j \quad - \quad na$$

The above equation 9 makes it clear that the rate of growth of output, r, is determined not only by the rate of investment, $I(t)/Y(t)$, but also by the structure of investment, $\sum_{j=1}^{n} \beta_j \lambda_j$. If $\beta_j = \beta$ for all j then equation (9) would reduce to equation (4) again.

Thus far, we have not defined what we precisely mean by the term structure of investment. A quantitative definition of the structure of investment would be obvious from the above equations: it is the weighted allocation of investment, the weights being the sectoral capital-output ratios. The allocation ratios, as we mentioned above, are policy parameters.

As emerges from equation (9), a change in the structure of investment can emanate from either a change in the sectoral capital-output ratios or from a change in the allocation parameters of aggregate investment. However, the two are not independent of each other because a change in the allocation parameter can lead to a change in the sectoral capital output ratios which is dependent on the qualitative aspects of investment and the techniques used. For example, if within a sector the proportion of investment in construction vis-a-vis that of machinery and equipment changes, the capital output ratio for the sector will also change.

In light of the above equation (9) equation (4) can be reformulated as:

$$r = \frac{I}{Y} \cdot \frac{1}{b} - a$$

$$= \frac{I}{Y} \cdot \beta - a$$

where $\beta = \beta_1 \lambda_1 + \beta_2 \lambda_2 \ldots\ldots\ldots \beta_n \lambda_n$

or $$\beta = \sum_{j=1}^{n} \beta_j \lambda_j \qquad \ldots\ldots\ldots\ldots (10)$$

If I/Y is assumed to be constant, changes in r are entirely governed by the changes in β which is sensitive to changes in both, λ_j's and b_j's.

Our purpose is to evaluate the response of Y to changes in λ_j's $(= I_j/I)$ and b_j's and determine for a unit change in I_j or b_j's what are the changes in b and consequently on r, other variables held constant. Our empirical analysis that follows is related to determine the changes in λ_j (Chapter 5 and 6) and b_j (Chapter 7).

Kalecki, whose concern was to deal with problems of changes in the structure of investment which result from a redistribution of national income, as against ours which is to assess the growth in national income resulting from a redistribution of investment across sectors, argues that capital-output ratios are independent of the sectoral allocation of investment. Based on this premise, in his analysis, he disregards the changes in capital-output ratio resulting from shifts in the allocation of investment arguing that, "even sizeable changes in the structure of investment affect the capital-output ratio only slightly".[4/]

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4. Kalecki, M. (1972) p.104.

Below we shall, with the help of arithmetic examples show that a moderate change in the allocation of investment, keeping the sectoral capital-output ratio constant lead to substantial changes in the aggregate capital output ratio.

Assume:

$\lambda_1 = I_1/I = 0.14 ; \quad b_1 = 10$

$\lambda_2 = I_2/I = 0.13 ; \quad b_2 = 15$

$\lambda_3 = I_3/I = 0.25 ; \quad b_3 = 8$

$\lambda_4 = I_4/I = 0.48 ; \quad b_4 = 2$

With these parameters we obtain b = 3.5. Now, changing the numerical values of λ_j's by roughly the same magnitude as done by Kalecki in his arithmetic example, to:

$\lambda'_1 = 0.26$

$\lambda'_2 = 0.49$

$\lambda'_3 = 0.12$

$\lambda'_4 = 0.13$

and keeping bj's constant. The aggregate capital output ratio b' = 7.2 - a change of more than 100%.

This discrepancy in the results between ours and Kalecki's is due to his assumption that capital output ratio for total investment does not depend upon the structure of investment. This assumption can only be satisfied under conditions of uniform, homogenous sectoral capital-output ratios, such that, for all $b_j = b$. This as we shall see in Chapter 7 is not an empirically supported assumption. There has to be a difference in the sectoral capital-output ratios not only because of the qualitative and compositional differences (See Chapter 6) in investment in different

sectors but also because of different techniques of production.

With the help of equation (9) let us illustrate by an arithmetic example the changes in r, consequent upon the changes in bj's and Ij's for given values of I/Y.

Consider the case where the sectoral capital-output ratios remains unchanged and so does the rate of investment, but the relative shares of investment change. In the first example above, r is 7.30%, given the rate of investment equal to 0.25 In the second case where only the relative shares, λj's, have been changed keeping everything else constant, the rate of growth obtained is 3.50%.

Now, consider the possibility of the sectoral capital-output ratio changing given the relative shares of investment and the rate of investment. Continuing with our earlier example, let the changed capital output ratios be:

$$b_1 = 13; \quad b_2 = 9; \quad b_3 = 7; \quad b_4 = 1$$

With these changed capital-output ratios, the rate of growth of output obtained is 13.49%, it may be recalled that with unchanged capital-output ratios, r obtained was 7.3%.

The third possibility of our interest is when both capital output ratios as well as the allocation of investment across sectors are altered keeping I/Y constant. The growth rate obtained in this case is 8.49%. It would have been observed that throughout our illustrative examples we have held rate of investment as constant. This is done not only to highlight the impact of the changes in structure of investment on the rate of growth of output but also with a view to approximate to the Indian situation where, as we observed in Chapter 2, the rate of investment has remained more or less constant.

From the above arithmetic examples, one can observe that the rate of growth of output is extremely sensitive to the changes in the structure of investment; the sensitivity being governed by the difference of β's between sectors. Also compared to the sensitivity to structure of investment we found r to be less sensitive to changes in the rate of investment.

Structure of Investment - Public and Private Sector:

In this thesis, since we are concerned with public investment and its impact on the rate of growth of output of the economy in general and the industrial sector in particular, we shall now try to incorporate the distinction between public sector and private sector into our above formulations.

Given that the economys output will be the aggregate of the public sector and private sector we have:

$$Y = Y + Y_p \quad \ldots\ldots\ldots \quad (11)$$

or $$\Delta Y = Y + Y_p \quad \ldots\ldots\ldots \quad (11a)$$

where Y = Public sector Output

Y_p = Private sector Output

Similarly for productive investment (i.e. capital formation) we have:

$$I = I + I_p \quad \ldots\ldots\ldots \quad (12)$$

Logically, what holds for a closed economy, should also hold for a sector, assuming for simplicity that there is no input-output relationship between the sectors.[5/]

Therefore: $$\Delta Y = \frac{1}{b} \cdot I \quad \ldots\ldots\ldots \quad (13)$$

for simplicity that there is not input-output relationship between the sectors.[5/]

Therefore: $\Delta Y = \frac{1}{b} \cdot I$ .....(13)

and $\Delta Y_p = \frac{1}{b_p} \cdot I_p$ .....(14)

Substituting equation 13 and 14 in 11(a) we get:

$$\Delta Y = \beta I + \beta_p . I_p$$

$$\frac{\Delta Y}{Y} = \frac{\beta I}{Y} + \frac{\beta_p . I_p}{Y} \quad \text{.....(15)}$$

For public sector, which is divided into j sub-sectors where $(j = 1,2 \ldots n)$ equation 10 can be reformulated as:

$$\beta = \sum_{j=1}^{n} \beta_j^g \lambda_j^g \quad \text{.....(16)}$$

And for the private sector as:

$$\beta_p = \sum_{j=1}^{n} \beta_j^p \lambda_j^p \quad \text{.... (17)}$$

---

5. The "cross effects of investment", sharing interdependence between the two sectors, private and public, can be introduced as:

$$\Delta Y = \frac{1}{b} \cdot I + r I_p \quad \text{.....} \quad (13a)$$

$$\Delta Y_p = \frac{1}{b_p} \cdot I_p + \theta I \quad \text{.....} \quad (14a)$$

r, can be negative or positive depending on the nature of relationship postulated between the sectors -- the former showing crowding out and the latter complimentarity. The magnitude of these will reflect the degree of interdependence.

Substituting equation (16) and (17) in 15;

$$\frac{\Delta Y}{Y} = \frac{I_G}{Y}\left\{\sum_{j=1}^{n} \beta_j^g \lambda_j^g\right\} + \frac{I_P}{Y}\left\{\sum_{j=1}^{n} \beta_j \lambda_j\right\} \qquad \ldots.(18)$$

$$r = \frac{I_G}{Y}\left\{\sum_{j=1}^{n} \beta_j^p \lambda_j^p\right\} + \frac{I_P}{Y}\left\{\sum_{j=1}^{n} \beta_j^p \lambda_j^p\right\} \qquad \ldots.(19.)$$

Thus far we have divided the economy into a number of sectors with different capital-output ratios, but it has been assumed that there are no gestation lags in investment. We shall now relax this assumption and assume that there is a one single uniform gestation lag of investment. The justification for this procedure could be given in the following way: If we assume that there is only one sector that produces investment goods which are delivered to all the other sectors for increasing their productive capacity then the gestation period may be said to represent the duration of the production process in that sector. In such a case there will be a uniform gestation lag.

The structure of our model discussed above in section (1) changes as follows: Equation 6 with the introduction of a time lag of duration "ℓ" gets transformed as:

$$K(t) - K(t-1) = I(t-\ell)$$

Accordingly:

$$\Delta Y(t) = \beta I(t-\ell) \qquad \ldots\ldots.(20)$$

Similarly for sectors 1 to n:

$$\begin{aligned} \Delta Y_1(t) &= \beta_1 I_1(t-\ell) - a_1 Y_1 \\ \Delta Y_2(t) &= \beta_2 I_2(t-\ell) - a_2 Y_2 \\ \Delta Y_n(t) &= \beta_n I_n(t-\ell) - a_n Y_n \end{aligned} \qquad \ldots\ldots.(21)$$

and

$$\begin{aligned} I_1(t-\ell) &= \lambda_1 I(t-\ell) \\ I_2(t-\ell) &= \lambda_2 I(t-\ell) \\ &\vdots \\ I_n(t-\ell) &= \lambda_n I(t-\ell) \end{aligned} \qquad \ldots\ldots\ldots (22)$$

Substituting equation 22 in equation 21 respectively

$$\begin{aligned} \Delta Y_1(t) &= \beta_1 \lambda_1 I(t-\ell) - a_1 Y_2 \\ \Delta Y_2(t) &= \beta_2 \lambda_2 I(t-\ell) - a_2 Y_2 \\ &\vdots \\ \Delta Y_n(t) &= \beta_n \lambda_{\frac{1}{n}} I(t-\ell) - a_n Y_n \end{aligned} \qquad \ldots\ldots\ldots (23)$$

$$\Delta Y(t) = \sum_{j=1}^{n} \Delta Y_j(t) = \left\{ \sum_{j=1}^{n} \beta_j \lambda_j \right\} I(t-\ell) - \sum_{j=1}^{n} a_j Y_j(t) \qquad \ldots\ldots (24)$$

Relaxing the assumption of uniform depreciation rate across sectors made earlier

$$\frac{\Delta Y(t)}{Y(t)} = \frac{I(t-\ell)}{Y} \left\{ \sum_{j=1}^{n} \beta_j \lambda_j \right\} - \sum_{j=1}^{n} a_j \frac{Y_j(t)}{Y(t)} \qquad \ldots\ldots\ldots (25)$$

$$r = \frac{I(t-\ell)}{Y} \left\{ \sum_{j=1}^{n} \beta_j \lambda_j \right\} - \sum_{j=1}^{n} a_j \frac{Y_j(t)}{Y(t)} \qquad \ldots\ldots\ldots (26)$$

Now, let us try to make our model a closer approximation of reality by assuming that the gestation lags of investment differ from sector to sector.

Let there be 'n' sectors and let the lags pertaining to different sectors be represented by $\ell_1, \ell_2, \ldots\ldots \ell_n$, *such that* $\ell_1 \quad \ell_2 \quad \ldots\ldots\ldots \quad \ell_n$, *where* ℓ_1 *is the shortest lag and* ℓ_n *is the longest, lag:*

The above basic equations can be reformulated as:

$$\begin{aligned} I_1(t-\ell_1) &= K_1(t) - K_1(t-1) \\ I_2(t-\ell_2) &= K_2(t) - K_2(t-1) \\ I_n(t-\ell_n) &= K_n(t) - K_n(t-1) \end{aligned} \qquad \ldots\ldots(27)$$

Accordingly:

$$\begin{aligned} \Delta Y_1(t) &= \beta_1 I_1(t-\ell_1) - a_1 Y_1 \\ \Delta Y_2(t) &= \beta_2 I_2(t-\ell_2) - a_2 Y_2 \\ \Delta Y_n(t) &= \beta_n I_n(t-\ell_n) - a_n Y_n \end{aligned} \qquad \ldots\ldots(28)$$

$$\begin{aligned} \beta_j I_j(t-\ell_j) - a_j Y_j &= Y_j(t) - Y_j(t-1) = \Delta Y_j(t) \\ \beta_j \lambda_j I(t-\ell_j) - a_j Y_j &= Y_j(t) - Y_j(t-1) = \Delta Y_j(t) \end{aligned} \qquad \ldots(29)$$

$$\Delta Y_j(t) = \sum_{j=1}^{n} \Delta Y_j(t) = \sum_{j=1}^{n} \beta_j \lambda_j \; I(t-\ell_j) \qquad \ldots(30)$$

$$\frac{\Delta Y(t)}{Y} = \frac{I(t-\ell_j)}{Y} \sum_{j=1}^{n} \beta_j \lambda_j \qquad \ldots(31)$$

$$r(t) = \frac{I(t-\ell_j)}{Y} \sum_{j=1}^{n} \beta_j \lambda_j \qquad \ldots(32)$$

In order to assess the impact of changes in the structure of public investment on the rate of growth of economy's output, we had formulated equation 19. To recall:

$$r = \frac{I_G}{Y}\left\{\sum_{j=1}^{n} \beta_j^g \lambda_j^g\right\} - \sum_{j=1}^{n} a_j^g + \frac{I_P}{Y}\left\{\sum_{j=1}^{r} \beta_j^p \lambda_j^p\right\} - \sum_{j=1}^{n} a_j^p \qquad \ldots(33)$$

In the light of equation 28 and 33, equation 19 can be reformulated as:

(i) with a uniform lag, and differential depreciation rates:

$$r(t) = \frac{I_G}{Y}(t-\ell)\left\{\sum_{j=1}^{n} \beta_j^g \lambda_j^g\right\} - \sum_{j=1}^{n} a_j^g \frac{Y_j}{Y(t)} + \frac{I_P}{Y}(t-\ell)\left\{\sum_{j=1}^{n} \beta_j^p \lambda_j^p\right\} - \sum_{j=1}^{n} a_j \frac{Y_j}{Y} \quad \cdots\cdots(34)$$

(ii) with differential lags:

$$r(t) = \left[\frac{I_G}{Y}(t-\ell)\left\{\sum_{j=1}^{n} \beta_j^g \lambda_j^g\right\} - \sum_{j=1}^{n} a_j \frac{Y_j(t)}{Y_j}\right] + \left[\frac{I_P}{Y}(t-\ell)\left\{\sum_{j=1}^{n} \beta_j \lambda_j\right\} - \sum_{j=1}^{n} a_j \frac{Y_j(t)}{Y_j}\right] \quad \cdots(35)$$

Chapter 5

COMPOSITION OF PUBLIC INVESTMENT: A DISAGGREGATED ANALYSIS BY INDUSTRY OF USE

We discussed in Chapter 2, the growth and instability of aggregate public investment and indicated that an insightful analysis of growth in public investment and its impact on the performance of the economy needs to be conducted at a suitable level of disaggregation. We tried to show that even though the rate of growth of public investment did decline, there had not been a decline in the rate of public investment, which we argued was the relevant indicator while analysing the impact of investment on the economy. This was all done at the aggregate level.

However, much can be learned by studying its various components and by distinguishing the structure of investment by sectors. The importance of the structure of investment was discussed in detail, theoretically, in Chapter 4, and it was established that with a given rate of investment, the rate of growth of output varies directly with the structure of investment.

The structure of investment, as defined in Chapter 4, is basically composed of:

i. allocation of investment between sectors (λ)

ii. the sectoral capital-output ratios (b)

In this chapter we shall empirically look into the allocation of investment between industrial categories within public sector, and determine the contribution of each category to changes in total public investment. In Chapter 6 we shall study

the allocation of investment at an even more disaggregated level i.e. within each category the allocation of investment between construction component, machinery and equipment, and stocks. Then in Chapter 7 we shall deal with the second component of the structure of investment i.e. sectoral capital-output ratios.

The disaggregation of public sector used in this chapter is the industry-of-use classification of National Accounts Statistics. The industry of use classification, it may be recalled, divides the public sector into four sub-sectors. Primary, Secondary, Transport, Communication and Trade, and Finance, Community and personal services. Each sub-sector is further divided into industrial categories such that Agriculture, Forestry and Mining and Quarry constitute the Primary sector. Secondary sector is made up of manufacturing, construction, electricity, gas, and water. Transport, storage, communication and trade hotel and restaurant comprises of transport communication and trade subsector whereas the finance, community and personal services comprises of banking and Insurance, Public Administration and Defence and other services.

The logic of studying capital formation at this disaggregated level is that different sectors may have diverse patterns of growth leading to changes in the structure of investment, which as we showed above is crucial in determining the rate of growth of output. Also the fact that all sectors are neither equally important in their contribution to the development process nor is their impact on the economy the same. Thus within public investment there can exist a dynamic situation wherein one can visualise some sectors growing faster than others. This phenomenon cannot be captured by looking at the aggregate level of public investment as these changes will get reflected only partially at that level depending on the magnitude of the change and weight of that particular sector. For example, a 10% decline in the rate of growth of capital formation in manufacturing will have an

impact on the economy which will be different from the impact due to a 10% decline in, say, Public Administration. Also the decline, even though of the same magnitude will get reflected differently in the aggregate public investment.

Primary Sector:

The role of public investment in the primary sector, is one of stimulating agent and the orientation of investment is towards providing economic, institutional, and technological infrastructure. The public sector has been steadily increasing its sphere of activity in the primary sector as is evident from its share in total investment in primary sector which has been increasing from 31.54% in 19606-61 to 44.26% in 1981-82.

The compound rate of growth of Gross domestic capital formation (hereafter GDCF) at current prices in the primary sector from 1960-61 to 1981-82 was 14.85% per annum. During the decade 1960-61 to 1970-71 it grew at a rate of 9.21% per annum, whereas during the second decade the rate of growth was 19.21%. However these rates were much lower when taken at constant prices particularly during the 70's when, as can be inferred from Table. 5.2.[1/], the prices of capital goods grew at a faster rate than in the 60's. For the period 1960-70 the rate of growth at constant prices was 4.31% and during the decade 1970-71 to 1980-81 it was 10.18% (See Table 5.2)

Looking at the rate of increase of Net domestic capital formation (hereafter, NDCF) in primary sector at constant prices we find that it grew at a slower rate as compared to GDCF during the period 1960-61 to 1970-71 but at a faster rate during 1970-71 to 1981-82. This would mean that rate of depreciation vis-a-vis GDCF (or NDCF) grew, at a faster rate during 70's compared to 60's. In the pre 1965 period

1. Tables relating to this chapter are given in the Statistical Annexure at the end of the chapter.

NCF rose at a rate of 8.45% p.a. but in the post 1965 period it increased at a rate of 8.63%. However, such periodisation of pre 1965 and post 1965, that is so frequently used in the stagnation debate is purely based on statistical and empirical considerations,[2] and therefore not very meaningful.[3] For examining the growth rate changes, periodisation should be based on structural and policy criteria - the factors which interact and produce outcomes. One such periodisation could be by the plans. During the third plan, GDCF grew at a rate of 9.21% per annum, in the fourth plan at a rate of 10% and during the fifth plan at a rate of 17.02%. The growth rate of GDCF in primary sector was severely affected only during the plan holiday i.e. 1966-67, 1967-68, 1968-69, when it declined in absolute magnitude at a rate of 0.63% per annum. In the initial years of the sixth plan it increased at a rate of 5.70% (Table 5.1)

Having seen that public investment i the primary sector did not register a trend decline but actually increased at a faster rate over time we shall try to see whether or not associated with this faster growth rate was a higher degree of instability.

Taking the coefficient of variation of the year to year percentages changes in public investment in the primary sector, we find that the instability has increased in the later period i.e. post 1965. While the coefficient of variation was 1.11% during the pre 1965 period, it increased to 1.49% in the latter period. Instability in public investment was highest during the plan holiday and as the table below shows it is the instability in these three years which increases the coefficient of variation in the later period (i.e. post 1965 period).

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2. Alagh, Y K (1985) p.5.

3. However we shall use such periodisation as and when necessary for making comparability with other studies possible.

Instability in Primary Sector

	Mean of the annual growth rate	Standard Deviation of annual growth rate	Coefficient of variation of Annual growth rate
1960-61 - 1965-66	7.808	8.672	1.111
1966-67 - 1981-82	7.96	11.827	1.486
1960-61 - 1981-82	7.92	11.15	1.408
Third Plan	7.808	8.672	1.111
Plan Holiday	0.59	4.003	6.746
Fourth Plan	8.93	7.10	0.794
Fifth Plan	13.31	17.722	1.331
Sixth Plan[4/]	4.77	2.946	0.617

Thus we find that the rate of growth (average annual as well as compound) of public investment in primary sector has been increasing over time, and even though the instability as measured by the coefficient of variation of annual growth rates shows an increase in the post 1965 period it is not a secular or trend rise but essentially because of a very high degree of instability during the plan holiday which distorts the post 1965 estimates.

That capital formation in the primary sector has been growing at a faster rate vis-a-vis other sectors is evident from its increasing weight within public sector. The relative allocation of investment in the primary sector has been increasing more or less secularly from 14.18% in 1960-61 to 19.7% in 1981-82. The

4. Only the initial years, upto 1981-82, are included.

Instability in Primary Sector

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fifth plan saw the relative allocation grow very rapidly from 16% to an all time high of 25.1% in 1977-78.

The primary sector itself comprises of three industrial categories viz. Agriculture, Forestry, and Mining and Quarry.

Though the scope for investment in the state agricultural sector proper i.e. in state agricultural enterprises is limited, it being restricted to organisation of a small number of state farms, (engaged mainly in the multiplication and distribution of improved seeds etc.) agriculture receives a substantial share of public investment - the bulk of public investment in agriculture being channelised for the development of infrastructure. This includes development of irrigation, land improvement, soil conservation, improved varieties of seeds, better agricultural implements, construction of foodgrain godowns and ware houses etc. The contribution of public investment to total investment in agriculture has consistently been around 29%.

Though the share of agriculture in total public investment has been more or less stable between 11-13%, its share has been consistently declining within the primary sector after 1968-69. The share of agriculture in primary sector declined from 78.89% in 1968-69 to 50.79% in 1981-82. This fall has been, with the exception of a couple of years, (e.g. 1977-78; 1978-79) uninterrupted. (See Table 5.4) The reason for this decline despite a rise in the relative share of primary sector in total public investment is, as we shall see below in detail, that the sector mining and quarrying has been growing at the expense of agriculture within the primary sector.

The rate of growth of public investment[5/] in agriculture for the period 1960-61 to 1981-82 was 5.86% per annum. While it grew at a rate of only 4.28%. From 1960-61 to 19 70-71 the rate of growth was 7.29% in the post 1970-71 period.

5. Unless, otherwise specified, investment/capital formation is in gross terms and at constant (1970-71) prices.

Net investment figures show the same pattern. The plan wise patterns of growth, as laid out in Table 5.1, shows that even during the plan holiday agriculture did not suffer as severe a cut back as other sectors. During the fifth plan it registered its highest rate of growth of 17.38%. However, it is during the initial years of the sixth plan that outlay on agriculture has declined in absolute magnitude by about -6% at constant prices.

As regards the instability of investment in agriculture, we find that the coefficient of variation of annual growth rates (of public investment in agriculture) was 1.958 during the entire period. The instability was much higher in the post 1965 period (Coefficient of Variation 2.3880) than in the pre 1965 period (Coefficient of Variation 0.7652). As in the case of primary sector, in agriculture also we find that the higher instability as reflected by the coefficient of variation in the post 1965 period is not a secular rise in instability but due to a very high degree of instability during the plan holiday (6.855), which pushes up the magnitude of

Public Investment in Agriculture

	Mean of Annual growth rates	Standard deviation of Annual growth rates	Coefficient of Variation of Annual growth rates
1960-61 to 1965-66	7.52	5.7545	0.7652
1966-67 to 1981-82	5.252	12.5418	2.3880
1960-61 to 1981-82	5.792	11.343	1.9584
Third Plan	7.52	5.7545	0.7652
Plan Holiday	1.5033	10.306	6.855
4th Plan	6.306	7.4119	1.1753
5th Plan	11.678	16.550	1.4172
6th Plan	-3.466	4.8853	-1.4092

instability in the latter period.

In absolute magnitude the public investment made in the sector forestry is low and consequently its share has never exceeded 0.9% within public sector. In fact, after 1969-70, the share of forestry has been on the decline and in 1982-82 it accounted for only 0.6% of total public investment. However even with such a low share within public sector, public sector contributes more than 75% of total capital formation made in the forestry sector in the economy. In 1961-62 the proportion of public investment to total investment in forestry was 92% but it has been steadily declining, and in 1981-82 it stood at about 74%.

Within primary sector, the weight of forestry in investment has been consistently falling after 1967-68. From a weight of 5.29% in 1967-68, it has secularly declined to 2.65% in 1981-82(refer Table 5.4)

During the period 1960-61 to 1981-82, public investment in forestry rose at a rate of 4.21% per annum. The rate of growth was much faster during the 1970's, i.e. 8.27%, as compared to 4.98% per annum during 1960's. However, as will be shown by plan-wise rates of growth, public investment did suffer a severe cutback in this sector. From a rate of growth of 12.26% in the Third plan, it fell to 3.03% in the plan holiday and declined still further by -2.32% per annum during the fourth plan. There was a recovery during the fifth plan when public investment rose by 20.83% but the initial years of the sixth plan again suggest a period of slow growth.

Since, according to the National Accounts Statistics, C.S.O., estimates there is no depreciation on capital in forestry, the net investment growth patterns are the same as above.

Though it has been claimed that Mining and Quarrying sector was one worst

affected sectors by the cutback of public investment[6], we find evidence quite contrary to this claim. In fact what we find is that Mining and Quarry is one of the fastest growing sector in terms of public investment.

Net capital formation in Mining and Quarry increased at a compound annual rate of 10.17% in the first half of sixties, whereas in the post 1965 period i.e. 1966-67 to 1981-82 it grew at a rate of 15.16%. During the decade of seventies it recorded an unprecedented growth rate of 25% (Table 5.3)

It might be interesting to note that while gross capital formation in Mining and Quarrying increased at the rate of 16.46% per annum during the seventies, the rate of growth of net capital formation during the same period was higher by 8.45% points. This would mean that the depreciation provisions declined in absolute magnitude.

Analysing the growth pattern by plans we can see that capital formation in mining and quarry grew at a very rapid rate throughout: 10.11% in the third plan, 17.23% in the fourth plan, 16.23% during the fifth plan and 22.73% during the sixth plan - except during the plan holiday when it was the worst hit amongst all sectors by the investment cutback. During this period i.e. 1966-67, 1967-68, and 1968-69 public investment in mining and quarrying declined at a rate of -26.14% per annum.

Consequent upon such high growth rates of investment, in absolute as well as relative terms i.e. vis-a-vis other sectors, the weight of mining and quarrying has increased within the public sector as well as the primary sector. In 1960-61 the relative share of public investment going into mining and quarry was 2.6% and over the years this has steadily increased to 9.2% in 1981-82 (Table 5.8).

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6. Ahluwalia (1984) P.76-77.

Above, we noted that inspite of the fact th the weight of primary sector in the public sector had increased from about 14% to 20%, the weight of agriculture and forestry within primary sector had declined. Looking at the share of mining and quarry, within the primary sector makes it clear that mining and quarrying grew at the expense of the two other sectors. The rise in the share of primary sector was entirely devoted to the mining and quarry sector, such that its share in investment Within primary sector increased from 16.16% in 1960-61 to 46.56% in 1981-82 (Table 5.4)

Secondary Sector:

The size and structure of the public sector was drastically changed in the period after 1955, mainly through public investment in the secondary sector, in particular the manufacturing industry. Since the data for investment in secondary sector is available only from 1960-61 onwards, the above fact can be substantiated by looking at the plan wise public sector outlays for Industry and Mining, which broadly corresponds to the definition of secondary sector as defined by National Accounts Statistics.

Public Sector Outlays for Industry and Mining 1950-51 to 1982-83

	Outlays (Rs. millions)	Percentage share of total public sector Outlays
First Five Year Plan (1951-56)	550	2.8
Second Five Year Plan (1956-61)	9,380	20.1
Third Five Year Plan (1961-66)	17,260	20.1
Annual Plans (1966-69)	15,100	22.8
Fourth Five Year Plan (1969-74)	28,740	18.3
Fifth Five Year Plan (revised) (1974-79)	1,02,000	26.0
Sixth Five Year Plan (draft) (1979-83)	1,33,400	19.2

The above table sharply brings out the change in policy which gave top priority to the industry: under the first five year plan, actual public sector outlays for industry and mining amounted to less than 3% of the total public sector outlay, whereas during the second plan period public sector outlay for the industrial sector was increased phenomenally to more than 20%. The rationale of this rise is to be sought in the objective of rapid industrialisation.

The role of public investment in the secondary sector is of inducing private investment and at the same time engaging in production sphere. The former role is fulfilled through the investments in sectors like construction and electricity, gas, and water and the latter by investment in manufacturing. The share of secondary sector in public investment has increased from 33.7% in 1960-61 to 45% in 1981-82 at constant prices.This rise has not been secular it rose till 1966-67 but between 1967-68 and 1973-74 registered a fall after which it has maintained a rising trend (Table 5.8)

The compound rate of growth of public sector GDCF at current prices in the secondary sector was 13.43% per annum. The rate of growth was much faster, 17.77%, in the seventies as compared to the sixties when it grew at a rate of 10.24%. The same pattern was observed at constant prices also. During the first period the rate of growth was 5.71% which increased to 8.82% in the second period. Over the entire period, 1960-61 to 1981-82, the rate of growth at constant prices was 6.55% (Table 5.2)

Looking at the NDCF we find that during the first period NDCF grew at a compound annual rate of 4.10%, slower as compared to GDCF but the rate of increase was 10.21% in the second period i.e. faster than that of GDCF.

The plan wise growth rates show that secondary sector investment suffered a substantial decline during the plan holiday. From a growth rate of 14.82% per

annum achieved during the third plan, the rate dropped down to -7.18% - a decline of 22 percentage points. In the two subsequent plans the growth rate was stable around 7.8% per annum. The initial years of the sixth plan show a slight decline in the rate.

Associated with the slow rate of growth in the first period was a higher degree of instability whereas the growth rate in the second period was not only faster but also more stable. While the coefficient of variation during the first period was 1.5526, for the second period it was only 0.5493 (See Table below)

Instability in Secondary Sector

	Mean of Annual growth rates	Standard Deviation of Annual growth rates	Coefficient of variation of Annual growth rates
1960-61 - 1981-82	8.203	7.987	0.973
1960-61 - 1970-71	6.362	9.877	1.5526
1971-72 - 1981-82	9.450	5.191	0.5493
Third Plan	14.006	7.351	0.5248
Plan Holiday	-4.83	3.29	-0.6820
Fourth Plan	7.43	5.52	0.7441
Fifth Plan	10.494	5.57	0.8944
Sixth Plan*	8.59	3.78	0.4406

However looking at the plan wise pattern of instability we find that the instability has been increasing over the plans. The coefficient of variation of the annual growth rates has increased from .5248 during the third plan to 0.8944 during the fifth plan. Thus a plan wise analysis of the growth and

instability in secondary sector investment shows that during plans associated with a higher growth rate is a higher degree of stability and vice versa.

The secondary sector itself comprises of three industrial categories: manufacturing, construction and electricity, gas and water.

The distribution of public investment within manufacturing is skewed heavily in favour of creation of new enterprises and expanding of existing ones. The major part of investment in the state sector is directed into the capital intensive branches of heavy industries with a long gestation period namely the metal industries, heavy engineering, chemical industries ship building etc.

The relative allocation of investment in manufacturing has been fluctuating. It rose from 17.5 in 1961-62 to 26.8 in 1966-67 thereafter it declined till 1970-71 when its weight was 15.7. The period 1970-71to 1974-75 saw it rise again to 25.3 and thereafter it has been fluctuating around 20 to 22 (See Table 5.8). However taking the entire period of 1960-61 to 1981-82 into account we find that the weight of manufacturing in total public investment has increased at a compound growth rate of 0.68% per annum. Within the secondary sector, the share of manufacturing has declined consistently from 67.20 in 1960-61 to 46.29 in 1981-82 except during the period 1964-65 to 1967-68 when the trend decline was reversed temporarily.

The decline in the weight of manufacturing in the later period is not explained by the slow rate of growth of capital formation in manufacturing; in fact the growth rate was substantially higher in the later period as compared to the earlier period. At current prices the compound rate of growth in the decade 1960-61 to 1970-71 was 7.85 which increased by over 10 percentage points during the seventies. At constant prices also the same pattern of growth is maintained. During the first period it increased at a lower compound rate of

3.50% while in the second period the rate was 8.32%. Even if one periodises according to the pre 1965, post 1965 periodisation the growth rate is lower in the pre 1965 period as compared to the post 1965 period. The increase in the later period is much sharper when one takes net capital formation. While net capital formation grew at a rate of only 1.21% per annum during the first period, the rate of growth was 9.40% during the second period. A persual of the growth rates, given in Table 5.1 according to plans shows that most of the rise in capital formation in manufacturing was attained during the fourth plan when the compound rate of growth was 14.18% per annum. Apart from the plan holiday, when public investment in manufacturing declined in absolute terms, fifth plan also was a period of slow growth.

The patterns of instability in public investment in manufacturing depends on the periodisation (See Table below). The pre 1965 and post 1965 periodisation

Instability in Investment in Manufacturing

Period	Mean of annual growth rates	Standard Deviation	Coefficient of variation
1960-61 to 1965-66	10.939	19.484	1.7813
1965-66 to 1981-82	5.314	14.466	2.722
1960-61 to 1981-82	6.653	15.986	2.4028
1960-61 to 1970-71	1.854	17.3760	9.3721
1971-72 to 1981-82	11.016	13.170	1.1955
Third Plan	10.938	19.484	1.7813
Plan Holiday	-7.093	9.841	-1.387
Fourth Plan	10.908	16.715	1.532
Fifth Plan	5.406	12.156	2.248
Sixth Plan	8.246	9.621	1.1666
1960-61 to 1966-67	10.251	17.85	1.74
1960-61 to 1967-68	6.734	18.639	2.7678
1960-61 to 1968-69	4.176	18.702	4.478
1960-61 to 1969-70	2.707	18.115	6.6903
1960-61 to 1970-71	1.854	17.37	9.3721

shows that associated with a higher rate of growth in the post 1965 period was associated a higher instability. On the other hand the decade wise periodisation would show exactly the opposite i.e. the instability was higher in the first period as compared to the second period. The plan wise pattern of instability shows that the magnitude of instability has remained more or less constant except during the fifth five year plan when it was higher. This situation clearly explains the point we were trying to make about the significance of periodisation in discussions of comparative performance between periods (See above)

Though the different periodisation's used above do not reveal it, a closer look at the data will show that the source of the very high magnitude of instability reflected by the coefficient of variation 9.37 during the period 1960-61 to 1970-71, lies in the period 1967-68 to 1970-71. As the table above shows the standard deviation of the growth rates does not indicate any significant variability it is a substantial decline in the average annual growth rate, from 10.25 to 1.85, during this period which increases the coefficient of variation of the annual growth rates thereby giving the impression of a sudden increase in the magnitude of instability. Since in a shorter time period the effects of these four years (i.e. 1967-68 to 1970-71) is likely to distort the picture therefore in this case we use the pre 1965 - post 1965 periodisation to argue that there was a higher degree of instability in the later period, associated with a higher rate of growth.

Public investment in electricity gas and water which accounts for almost entirely the total investment made in this sector is infrastructural in nature.

Above we saw that though the share of secondary sector in total public investment had increased that of manufacturing fell both within the secondary sector as well as the total public sector investment. The reason for this as Table 5.8 shows is the substantial increase in the weightage of electricity

gas and water sector in public sector from 10% in 1960-61 to 22.5% in 1981-82. In fact, the entire rise in the allocation of gross investment in secondary sector has been concentrated in electricity, gas and water where its share has increased from 29% to 50% during the two decades. While the share of electricity, gas and water increased secularly within the secondary sector it was not so within public sector as a whole. The relative allocation of electricity gas and water in public sector gross investment increased till 1970-71, thereafter it registered a sharp fall till 1973-74 and then its share again increased till 1981-82. It is interesting to note that the movement in the share of electricity, gas and water was counter cyclical to that of manufacturing within total public investment suggesting that the two sectors compete for resources and that in the later period electricity, gas and water grew at the expense of manufacturing.

Electricity, Gas and Water is the only sector that suffered a persistent investment cutback during the plan holiday which was continued even during the fourth plan. The rate of growth of investment in electricity, gas and water sector was 12.16% which declined to 1.40% during the plan holiday. The fourth plan also was a period of stagnation in investment when it grew at 1.85% per annum. It was during the fifth plan that the earlier trend was restored and a growth rate of 12.30% per annum was attained. In the initial years of the sixth plan the growth rate has been over 8%. The rate of growth of investment during the pre 1965 period was very high, about 18%, but this does not give the correct picture because the figures are to a large extent distorted by the small base over which they are calculated. This argument is validated if we look at Table 5.2 which shows that the growth rate during 1960-61 to 1970-71 which was 8.42% per annum - lower than what was achieved during 1970-71 to 1981-82 when it rose at 9.06% per annum.

As the table below shows there has been no significant change in the pattern

Instability in Investment in Electricity Gas and Water

Period	Mean of Annual growth rate	Standard Deviation of Annual Growth rates	Coefficient of variation of Annual growth rates
1960-61 - 1965-66	24.168	22.675	0.9382
1966-67 - 1981-82	7.120	12.51	1.7579
1960-61 - 1981-82	11.179	17.161	1.5351
1960-61 - 1970-71	14.766	20.076	1.3596
1971-72 - 1981-82	7.919	13.173	1.6635
Third Plan	24.168	22.675	0.9382
Plan Holiday	-2.293	6.336	-2.7629
Fourth Plan	5.338	9.6224	1.8026
Fifth Plan	13.562	16.8740	1.2442
Sixth Plan	8.77	0.9579	0.1092

of instability, though there is a slightly higher instability in the later period primarily because of an erratic investment allocation during the plan holiday.

As we mentioned above apart from manufacturing and electricity gas and water, the secondary sector also comprises of construction. The scope for public investment in construction is extremely limited as is reflected by the magnitude of investments made in this sector. The relative allocation of public investment in construction has increased from 0.6% in 1960-61 to 1.6% in 1981-82. Within the secondary sector its weight has remained constant around 3.5%.

The absolute magnitude of investment in construction being small consequently the growth rates (particularly year to year) registered are very high and fluctuative ranging from -90% to +725%, as can be seen from Table 5.9. Unlike all other sectors

which received a cutback in investment during the plan holiday, investment in construction rose at a compound annual rate of 21.06% in that period. The fourth and fifth five year plan were the periods of slow growth for investment in construction. But during the sixth plan it has picked up again, growing at a rate of 35.66% per annum.

The magnitude of instability of investment in construction has been higher than in most of the other sectors. The coefficient of variation of the annual growth rates of investment in construction was 3.721 over the period 1960-61 to 1981-82. In the period 1960-61 to 1970-71 associated with a growth rate of -0.45% per annum was a lower level of instability as reflected by the coefficient of variation 0.9037. But during the second decade a higher growth rate of 21.94%

Instability in Construction Investment

Period	Mean of Annual growth rate	Standard Deviation of Annual growth rate	Coefficient of Variation of Annual growth rate
1960-61 - 1965-66	16.954	15.322	0.9037
1965-66 - 1980-82	50.48	181.26	3.568
1960-61 - 1970-71	3.497	35.880	10.174
1970-71 - 1981-82	69.49	215.7	3.10
1960-61 - 1981-82	42.74	159.052	3.721
Plan Holiday	13.61	21.617	1.58
Fourth Plan	113.322	308.13	2.719
Fifth Plan	26.758	52.403	1.95
Sixth Plan	23.856	48.569	2.035

was associated with a higher degree of instability, coefficient of variation being 3.568.

Transport Communication and Trade Sector:

The transport, communication and trade sector is divided into (a) Transport, Storage and Communication and (b) Trade, Hotel and Restaurants. The former, which comes closest to infrastructure sector under National Accounts Statistics classification, is further subdivided into three industries viz. (i) Railways (ii) Communication (iii) Transport by other means.

The share of transport, communication and trade sector has been declining over time. The share which was over 25% between 1960-61 to 1964-65 has come down to about 15% between 1977-78 and 1981-82.

The reduced priority accorded to th.. sector as reflected by its decreasing share is corroborated by the slow rate of growth of investment in this sector. Over the two decades the rate of growth of investment in transport, storage, and communication was 2.70% per annum. Most of this growth was recorded in the pre 1965 period when it grew at a rate of more than 12%.

It is essential to see how much of this decline was suffered by the infrastructural component of the sector. Since it has been widely argued that infrastructure was the worst hit of all sectors by the slow down in public investment, we shall reclassify the industrial categories to get the investments in the infrastructural sectors. In addition to the transport, storage and communication (comprising of Railways, transport by other means, and communication) we shall take electricity, gas and water sector and the mining and quarrying sector. Ahluwalia (1984) has also reclassified the sectors given in National Accounts Statistics to arrive at the infrastructural sector. Though she considers railways as a part of infrastructure, transport by other means is not taken to be a part of infrastructure, the logic of which is not clear. As Table below shows there

Infrastructural Investment

At Constant Prices
(Rs. Crores)

Year	Ralway	Electricity Gas and water	Mining and Quarry	Transport storage & Communication[1]/	Total Infra-stru-cture	Share in Total Invest-ment	
1960-61	280	185	47	372	604	33.07	
1961-62	345	308	48	463	819	45.57	
1962-63	468	355	73	584	1012	46.40	
1963-64	531	445	98	676	1219	50.35	43.77
1964-65	524	444	103	679	1226	46.00	
1965-66	452	506	67	601	1174	41.25	
1966-67	312	456	112	522	1090	42.34	
1967-68	283	444	88	460	992	37.64	
1968-69	240	469	66	445	980	40.88	
1969-70	189	535	86	385	1006	42.39	
1970-71	251	640	84	571	1235	44.53	41.32
1971-72	281	625	90	545	1260	42.61	
1972-73	305	621	129	690	1440	45.93	
1973-74	270	596	165	597	1358	36.32	
1974-75	237	617	168	611	1396	39.69	
1975-76	243	902	293	619	1814	40.92	
1976-77	203	906	390	619	1915	38.92	
1977-78	238	1025	371	620	2025	48.39	
1978-79	273	1071	336	705	2112	42.13	43.7
1979-80	327	1166	356	713	2235	42.09	
1980-81	415	1254	454	834	2542	45.32	
1981-82	438	1378	561	838	2777	45.35	

Plan-wise Growth Rates of Investment in Infrastructure

(Constant Prices)

Plans	Rate of Growth
Third Plan	9.12%
Plan Holiday	-5.31%
Fourth Plan	7.53%
Fifth Plan	9.38%
Sixth Plan	10.85%

1. Inclusive of Railways

has been no trend decline in the share of infrastructure which has in fact increased from 33.07% in 1960-61 to 45.35% in 1981-82. Between 1960-61 and 1965-66 the average share of infrastructure was 43.77, which in the following decade declined slightly to 41.56, and again reached 43.75 thereafter. Hence the argument forwarded by Ahluwalia that there was a 7% point decline in the share of infrastructure between 1960-61 to 1965-66 and 1966-67 to 1975-76 does not seem to be correct. The discrepancy in the results can be possibly attributed to her ommission of transport by other means as infrastructure.

Our argument is also substantiated by looking at the compound rates of growth of investment in the infrastructure sector. Except during the plan holiday when investment in this sector declined at a rate of 5.32% per annum, the rate of growth has been consistently high. In the third plan it grew at a rate of 9.12%, in the fourth plan at a rate of 7.53%, in the fifth plan at a rate of 9.38% and in the initial years of the sixth plan the rate of growth has been 10.85%.

Instability in capital formation in transport, communication and trade has been consistently high as compared to the other sectors. The magnitude of instability has been in the range of 360 - 400% throughout. As we see below, this instability is primarily due to an extremely fluctuating investment allocations pursued with regard to trade sector.

Within this sector i.e. transport communication and trade the sector that has borne the brunt of the investment cutback is railways. This becomes evident by looking at its share within transport, communication and trade which has declined from 72.18% in 1960-61 to 40.66% in 1981-82 as given in Table 5.6. In 1976-77 the share of railways was as low as 15%. The share of railways has been declinining at a compound annual rate of -4.39 per year. The weight of railway in overall public sector investment also has declined uninterupted from about 22% in 1963-64 to 7.2% in 1981-82.

The rate of growth of investment in railways from 1960-61 to 1981-82 was -1.82%. The plan wise pattern of rate of growth of investment given in table 5.1 reveals that during the plan holiday, investment in railway declined in absolute magnitude at a rate of -13.11% per annum. While the third and fourth plans were periods of steady growth, in the fifth plan investment again slowed down to a rate of 2.62% per annum. However, in the initial years of the sixth plan an unprecedented growth rate of over 14% per annum has been achieved.

There is thus overwhelming evidence to the effect that the growth of public investment in railways slowed down significantly after mid sixties. However it seems to have been taken for granted that this slow down was the cause rather than the effect of industrial stagnation. Given the plan policy, outlined throughout the plans, of attempting to coordinate the programmes of railway development with programmes of industrial development this presumption could be questioned. To do this, one needs to look into the criteria and method of investment allocations in transport in general and railways in particular.

Investment in transport development is necessarily based on estimates of the additional requirements for each mode of transport. The Planning Commission has tried to make such estimates for each of the five year plans. The type and coverage of data, the general limitations associated with demand estimation and changes in factors entering the demand function make it an exercise beset with a number of problems. Nevertheless they do provide a broad idea on which investment plans are based. Various commodity transport studies dealing with the volume of production of different commodities (e.g. coal, cement, iron-ore, limestone, petroleum, oil products, fertilizers, foodgrains, jute, raw cotton, timber etc.) by the end of a target year and the various modes of transportation required by each of these commodities as also their share of the commodity for transportation.

Such detailed technical and economic studies are behind the presentations of the estimates of additional transport requirements in each of the five year plans. In case of railways the main aim has been specifically to match the transport capacity to the growing transportation demand. The First Plan[7] made clear its inability to estimate precisely the requirements of the railways in respect of all additional demands that might be made on them but the Second Plan[8] made an attempt to integrate railway expansion with production targets of several other sectors and estimated the additional originating traffic for the railways at 60.8 million tons taking account of passenger and commodity demand seperately. The third plan[9] made more detailed estimates of the additional transport requirements based on the production targets, proposed location of the production units patterns of movement of commodities, and correlation between production and freight traffic. The originating traffic was estimated to increase during the third plan by 91 million tonnes i.e. 59%. The railway investments made were based on these calculations. Similar exercise was carried out for the fourth plan and the additional originating traffic for the plan period was estimated at 61 million tonnes (FFYP p.340-41)[10] But after a mid term appraisal[11] in 1971 (Fourth Plan Mid term Appraisal, Vol.II; p.173) the traffic forecast for 1973-74 was reduced from 265 million tonnes to 240 million tonnes which meant a substantial reduction in the originally estimated additional originating traffic. This was done in light of the actual diminution in freight traffic from 208 million tonnes in 1969-70 to 199 million tonnes in

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7. First Five Year Plan, P.466-467
8. Second Five Year Plan, P.464
9. Third Five Year Plan p.542-543
10. Fourth Five Year Plan p.340-341.
11. Fourth Plan Mid Term Appraisal, Vol.II; p.173.

1970-71.[12] Similarly on the basis of production targets the Fifth plan estimated additional originating traffic ... less than the third and fourth plan

Thus far our discussion of investment in railways indicate that there was an increase planned in the railway traffic facilities to be made available. Now it is important to consider whether this was commensurate with the growing demand. We described above the methodology adopted in estimating the targets for freights and passenger traffic under the plans. The actual increases in goods and passengers carried from plan period to plan period are shown below.

The below table shows that from 1950-51 to 1965-66, both goods and passengers traffic show a rising trend, but since 1965-66, there has been a slackening in demand as indicated by figures. Originating traffic in goods which increased from 94 million tonnes in 1950-51 to 204 million tonnes in 1965-66 diminished to 198 million tonnes in 1971-72. The rate of increase in the volume of goods traffic, passenger traffic originating, and passenger kilometers, also show a very marked decline after 1965-66 reversing the trend of previous fifteen years. The entire increase between 1950-51 and 1971-72 in the originating goods traffic by 104 million tonnes, 73 out of the total increase by about 89 billion tonne kilometers

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12. The arguments put forth above are substantiated by a private communication received by J. Toye from L.K. Jha which he quotes in his book. It says "In 1967, L K Jha then head of the Prime Ministers Secretariat succeeded in persuading both the Prime Minister and the Finance Minister that it was desirable that Railway Board should place additional orders for capital equipment. But the governments suggestion to this end was successfully resisted by the railway Board. Its arguements was that the existing stock was not then fully utilised and that additional investment which merely added to the an existing surplus of equipment would not yield extra revenue and thus would contradict its obligation to act as a commercial undertaking" Toye (1981), p.136

of goods traffic and 905 out of the increase by 1143 million passengers originating have taken place between 1950-51 and 1965-66.

Railway Route Length and Traffic

	1950-51	1955-56	1960-61	1965-66	1969-70	1971-72
1. Railway Route length (Kms)	54,845	55,902	56,962	59,061	60,138	60,275
2. Railway Rolling Stock in Service						
a. Locomotives (000)	8.6	-	10.7	11.8	-	11.2
b. Passenger Carrier (000)	15	-	21	24	-	26.9
c. Goods Wagon (000)	213	-	311	373	-	384
3. Goods Carried						
a. Originating traffic (MT)	94	117	158	264	209	198
b. Volume of traffic (BT Kms)	44.16	59.64	87.76	117.0	128.3	133.3
4. PassengersCarried						
a. Passengers originating (Mi)	1,308	1,297	1,164	2,213	2,357	2,451
b. Passenger Kilometers (Bi)	67.1	62.9	78.1	96.8	113.7	125.5

Source: CSO Basic Statistics and Indian Railways (Year Book)

The explanation for the above trends is obviously to be sought in the close relationship between industrial growth and demand for railway transport. About 70% of the increase in railway traffic anticipated for 1956-61 and 80% of that anticipated for the period 1961-66 was accounted for by the development of coal, iron ore and cement. The slackening in demand since 1965-66 and the investment cutbacks as shown above may be the effect of industrial stagnation. This situation would suggest underutilization, excess capacity and consequent impact on further development of railways -- an issue that needs taken up in detail.

More important than the total investment allocation, which certainly would have had an impact on the development of the industry and railways, was the mis-allocation at subsectoral level. Healey[13] has shown by a detailed analysis of investment in Indian Railways that the transport strains in the mid sixties were essentially due to unstable timing of investment expenditure with reference to the balance between wagon capacity, locomotive capacity, and line capacity. There have been occasions when tractive effort has been hindered by lack of locomotives though there was excess wagon capacity. This kind of experience suggests the mis-allocation of funds rather than lack of funds.

Within the transport, communication and trade sector all other industries apart from railways have increased their share. Communication at a rate of 7.12% per annum between 1960-61 and 1981-82 increased its weight within the transport communication and trade sector from 9.358 during 1960-61 - 1964-65 to 19.542 during 1977-78 - 1918-82. The plan wise growth rates show that communication has been the fastest growing sector, but because of its small weight doesn't get reflected either in the transport, communication and trade sector or the overall public sector. (Table 5.6)

Transport by other means is another sector where the growth rates have been widely fluctuating from +40% to -25%. Consequent upon this pattern of growth, itsshare also has been fluctuating. It share in public investment increased from 3.5 in 1960-61 to 8.6 in 1972-73 but thereafter it has declined and in 1980-81 its share was less than what it was in 1960-61. However within transport communi-cation and trade its share has increased considerably from 12.866 during 1960-61 to 1964-65 to 32.88 during 1977-78 to 1981-82. To that extent one can say it has

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13. J.M. Healey: The Development of Social Overhead Capital in India(1965)

grown at the expense of railways within the transport sector.

Finance Community and Personal Services:

This sector which comprises of (i) Public Administration (ii) Banking and Insurance (iii) Other services is essentially the tertiary sector.

The proportion of public investment going into this sector can be phased into three period - 1960-61 to 1968-69 when it declined from 30.8 to 15.2, 1968-69 to 1972-73 during which it increased to 26.1 and finally 1973-74 onwards where it again starting declining. This sector has been growing at a rate of 3.5% per annum between 1960-61 and 1981-82. The plan wise pattern of growth shows that like almost all other sectors the rate of growth of investment in FC & PS dropped down considerably during the plan holiday. This period of absolute decline in public investment in this sector was followed by a very high growth rate of more than 16% during the 4th plan. During the fifth and sixth plan a steady rate of about 5% per annum has been maintained.

Within this sector, the slowest growing has been Public Administration and Defence. Growing at a rate of 2.35% per annum between 1960-61 and 1981-82 its share in total public investment has been declining particularly since 1973-74. Even within the finance, community and personal services sector its share has dropped secularly from 94% in 1960-61 to 76 in 1981-82.

As against this, the two other sector banking and insurance, and other services have been growing relatively faster - the former grew at an annual rate of 9.5% while the latter registered a growth rate of over 10% during the two decades. The rate of growth of investment in banking and insurance during the third plan was 20.57%, 15.85% during the fourth plan, 13.26% and 24.89% respectively in the fifth and sixth plan. However its share of investment in total public sector investment being very low, not even 1%, these high growth rates

don't get reflected in total investment.

Nevertheless consequent upon such high growth rates the share of banking and insurance within finance community and personal services, has increased from 1.24% in 1960-61 to 4.68% in 1981-82 and that of other services from 4.45% in 1960-61 to 18.55% in 1981-82. Inspite of the increase of the relative share of other services and banking and insurance within finance community and personal sector, its share has been declining in total public investment.

So far we have discussed the growth and pattern of instability at the sectoral level. Before commenting on the compositional changes in public investment between 1960-61 - 1981-82 we shall try to decompose the changes in the growth rate of public investment into their sectoral shares i.e. contribution of each sector to the change in growth rates of public sector.

Framework for Analysing Contribution of Sectors:

Assume:

I_t is total public investment in time period t;

and I_{t+1} is total public investment in time period $t+1$

Since

$$I_t = \sum_{i=1}^{n} I_{i(t)} \qquad \ldots\ldots\ldots \quad (i)$$

and

$$I_{t+1} = \sum_{i=1}^{n} I_i(t+1) \qquad \ldots\ldots\ldots \quad (ii)$$

where $I_{i(t)}$ is public investment in sector i, in time period t

and $I_{i(t+1)}$ is public investment in sector i in time period t_{1+t}

If G_t is the rate of growth of public investment in time period t, then as defined by (i) and (ii) we can have:

$$G_t = \sum_{i=1}^{n} g_{it} \cdot W_{it} \qquad \ldots\ldots \qquad (iii)$$

$$G_{t+1} = \sum_{i=1}^{n} g_{i(t+1)} W_{i(t+1)} \qquad \ldots\ldots \qquad (iv)$$

where: g_{it} = growth rate of public investment in the i^{th} sector in time period t;

W_{it} = share of i^{th} sector in total public investment in time period t

From (iii) and (iv) we have:

$$G_{(t+1)} - G_{(t)} = \sum_{i=1}^{n} \left\{ g_{i(t+1)} W_{i(t+1)} - g_{it} \cdot W_{it} \right\} \qquad \ldots (v)$$

$$G_{(t+1)} - G_{(t)} = \sum_{i=1}^{n} \left\{ W_{it}(g_{i(t+1)} - g_{i(t)} + g_{it}(W_{i(t+1)} - W_{i(t)}) + (g_{i(t+1)} - g_{it})(W_{i(t+1)} - W_{it}) \right\} \ldots (vi)$$

$$\frac{G_{(t+1)} - G_t}{G_t} = \frac{1}{\sum_{i=1}^{n} g_{it} \cdot W_{it}} \sum_{i=1}^{n} \left\{ W_{it}(g_{i(t+1)} - g_{i(t)} + g_{it}(W_{i(t+1)} - W_{i(t)} + g_{i(t+1)} - g_{it})(W_{i(t+1} - W_{it}) \right\} \ldots (vii)$$

In the above equation (vi) the rate of change in the growth rate of public investment over successive years has been decomposed into:[14]

$$W_{it}(g_{i(t+1)} - g_{i(t)}) \quad = \quad \text{Pure Growth Effect}$$

$$g_{it}(W_{i(t+1)} - W_{i(t)}) \quad = \quad \text{Pure Weightage Effect}$$

$$\left\{g_{i(t+1)} - g_{i(t)}\right\}\left\{W_{i(t+1)} - W_{i(t)}\right\} \quad = \quad \text{Interaction term}$$

The above algebraic formulation has been used to arrive at the contribution of different sub-sectors to the change in the rate of growth of public investment.

Table 5.11 gives the year to year decomposition by sub-sectors of a change in the growth rate of public investment. The change in the annual growth rates has been decomposed into the contributions of primary, secondary, transport, communication and trade, and Finance, Community and personal services.

Since our interest lies in locating the sectoral origin of the decline we have given below a summary table of Table. 5.11, focussing on the years in which the change in the rate of growth was negative.

During the period 1960-61 to 1975-76, a fall in the rate of growth in all years,except 1972-73 to 1973-74, was not associated with a fall in the secondary sector. In 1961-62 to 1962-63 when rate of growth of public investment declined by -10.36%, 65% of this decline was accounted by the sector finance community and personal services and about 25% by the transport, communication and trade sector. During this period the change in the rate of growth of investment in the secondary sector was positive and its contribution was +9.23%.

In period 2 i.e. the years 1963-64 to 1964-65, the change in the rate

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14. Equation VII decomposes the rate of change of the growth rate in public investment into the same components.

Decomposition Results Pure Growth Effect (Summary of Table 5.11)

[Percentage contribution of each sector to change in growth of public Investment]

Period Year/Sector	Primary	Secondary	Transport Communi-cation and Trade	Finance Community Personal Services	Change in the rate of Growth of Public
1. 1961-62- 1962-63	-17.89	+9.23	-24.95	-64.78	-10.36
2. 1963-64- 1964-65	-61.75	+167.29	1.248	-197.70	- 3.28
3. 1964-65- 1965-66	+ 4.88	+53.35	-26.51	-130.85	-16.34
4. 1966-67- 1967-68	+12.19	+14.59	24.23	-126.59	-11.40
5. 1969-70- 1970-71	+ 3.24	+12.07	-124.07	+18.34	-10.21
6. 1972-73- 1973-74	-10.90	-13.45	-25.59	-52.32	-25.29
7. 1974-75- 1975-76	+ 3.268	- 1.095	-100.58	+ 2.61	-15.05
8. 1975-76- 1976-77	-18.08	-14.82	-64.27	-11.87	-25.94
9. 1978-79- 1979-80	491.03	-1202.30	694.70	-299.32	- 0.27

of growth of public investment was -3.287%. 197.70% of this decline was due to a fall in the rate of growth of investment in finance, community and personal services sector, which declined by -6.498%. As against this the investment in the secondary sector increased at +5.49% thereby contributing +167.26% to the change in the rate of growth of public investment.

Similarly during 3rd, 4th and 5th period the contribution of the secondary sector to the negative change in the rate of growth of public investment have

been of an offsetting nature. The source of the decline in the 3rd period and 4th period has been the finance, community and personal services, whereas in the 5th period the main source of the decline has been the transport, communication and trade sector.

In period 3, 26.51% of the total decline in public investment has been due to a fall in the transport, communication and trade sector while its contribution in the 5th period was -124.07%. Decomposing the transport, communication and trade sector further, we find that most of this decline originates in the trade, hotel and restaurat component (See Table below). Thus in the third period

Investment in sector Transport, Communication and Trade: Contribution of Industrial Categories

Period: Year/Sector	Railways	Communication	Transport by other means	Trade, Hotels, Restaurant
1. 1961-62 - 1962-63	-41.40	-1.75	-15.70	+0.92 (negligible)
2. 1964-65 - 1965-66	-20.72	+11.01	+ 4.866	-19.66 (74.16%)
3. 1969-70 - 1970-71	-16.24	+14.81	-35.23	-70.73 (57.00%)
4. 1972-73 - 1973-74	-28.89	+ 3.90	10.42	-42.68 (166.78%)
5. 1974-75 - 1975-76	- 8.49	- 0.99	+ 8.03	-97.38 (96.81%)
6. 1975-76 - 1976-77	7.12	- 1.07	- 4.39	-66.40 (103.31%)

75% of the contribution of transport communication and trade is due to a fall in investment in the trade, hotel and restaurant component whereas in the fifth

period its contribution to the decline in investment was 57%. Apart from trade, hotels and restaurant, railways have contributed to the decline.

The decomposition schema thus clearly shows that the decline in public investment till 1975-76 was concentrated within the finance community and personal services sector, and in one year it was because of the transport, communication and trade sector. Within the transport, communication and trade sector, a major part of the decline was due to the trade, hotel and restaurants. Thus it can be argued that the source of decline in investment in the pre 1975 (or 1965-75) period was essentially the tertiary sector i.e. trade, hotels and restaurants, Public Administration, Banking and Insurance, and other services.

Unlike, prior to 1975, after 1975 whenever there has been a cut back in public investment, secondary sector investment has also declined. During this relatively faster growing period of post 1975 the contribution of secondary sector to the decline in public investment has been -15% in period 8, -1292.30% in period 9 and -8% in period 10. The secondary sector's decline has been accompanied by a decline in the finance, community and personal services sector also.

What emerges from the above analysis therefore is that whenever there has been a decline in total public investment it has been concentrated in the tertiary sector. However in the post 1975 phase the decline has been shared along with the transport, communication and trade sub sector, by the secondary sector.

In order to analyse the changes in the contribution to growth of public investment over this period 1960-61 to 1981-82 we divided this period as: 1960-61 to 1965-66 and 1976-77 to 1981-82. For each of these two periods we arrived at the contribution of Primary, Secondary, transport, communication and trade and Finance, Community and personal services, sectors.

The results in the table below indic te that, whereas in the period 1960-61

Contribution to Growth[15/]

(in percentage)

Period:	Primary Sector	Secondary Sector	Transport, Communication and Trade Sector	Finance, Community and Personal Services Sector
1960-61 - 1965-66	12.93	47.38	29.66	10.06
1976-77 - 1981-82	13.12	57.30	-0.05	35.05

to 1965-66, the Finance, community and personal services sector contributed 10% to the growth of investment in the later period its contribution has increased to 35% primarily at the expense of transport, communication and trade sector whose share has dwindled down from 29% to 0.5%. This substantiates our argument made earlier that there has been a gradual shift in the composition of public investment, particularly after 1975-76 towards the finance, community and personal services. Also, the, phenomenal decline in the contribution of transport, communication and trade sector is to a large extent because of a decline in investment in the trade, hotel and restaurant apart from railways.

Relationship Between Public Investment and Private Investment by Industry of Use:

In chapter 1 and 2, we observed that one of the crucial elements in the explanations associating public investment with industrial deceleration was the

15. The same decomposition framework asoutlined above has been used for calculating these contributions

assumption of a strong complimentarity between public investment and private investment. We also indicated there, at a preliminary level, that though there was a positive relationship between private investment and public investment in the period prior to third plan, this relationship was not only considerably weakened but was negative in the post third plan period.

The need for a disaggregated study of the relationship between public sector investment and private sector investment arises because the behaviour of the relationship depends primarily on the composition of public investment. The response and the time shape of the response of private investment to public investment will be governed by the allocation of investment, in public sector, between sub sectors, and also the type of assets that go into public investment. For example, an increased priority to subsectors like power and irrigation in public investment, would tend to strengthen the positive relationship between public and private investment, whereas an increased investment in manufacturing may tend to weaken the relationship. Similarly a higher proportion of construction component in public investment as against the machinery and equipment component will tend to make the relationship between public and private investment negative in a situation like that of India where there is a controlled supply of intermediary goods like cement and steel. Thus not only will we be able to better understand the inter-sectoral relationships but we may also be able to explain the behaviour of these relationships.

A sub-sector wise study is also warranted because, while complimentarity may prevail in certain sectors and crowding out effect may dominate in others; this perspective gets lost at the aggregate level. In fact this may be instrumental in explaining the observed changed relationship, at the aggregate level, over time. Moreover at the aggregate level we lose sight of the fact that a

fall in public investment even if compensated by a rise in private investment might shift the industrial composition of total investment in the economy, that may not be desirable or contrary to the overall plan. Such a shift can be captured only at the disaggregated level.

The empirical results of regressing private GDCF on public sector GDCF by industry of use, given overleaf, show that only in two sub sectors there is a positive and significant relationship between private investment and public investment. These subsectors are agriculture, and electricity, gas and water. The unlagged regression coefficient of public investment in agriculture for the period 1960-61 to 1981-82 is 1.437 significant at 1% level. The partial correlation coefficient is 0.631, which means public investment explains 40% of the variation in private investment when both variables are taken net of time. The same pattern of relationship holds with a one year time lag but breaks off with a two year time lag.

Within subperiods also the positive relationship is significant, with zero and 1 year time lag. However it needs to be mentioned here that since we have just 5 years data by industry of use prior to 1965-66 which get reduced once time lags are introduced, the regression estimates for pre 1965-66 in this chapter are not meaningful and have been hence avoided.

The strong, positive relationship between public sector and private sector in agriculture is understandable. Private investment in agriculture, by and large, draws physical inputs for investment indigenously from within the sector and taxation of agriculture sector is minimal. Because of public resource transfer to agriculture, by direct investment in agriculture and public financial support to private investment in agriculture, total investment in agriculture is somewhat higher than private savings in the sector.[16/] Complementarity between public and

16. Krishna & Raychaudri: (1982) Trends in Rural Saving and Private Capital Formation in India; in Economic Development and Cultural Change, (Jan)

Regression Results

Private GDCF Regressed on Public GDCF by Industry of Use

Industry/ Lag	Regression coefficient	Value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\bar{R}^2$
Agriculture						
Period I*						
Lag 0**	1.437	3.58	0.943	0.631	0.901	0.896
Lag 1	1.08	2.34	0.916	0.484	0.868	0.861
Lag 2	0.312	0.566	0.839	0.132	0.80	0.79
Period II						
Lag 0	5.10	3.53	0.905	0.926	0.94	0.92
	-1.63	0.413	.829	-0.226	0.785	0.7319
Period III						
Lag 0	1.73	3.40	0.923	0.673	0.852	0.842
Lag 1	1.22	1.92	0.886	0.468	0.797	0.783
Lag 2	0.088	0.117	0.771	0.032	0.708	0.685
Forestry						
Period I						
Lag 0	-0.052	0.591	0.624	-0.133	0.656	0.638
Lag 1	0.015	0.170	0.650	0.040	0.629	0.610
Lag 2	-0.08	0.75	0.526	-0.179	0.614	0.592
Period II						
Lag 0	-0.083	0.250	0.142	-0.175	0.111	0.185
Lag 1	0.313	0.1085	0.469	0.062	0.25	0.06
Period III						
Lag 0	-0.06	0.627	0.482	-0.1658	0.548	0.518
Lag 1	-0.001	0.016	0.524	-0.004	0.546	0.514
Lag 2	-0.075	0.6093	0.358	-0.174	0.524	0.487

* Period I refers to 1960-61 to 1981-82
Period II refers to 1960-61 to 1965-66
Period III refers to 1965-66 to 1981-82

** Lag 0 means there is no time lag.

Industry/Lag	Coefficient	T-value	Coefficient of Correlation	Partial Correlation coefficient	R^2	$\bar{R}^2$
Mining and Quarry						
Period I						
Lag 0	0.009	0.1346	0.163	0.030	0.0296	0.018
Lag 1	-0.03	0.4351	0.101	-0.102	0.399	0.010
Lag 2	-0.111	1.218	-0.006	-0.283	0.105	0.055
Period II						
Lag 0	-0.66	0.55	0.4	-0.364	0.351	0.135
Lag 1	0.400	0.82	0.15	0.431	0.236	0.452
Lag 2						
Period III						
Lag 0	-0.02	0.2601	0.166	-0.0709	0.485	0.148
Lag 1	-0.070	0.5627	0.04	-0.155	0.0377	0.0310
Lag 2	-0.136	1.49	-0.10	-0.290	0.084	0.014
Primary						
Period I						
Lag 0	0.5041	2.11	0.917	0.4359	0.879	0.873
Lag 1	0.539	2.21	0.914	0.463	0.878	0.872
Lag 2	0.330	1.15	0.867	0.269	0.838	0.829
Period II						
Lag 0	3.50	1.41	0.807	0.706	0.752	0.670
Lag 1	2.98	1.64	0.92	0.688	0.8601	0.8252
Lag 2						
Period III						
Lag 0	0.739	2.07	0.90	0.487	0.814	0.802
Lag 1	0.6438	1.78	0.896	0.442	0.816	0.803
Lag 2	0.260	0.618	0.826	0.1740	0.747	0.7281

Lag 1 means 1 year time lag has been introduced
Lag 2 means 2 year time lag has been introduced

Industry/Lag	Regression Coefficient	T value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\bar{R}^2$
Manufacturing						
Period I						
Lag 0	0.517	0.955	0.806	0.212	0.711	0.696
Lag 1	0.305	0.530	0.767	0.124	0.685	0.669
Lag 2	0.117	0.188	0.723	0.046	0.660	0.641
Period II						
Lag 0	0.295	0.339	0.472	0.233	0.361	0.148
Lag 1	1.475	2.105	.9 5	0.773	0.872	0.840
Period III						
Lag 0	0.461	0.688	0.715	0.182	0.578	0.550
Lag 1	0.2353	0.3307	0.651	0.0904	0.5360	0.5028
Lag 2	-0.0891	0.1235	0.608	-0.0351	0.587	0.555
Construction						
Period I						
Lag 0	0.450	0.881	0.136	0.198	0.393	0.353
Lag 1	-0.06	0.104	0.061	-0.242	0.012	-0.03
Lag 2	1.04	1.72	0.254	0.385	0.150	0.103
Period II						
Lag 0	10.86	0.545	0.446	0.3589	0.229	0.027
Lag 1	13.98	1.14	.677	0.551	.511	.389
Period III						
Lag 0	0.281	0.610	0.263	0.162	0.069	0.049
Lag 1	-0.4108	0.9430	0.136	-0.254	0.2458	0.192
Lag 2	0.720	1.511	0.587	0.3995	0.3930	0.3463

Industry/Lag	Coefficient	T value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\bar{R}^2$
Electricity; Gas; Water						
Period I						
Lag 0	0.145	2.57	0.334	0.5122	0.283	0.247
Lag 1	0.188	3.08	0.346	0.586	0.363	0.329
Lag 2	0.1647	2.20	0.296	0.4718	0.2384	0.1961
Period II						
Lag 0	0.3608	0.4467	0.079	0.298	0.09	0.21
Lag 1	0.3841	.7057	-0.328	0.3757	.302	.127
Lag 2						
Period III						
Lag 0	0.120	1.93	0.581	0.460	0.388	0.347
Lag 1	0.1727	2.83	0.661	0.6168	0.5397	0.506
Lag 2	0.1911	2.92	0.684	0.6443	0.568	0.535
Secondary						
Period I						
Lag 0	0.524	1.64	0.852	0.351	0.734	0.721
Lag 1	0.481	1.33	0.836	0.303	0.714	0.699
Lag 2	0.5328	1.28	0.820	0.2957	0.688	0.670
Period II						
Lag 0	0.543	0.335	0.703	0.2298	0.494	0.3262
Lag 1	1.354	1.430	.938	0.638	.883	.853
Period III						
Lag 0	0.515	1.22	0.787	0.311	0.627	0.602
Lag 1	0.436	0.93	0.759	0.2477	0.596	0.567
Lag 2	0.300	0.6052	0.766	0.1714	0.6426	0.6151

Industry/Lag	Coefficient	T value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\bar{R}^2$
Transport, Storage, Comm						
Period I						
Lag 0	0.228	2.002	0.718	0.416	0.722	0.708
Lag 1	0.261	2.20	0.699	0.461	0.710	0.695
Lag 2	0.135	0.943	0.522	0.223	0.635	0.615
Period II						
Lag 0	-0.129	0.3481	0.380	-0.240	0.2453	0.224
Lag 1	-0.0881	0.2480	.495	-0.1419	.4620	.3276
Lag 2						
Period III						
Lag 0	0.536	3.25	0.84	0.6580	0.721	0.702
Lag 1	0.285	1.62	0.782	0.409	0.720	0.700
Lag 2	-0.208	1.067	0.494	-0.2943	0.7325	0.7119
Communication						
Period I						
Lag 0	-1.364	1.639	0.755	-0.351	0.783	0.772
Lag 1	-0.161	0.144	0.798	-0.036	0.725	0.710
Lag 2	-0.031	0.027	0.791	-0.0045	0.7162	0.700
Period II						
Lag 0	-5.33	19.48	-0.422	-0.99	0.994	0.993
Lag 1	-0.203	0.06	0.476	0.041	0.3460	.1825
Lag 2						
Period III						
Lag 0	-1.06	0.902	0.657	-0.236	0.591	0.564
Lag 1	-0.74	0.5091	0.715	-0.137	0.627	0.600
Lag 2	-1.54	1.052	0.662	-0.290	0.634	0.60

Industry/Lag	Coefficient	T Value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\bar{R}^2$
Transport by other means:						
Period I						
Lag 0	-1.13	11.91	-0.857	-0.941	0.922	0.918
Lag 1	-0.486	2.868	-0.605	-0.307	0.369	0.336
Lag 2	-0.90	2.70	-0.666	-0.550	0.5078	0.4805
Period II						
Lag 0	-1.39	4.63	-0.208	-0.956	0.959	0.945
Lag 1	-0.148	0.981	-0.204	-0.085	0.55	0.18
Lag 2						
Period III						
Lag 0	-1.08	11.43	-0.76	-0.9511	0.910	0.9047
Lag 1	-0.465	1.2162	-0.291	-0.319	0.126	0.0645
Lag 2	-1.09	3.72	-3.90	-0.729	0.538	0.5025
Trade, Hotels, Restaurant						
Period I						
Lag 0	-0.370	2.000	0.008	-0.416	0.694	0.679
Lag 1	-0.258	1.387	0.071	-0.311	0.7097	0.694
Lag 2	0.3669	1.84	0.557	0.4081	0.709	0.692
Period II						
Lag 0	-18.15	0.29	-0.12	-0.2013	0.425	0.276
Lag 1	3.11	1.02	0.506	0.536	.3139	.1424
Lag 2						
Period III						
Lag 0	-0.338	1.80	-0.14	-0.434	0.717	0.699
Lag 1	-0.250	1.31	-0.137	-0.343	0.632	0.606
Lag 2	0.366	1.796	0.490	0.460	0.666	0.640

Industry/Lag	Coefficient	T Value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\bar{R}^2$
Transport, Comm, Trade						
Period I						
Lag 0	-0.340	1.560	0.361	-0.338	0.737	0.723
Lag 1	-0.347	1.640	0.317	-0.360	0.766	0.754
Lag 2	0.269	1.160	0.611	0.2741	0.7308	0.7158
Period II						
Lag 0	0.3460	0.1735	0.073	0.1230	0.167	0.110
Lag 1	-0.017	0.015	0.502	-0.008	.2936	.1170
Period III						
Lag 0	-0.384	1.69	0.241	-0.410	0.741	0.724
Lag 1	-0.37	1.54	0.157	-0.392	0.696	0.674
Banking and Insurance						
Period I						
Lag 0	-0.085	0.348	0.592	-0.080	0.457	0.430
Lag 1	0.430	1.510	0.698	0.339	0.488	0.461
Lag 2	0.7021	2.22	0.719	0.4754	0.5246	0.498
Period II						
Lag 0	-0.915	2.04	-0.82	-0.822	0.690	0.587
Lag 1	0.1103	0.227	0.231	0.1272	.363	.204
Period III						
Lag 0	-0.119	0.381	0.494	-0.100	0.354	0.311
Lag 1	0.450	1.23	0.641	0.323	0.411	0.369
Lag 2	0.782	1.94	0.690	0.4879	0.482	0.442
Other Services						
Period I						
Lag 0	0.2589	0.8523	-0.816	0.199	0.780	0.769
Lag 1	0.608	2.150	-0.780	0.4534	0.863	0.856
Lag 2	0.642	1.96	-0.772	0.4276	0.8124	0.802
Period II						
Lag 0	12.15	1.373	0.396	0.682	0.535	0.380
Lag 1	-7.112	1.65	-0.467	-0.693	.548	.436
Lag 2						
Period III						
Lag 0	0.874	1.85	-0.731	0.448	0.721	0.703
Lag 1	0.957	2.16	-0.662	0.524	0.695	0.673
Lag 2	0.547	1.00	-0.636	0.284	0.540	0.505

Industry/Lag	Coefficient	T Value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\bar{R}^2$
Finance and Personal Services						
Period I						
Lag 0	-0.022	0.5726	-0.735	-0.130	0.848	0.840
Lag 1	-0.012	0.3131	-0.689	-0.071	0.86	0.85
Lag 2	0.03	0.765	-0.565	0.1835	0.859	0.8520
Period II						
Lag 0	-0.09	0.785	-0.281	-0.4855	0.307	0.076
Lag 1	-0.053	0.5443	-0.528	-0.300	0.4215	.2796
Lag 2						
Period III						
Lag 0	-0.01	0.274	-0.71	-0.071	0.777	0.762
Lag 1	-0.02	0.574	-0.683	-0.155	0.739	0.720
Lag 2	0.0177	0.343	-0.505	0.099	0.681	0.656
Public Sector (Aggregate)						
Period I						
Lag 0	-0.0047	0.0162	0.852	-0.0047	0.830	0.821
Lag 1	-0.0003	0.001	0.844	-0.0028	0.823	0.814
Lag 2	0.569	1.80	0.894	0.4011	0.832	0.823
Period II						
Lag 0	1.65	3.69	0.754	0.9341	0.915	0.887
Lag 1	-0.434	0.2945	.909	0.182	.884	.856
Lag 2						
Period III						
Lag 0	-0.01	0.035	0.787	-0.089	0.704	0.684
Lag 1	-0.014	0.326	0.764	-0.011	0.67	0.64
Lag 2	0.550	1.27	0.83	0.342	0.7286	0.707

private investment, must, therefore prevail in agriculture.

The second sub sector where complimentarity prevails is electricity, gas and water. A significant positive relationship, with a partial correlation coefficient of 0.5122, dominates the relationship in this subsector and continues to do with 1 and 2 year time lags. Public Investment in electricity, gas and water explain about 26% of the variation in private investment, when both the variables are netted of their time trend. The channels of influence of electricity, water and gas investment on private sector investment operate from both the demand side as well as the supply side. The forward linkages on the supply side provide the critical input, electricity while it augments the demand for machinery and equipment through the operation of backward linkages.

As against this, the negative influence of public investment dominates in the transport by other means subsector. The negative relationship between public and private investment in this sector (which includes road, water and air transport) is very strong and significant at 1% level. That public investment crowds out private investment in this sector is evident from the regression coefficient of -1.13 and the corresponding partial correlation coefficient of -0.94. Therefore, public investment explains about 90% of the variation in private investment, net of time. The same relationship holds with 1 and 2 year lags.

In all other sub-sectors there is no statistically significant relationship between public investment and private investment either in the period 1960-61 to 1981-82 or in the period 1965-66 to 1981-82.

It might be however, interesting to note that in subsectors: manufacturing, construction, communication, transport communication and trade the relationship changes from positive to negative in the second period (1965-66 to 1981-82) whereas

prior to 1965-66 it is positive. In both cases however these are not statistically significant and no firm conclusions can be drawn. In the case of public sector as a whole, there is a significantly positive relationship prior to 1965-66 with a partial correlation coefficient of 0.931. In the post 1965 period however this relationship is negative though statistically insignificant.

It is possible that the statistical significance of these coefficients is getting distorted by a common time trend in both variables i.e. the problem of multicollinearity is distorting the actual picture. There is evidence to this effect as the time trend is very significant in these regression.

In order to take account or themulticollinearity we regressed increments to private capital formation by industry of use on public sector capital formation. By doing this the time element is automatically eliminated.

These regression (by increments) substantiate the positive relationship argument between public sector and private sector investment in agriculture. But more importantly they show that in the period 1960-61 to 1980-81 there is a significantly negative relationship between public and private sector investment in communication and transport by other means, with no time lag, and between transport, communication andtrade subsectors with a one year lag.

This result of a negative relationship between public investment and private investment in transport communication and trade subsector, as shown by the statistically significant regression coefficient of -0.4386 and corresponding partial correlation coefficient of 0.449, is particularly important in light of the evidence provided in section II, which showed that most of the decline in total public investment occured in this sector. This negative relationship possibly reflects a competition between railway and truck transport.

The results of the regression carried out with increments of private sector GDCF on public sector GDCF are given below:

Subsector	(Lag)	Regression Coefficient	T-value	Correlation Coefficient	R^2
Construction	1	-1.0113	2.012	-0.428	.1836
Transport bt other means	1	-0.4386	2.1325	-0.449	.2016
	0	-1.008	9.76	- .913	.8393
Trade/Hotels	1	-0.4043	2.20	-0.462	.2133
Trans/Communi-cation/Trade	0	-0.4386	2.1325	-0.449	.2016

The above results do give us some indication that there does not exist a complementarity between public and private sector but on the contrary it seems there is a negative relationship in certain sectors and in general no relationship particularly after 1965-66. We shall however defer a conclusion on this issue till Chapter 6 where some more evidence regarding the relationship of public investment and private investment will be presented.

To recapitulate, from the disaggregated analysis of public investment by industry of use what emerges is that:

a. though most of the industrial categories did face an investment cutback during the plan holiday (with the notable exception of agriculture and transport, communication and trade) there does not seem to be a deceleration in the rate of growth of public investment at the sectoral level, especially on the basis of plan-wise periodisation.

b. whenever there was a decline in the rate of growth of public investment, it was not uniformly distributed across industrial categories and sectors but was disproportionally borne by the 'tertiary sector'.

c. consequent upon differential rates of growth and (b) above, there has been a shift in the composition of public investment, away from transport, communication and trade, and towards finance, community and personal services after 1975-76.

d. in almost all the industrial categories, instability in public investment has increased over time.

e. though there seems to have been a significantly positive relationship between public and private investment in the period prior to the plan holiday, this relationship in general does not hold in the post 1965-66 period. With the exception of agriculture and electricity gas and water the relationship between public and private sector investment in the period after 1965-66 is either signficantly negative (e.g. in transport, communication and trade) or has changed from positive to negative (e.g. manufacturing, construction) which is not significant. It was also observed that the positive/negative relationship is, in general, of an unlagged nature suggesting therefore that the relationship is supply side based rather than demand based.

STATISTICAL ANNEXURE

TO

CHAPTER 5

Note: The source for all data, unless otherwise specified, is:
National Accounts Statistics, C.S.O. (Various issues)

Table 5.0: Gross Domestic Capital Formation in Public Sector by Industry of Use

At 1970-71 prices

Industry	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
Agriculture	211	210	240	246	278	301	270	270	310	311	329
Forestry	12	11	14	13	16	19	16	20	17	17	19
Mining and Quarry	47	48	73	98	103	67	112	88	66	86	84
Sub Total: Primary	270	269	327	357	397	387	398	378	393	414	432
Manufacturing	420	314	363	406	484	645	689	590	509	463	436
Construction	11	13	18	22	20	23	21	30	32	32	3
Electricity,Gas, Water Supply	185	308	355	445	444	50	456	444	469	535	640
Sub Total:Secondary	616	635	736	873	948	1174	1166	1064	1010	1030	1079
Transport, Storage Comm.	372	463	584	676	679	601	522	460	445	385	511
Railways	280	345	468	531	524	452	312	283	240	189	251
Communication	28	28	44	64	70	50	70	64	62	66	56
Transport by other means	64	90	72	81	85	99	140	113	143	130	204
Trade, Hotel, Restaurant	6	10	11	14	13	94	60	111	185	39	199
Total: Transport, Communication,Trade	378	473	595	690	692	695	582	571	630	424	710
Banking and Insurance	10	6	6	4	10	13	15	11	13	10	17
Public Administration and Defence	530	388	487	464	583	535	373	566	303	444	471
Other Services	22	26	30	33	35	42	40	45	48	51	64
Sub Total:Finance,	562	420	523	501	628	590	428	622	364	505	552
Total Public Sector	,1862	2,181	2,421	2,665	2,846	2,574	2,574	2,635	2,397	2,373	2,773

Table 5.0 continued

Industry	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Agriculture	349	419	416	358	408	561	644	683	690	682	612
Forestry	20	17	16	14	16	24	28	30	29	35	32
Mining and Quarry	90	129	165	168	293	390	371	336	356	454	561
Sub Total: Primary	459	565	597	540	717	975	1043	1049	1075	1171	1205
Manufacturing	522	593	807	889	822	1035	932	1016	1238	1259	1274
Construction	14	4	33	62	36	28	55	66	49	93	100
Electricity, Gas, Water	625	621	596	617	902	906	1025	1071	1166	1254	1378
Sub Total:Secondary	1161	1218	1436	1568	1760	1969	2012	2153	2453	2606	2752
Transportation, Storage, Communication	545	690	597	611	619	619	629	705	713	834	838
Railways	281	305	270	237	243	203	238	273	327	415	438
Communication	78	115	94	102	120	135	138	145	137	146	196
Transport by other means	186	270	233	272	256	281	253	287	249	273	204
Trade Hotel Restaurant	140	-157	161	180	689	663	-97	249	79	-97	239
Sub Total:Trade, Communication & Trade	685	533	758	791	1308	1282	532	954	792	737	1077
Banking & Insurance	27	23	19	23	21	29	29	38	31	44	51
Public Administration & Defence	551	693	816	494	523	519	425	651	778	851	836
Other Services	74	103	112	101	104	146	143	167	180	200	202
Sub Total:Finance & CPS	652	819	947	618	648	694	597	856	989	1095	1089
Total:Public Sector	2957	3135	3738	3517	4433	4920	4184	5012	5309	5609	6123

Table 5.1: Compound Growth Rates of Gross Domestic Capital Formation in Public Sector by Industry of Use

(At constant prices)

Industry of Use	Third Plan	Plan Holiday	Fourth Plan	Fifth Plan	Sixth Plan
Agriculture	8.66	6.90	8.23	17.48	-5.99
Forestry	12.26	3.03	-2.32	20.83	4.92
Mining and Quarry	10.11	-26.44	17.23	16.23	22.73
Primary	9.21	-0.63	10.00	17.02	5.70
Manufacture	17.27	-15.13	14.18	3.92	1.43
Construction	12.46	21.06	3.49	5.48	35.66
Electricity, Gas Water	12.16	1.40	1.85	12.30	8.35
Secondary	14.82	-7.18	7.85	7.67	5.75
Transport; Storage	6.72	-7.97	11.77	3.02	8.07
Railways	6.53	-13.11	9.08	2.62	14.61
Communication	16.23	-6.06	14.26	8.43	17.90
Transport	3.56	1.06	14.47	0.95	-9.96
Trade	46.48	56.30	-	-	-
Transport Communication and trade	9.20	3.96	8.75	-5.24	15.36
Banking and Insurance	20.57	-7.15	15.85	13.26	24.89
Public Administration and Defence	8.22	-10.39	16.03	3.44	3.59
Other Services	11.13	9.11	20.49	13.24	5.76
Finance and personal services	8.62	-8.09	16.52	5.69	4.81
Total	11.20	-3.56	10.31	6.50	7.13

Table 5.2: Compound Growth Rates of Gross Domestic Capital Formation in Public Sector

(At constant prices)

Industry of Use	At Current prices	At 1970-71 prices			
	1960-61 to 1970-71	1970-71 to 1980-81	1960-61 to 1970-71	1970-71 to 1981-82	1960-61 to 1981-82
Agriculture	9.31	17.00	4.28	7.29	5.86
Forestry	10.24	16.77	4.98	8.27	4.21
Mining and Quarry	8.73	26.30	4.36	16.46	11.01
Primary	9.21	19.73	4.31	10.18	7.29
Manufacturing	7.85	17.92	3.50	8.32	5.96
Construction	3.31	36.32	-0.45	21.94	7.78
Electricity Gas	13.32	17.26	8.42	9.06	7.27
Secondary	10.24	17.77	5.71	8.82	6.55
Transport Storage	3.82	11.93	-0.90	3.37	2.14
Railways	-1.57	10.87	-6.122	3.89	-1.33
Communication	11.94	17.19	7.20	6.85	7.66
Transport	13.73	10.70	9.53	0.66	7.12
Trade	38.19	-			
Transport Comm. Trade	6.84	11.00	2.12	2.87	2.70
Banking and Insurance	12.16	15.71	8.58	7.75	9.54
Public Administration and Defence	3.86	13.28	-1.38	2.82	2.35
Other Services	14.02	19.57	9.27	9.47	10.88
Finances Comm	4.84	14.34	6.35	4.02	3.50
Total	8.12	16.17	3.29	6.96	5.27

Table 5.3: Growth Rates of Net Capital Formation in Public Sector

(At Constant Prices)

Industry of Use	Pre 1965	Post 1965	1960-61 to 1970-71	1970-71 to 1981-82	1960-61 to 1981-82
Agriculture	7.76	6.82	4.10	7.29	5.91
Forestry	9.56	4.70	4.98	8.27	4.21
Mining and Quarry	10.17	15.16	-.61	24.91	9.27
Primary	8.45	8.63	3.42	10.29	6.67
Manufacturing	9.52	7.53	1.21	9.40	5.93
Construction	11.07	6.35	-6.49	26.01	3.22
Electricity, Gas Water	18.72	8.05	7.34	10.85	6.92
Secondary	12.88	7.61	4.10	10.21	6.24
Transport	12.60	3.86	-2.15	2.67	1/64
Railways	13.43	2.89	-8.33	3.24	-1.45
Communication	16.38	6.89	6.00	7.66	6.89
Transport	5.85	3.15	9.61	-1.93	-6.13
Trade	42.88	-			
Transport Communication and Trade	14.85	3.52	1.87	2.47	2.69
Banking and Insurance	2.01	9.69	8.23	10.17	10.14
Public Administration and Defence	3.48	4.39	-1.38	2.04	2.60
Other Services	11.17	9.82	11.19	6.03	10.85
Finance	3.95	5.33	-0.16	2.88	3.68
Total	10.09	6.64	2.45	7.15	5.13

Table 5.4: Allocation of Public Investment within: Primary Sector (In percentage)

At Constant Prices

Year	Agriculture as a percentage of primary	Forestry as a percentage of Primary	Mining & Quarying as a % of Primary
1960-61	79.23	4.61	16.16
1961-62	80.23	4.26	15.51
1962-63	75.48	4.46	20.06
1963-64	70.84	3.79	25.37
1964-65	72.63	4.21	23.15
1965-66	77.78	4.90	17.31
1966-67	67.84	4.02	28.14
1967-68	71.42	5.29	23.28
1968-69	78.89	4.32	16.79
1969-70	75.12	4.10	20.77
1970-71	76.16	4.39	19.45
1971-72	76.03	4.35	19.60
1972-73	74.16	3.00	22.84
1973-74	69.68	2.68	27.64
1974-75	66.29	2.59	31.12
1975-76	56.90	2.23	40.86
1976-77	57.53	2.46	40.07
1977-78	61.74	2.68	35.57
1978-79	65.11	2.86	32.03
1979-80	64.19	2.70	33.11
1980-81	58.24	2.99	38.77
1981-82	50.79	2.65	46.56

Table 5.5: Allocation of Public Investment within: Finance, Community and Personal Services Sector (in percentage)

At constant Prices

Year	Banking and Insurance as of percentage of finance community and personal services	Public Administration and Defence as a % of finance community and personal services	Other services as of percentage of finance community and personal services
1960-61	1.24	94.31	4.45
1961-62	1.19	92.38	6.43
1962-63	0.58	94.01	5.41
1963-64	0.20	92.98	6.82
1964-65	0.96	93.43	5.61
1965-66	2.20	90.68	7.12
1966-67	3.50	87.15	9.35
1967-68	1.77	90.99	7.24
1968-69	3.57	83.24	13.18
1969-70	1.98	87.92	10.10
1970-71	3.08	85.33	11.59
1971-72	4.14	84.51	11.34
1972-73	2.81	84.61	12.57
1973-74	2.01	86.16	11.82
1974-75	3.72	79.93	16.34
1975-76	3.24	80.71	16.05
1976-77	4.18	74.78	21.04
1977-78	4.85	71.18	23.95
1978-79	4.44	76.05	19.51
1979-80	3.13	78.66	18.20
1980-81	4.02	77.72	18.26
1981-82	4.68	76.77	18.55

Table 5.6: Allocation of Public Investment within: Transport, Communication and trade sector (in percentage)

At constant prices

Year	Railway as a percentage of transpot, communication and trade sector	Communication as a percentage of transpot, communication and trade sector	Transpor	Trade hotel and restaurant as a percentage of transport, communication and trade sector
1960-61	72.18	9.40	16.16	2.25
1961-62	72.00	6.91	18.51	2.48
1962-63	78.97	8.80	10.30	1.93
1963-64	77.36	10.87	9.27	2.50
1964-65	76.93	10.81	10.09	2.17
1965-66	65.03	7.19	14.24	13.52
1966-67	53.61	12.02	24.05	10.30
1967-68	49.56	11.20	19.78	19.43
1968-69	38.09	9.84	22.69	29.36
1969-70	44.57	15.56	30.66	9.20
1970-71	35.35	7.88	28.73	28.02
1971-72	41.02	11.38	27.15	20.43
1972-73	57.22	21.57	50.66	-29.45
1973-74	35.62	12.40	30.73	21.24
1974-75	29.96	12.89	34.38	22.75
1975-76	18.57	9.17	19.57	52.67
1976-77	15.83	10.53	21.91	51.71
1977-78	44.73	25.94	47.55	-18.23
1978-79	28.61	15.19	30.08	26.10
1979-80	41.28	17.29	31.43	9.97
1980-81	56.30	19.81	37.04	-13.16
1981-82	40.66	18.19	18.94	22.19

Table 5.7: Allocation of Public Investment within Secondary Sector (In Percentage)

At Constant Prices

Year	Manufacturing in Secondary Sector	Construction in Secondary Sector	Electricity & Gas Water in secondary Sector
1960-61	67.20	3.76	29.04
1961-62	45.08	4.29	50.63
1962-63	45.23	4.61	50.15
1963-64	42.37	4.65	52.97
1964-65	47.33	3.88	48.79
1965-66	54.94	1.96	43.10
1966-67	59.09	1.80	39.11
1967-68	55.45	2.82	41.73
1968-69	50.39	3.17	46.43
1969-70	44.95	3.11	51.94
1970-71	40.41	0.28	59.31
1971-72	44.96	1.21	53.83
1972-73	48.68	0.33	50.98
1973-74	56.10	2.30	41.50
1974-75	56.69	3.95	39.36
1975-76	46.70	2.04	51.26
1976-77	52.56	1.42	46.01
1977-78	46.32	2.73	50.94
1978-79	47.18	3.07	49.74
1979-80	50.46	2.00	47.53
1980-81	48.31	3.57	48.12
1981-82	46.29	3.63	50.07

Table 5.8: Sectoral Allocation of Gross Domestic Capital Formation in Public Sector

At constant Prices

Industry/ Year	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
Agriculture	11.6	11.7	11.0	10.2	10.4	10.6	10.5	10.2	12.9	13.1	11.9
Forestry	0.7	0.6	0.6	0.5	0.6	0.7	0.6	0.8	0.7	0.7	0.7
Mining/Quarry	2.6	2.7	3.3	4.0	3.9	2.4	4.4	3.3	2.8	3.6	3.0
Primary	14.8	15.0	15.0	14.7	14.9	13.6	15.5	14.3	16.4	17.4	15.6
Manufacture	23.0	17.5	16.6	16.8	18.2	22.7	26.8	22.4	21.2	19.5	15.7
Construction	0.6	0.7	0.8	0.9	0.8	0.8	0.8	1.1	1.3	1.3	0.1
Electricity/Gas	10.1	17.1	16.3	18.4	16.7	17.8	17.7	16.9	19.6	22.5	23.1
Secondary	33.7	35.3	33.7	36.1	35.6	41.3	45.3	40.4	42.1	43.4	38.9
Transport Storage	20.4	25.8	26.8	27.9	25.5	21.1	20.3	17.5	18.6	16.2	18.4
Railways	15.3	19.2	21.5	21.9	19.7	15.9	12.1	10.7	10.0	8.0	9.1
Communication	1.5	1.6	2.0	2.6	2.6	1.8	2.7	2.4	2.6	2.8	2.0
Transport	3.5	5.0	3.3	3.3	3.2	3.5	5.4	4.3	6.0	5.5	7.4
Trade	0.2	0.6	0.5	0.6	0.5	3.3	2.3	4.2	7.7	1.6	7.2
Transport Comm- Trade Transport Commun.	20.7	26.3	27.3	28.5	26.0	24.4	22.6	21.7	26.3	17.9	25.6
Banking/Insurance	0.5	0.3	0.3	0.2	0.4	0.5	0.6	0.4	0.5	0.4	0.6
Public Administration	29.0	21.6	22.3	19.2	21.9	18.8	14.5	21.5	12.6	18.7	17.0
Other Services	1.2	1.4	1.4	1.4	1.5	1.5	1.6	1.7	2.0	2.1	2.3
Finance and personal services	30.8	23.4	24.0	20.7	23.6	20.7	16.6	23.6	15.2	21.3	19.9

Table 5.8 continued

At constant Prices

Industry/Year	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Agriculture	11.8	13.4	11.1	10.2	9.2	13.1	15.6	13.6	13.0	12.2	10.0
Forestry	0.7	0.5	0.4	0.4	0.4	0.6	0.7	0.6	0.5	0.6	0.5
Mining/Quarry	3.0	4.1	4.4	4.8	6.6	8.9	8.9	6.7	6.7	8.1	9.2
Primary	15.5	18.0	16.0	15.4	16.2	22.5	25.1	20.9	20.2	20.9	19.7
Manufacturing	17.7	18.9	21.6	25.3	18.5	23.8	22.6	20.3	23.3	22.4	20.8
Construction	0.5	0.1	0.9	1.8	0.8	0.7	1.3	1.3	0.9	1.7	1.6
Electricity/Gas	21.1	19.8	15.9	17.5	20.3	20.7	23.8	21.4	22.0	22.4	22.5
Secondary	39.3	38.9	38.4	44.6	39.7	45.1	47.7	43.0	46.2	46.5	44.9
Transport Storage	18.4	22.0	16.0	17.4	14.0	14.3	14.8	14.1	13.4	14.9	13.7
Railways	9.5	9.7	7.2	6.7	5.5	4.7	5.7	5.4	6.2	7.4	7.2
Communication	2.6	3.7	2.5	2.9	2.7	3.1	3.3	2.9	2.6	2.6	3.2
Transport	6.3	8.6	6.2	7.7	5.8	6.4	5.7	5.7	4.7	4.9	3.3
Trade	4.7	-5.0	4.3	5.1	15.5	1.9	-2.0	5.0	1.5	-1.7	3.9
Transport Comm Trade	23.2	17.0	20.3	22.5	29.5	16.2	12.8	19.0	14.9	13.1	17.6
Banking/Insurance	0.9	0.7	0.5	0.7	0.5	0.7	0.7	0.8	0.6	0.8	0.8
Public Administration	18.6	22.1	21.8	14.0	11.8	12.1	10.3	13.0	14.7	15.2	13.7
Other Services	2.5	3.3	3.0	2.9	2.3	3.4	3.5	3.3	3.4	3.6	3.3
Finance and Personal Services	22.0	26.1	25.3	17.6	14.6	16.1	14.4	17.1	18.6	19.5	17.8

Table 5.9: Sectoral Allocation of Net Domestic Capital Formation in Public Sector

At Constant Prices

Industry/Year	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
Agriculture	12.5	12.9	12.2	11.2	11.6	11.6	11.6	11.3	14.7	15.2	14.1
Forestry	0 .7	0.7	0.7	0.6	0.7	0.7	0.7	0.9	0.8	0.9	0.8
Mining/Quarry	2.6	2.5	3.2	4.0	3.7	1.9	4.2	2.8	1.9	2.7	1.9
Primary	15.8	16.1	16.1	15.8	15.9	14.3	16.4	15.0	17.4	18.7	16.8
Manufacture	22.8	15.8	15.1	15.1	16.4	21.4	25.6	20.4	18.5	16.1	12.2
Construction	1.3	1.5	1.5	1.7	1.3	1.4	1.5	1.9	2.3	2.4	0.1
Electricity, Gas Water	9.8	17.7	16.7	18.8	16.9	18.1	17.6	16.6	19.1	22.6	22.9
Secondary	33.9	35.0	33.4	35.6	34.6	41.0	44.8	39.0	39.9	41.0	35.3
Transport, Storage	15.8	22.1	23.5	25.1	22.8	18.2	17.1	13.8	15.4	12.6	15.6
Railways	11.7	16.3	18.9	19.9	17.9	13.8	9.6	7.8	7.7	5.2	7.6
Communication	1.5	1.6	2.1	2.8	2.5	1.7	2.8	2.6	2.8	3.3	1.6
Transport	2.6	4.2	2.5	2.4	2.3	2.8	4.6	3.3	4.9	4.2	6.4
Trade	0.4	0.6	0.5	0.6	0.5	3.6	2.6	4.8	9.0	1.7	8.3
Transport, Comm Trade	16.2	22.6	23.9	25.8	23.3	21.8	19.7	18.5	24.4	14.4	23.9
Banking and Insurance	0.4	0.3	0.2	0.0	0.3	0.4	0.5	0.3	0.5	0.3	0.4
Public Administration	32.2	24.3	25.0	21.3	24.5	20.8	16.5	24.8	15.0	22.6	20.3
Other Services	1.5	1.7	1.4	1.6	1.5	1.8	2.1	2.4	2.9	3.0	3.4
Finances and Personal Services	34.1	26.3	26.6	22.9	26.2	22.9	19.1	27.5	18.3	25.9	24.1

Table 5.9 continued

	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Agriculture	14.1	16.3	13.1	10.8	10.3	12.8	18.2	15.7	14.9	14.0	11.6
Forestry	0.8	0.7	0.5	0.4	0.4	0.6	0.8	0.7	0.6	0.7	0.6
Mining/Quarry	0.7	2.1	1.6	4.2	5.7	6.7	6.7	4.7	5.1	6.3	7.1
Primary	15.6	19.1	15.2	15.4	16.4	20.0	25.6	21.1	20.7	21.0	19.3
Manufacture	15.0	17.0	20.2	23.1	17.9	20.1	21.1	18.9	22.0	21.5	20.2
Construction	0.5		0.9	1.8	1.2	0.5	1.3	1.3	0.9	1.7	1.8
Electricity, Gas, Water	20.5	19.1	14.7	14.8	14.6	18.3	25.6	21.9	22.6	23.1	23.5
Secondary	36.0	36.1	35.7	39.7	35.6	38.9	48.0	42.1	45.4	46.3	45.5
Transport, Storage	16.3	18.6	13.1	13.9	12.1	10.2	12.7	11.7	11.0	12.3	10.0
Railways	8.8	8.7	5.9	5.6	4.8	3.4	5.3	5.0	5.6	6.6	4.9
Communication	2.3	3.6	2.3	2.5	2.5	2.6	3.2	2.7	2.4	2.4	3.2
Transport	5.2	6.3	5.0	5.8	4.8	4.3	4.2	3.9	3.1	3.3	1.9
Trade	5.5	-6.4	5.0	4.6	16.7	15.1	-3.0	5.6	1.5	-2.2	4.4
Transport, Comm Trade	21.8	12.2	18.1	18.4	28.8	25.3	9.7	17.2	12.6	10.1	14.5
Banking & Insurance	0.6	0.5	0.4	0.4	0.2	0.4	0.5	0.6	0.4	0.7	0.7
Public Administration	22.3	26.9	25.8	21.9	16.9	12.0	12.1	15.1	17.0	17.7	16.1
Other Services	3.6	5.2	4.7	4.1	4.0	3.4	4.0	3.9	3.9	4.2	3.9
Finance and Personal Services	26.6	32.6	30.9	26.4	21.1	15.8	16.6	19.6	21.3	22.6	20.7

Table 5.10: Year to Year Growth Rates in GDCF

(in %) At current prices

Industry/Year	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
Agriculture	-0.47	14.29	2.50	13.01	8.27	-10.30	0.00	14.81	0.32	5.79	6.08
Forestry	-8.33	27.27	-7.14	23.08	18.75	-15.79	25.00	-15.00	0.00	11.76	5.26
Mining & Quarry	2.13	52.08	34.25	5.10	-34.95	67.16	-21.43	-25.00	30.30	-2.33	7.14
Primary	- .37	21.56	9.17	11.2	-2.52	2.84	-5.03	3.97	5.34	4.35	6.25
Manufacturing	25.24	15.61	11.85	19.21	33.26	6.82	-14.37	-13.73	-9.04	-5.83	19.72
Construction	18.18	38.46	22.22	-9.09	15.00	-8.70	42.86	6.67	0.00	-90.63	3.67
Electricity Gas	66.49	15.26	25.35	- .22	13.96	-9.88	-2.63	5.63	14.07	19.63	-2.34
Secondary	3.08	15.91	18.61	8.59	23.84	- .68	-8.75	-5.08	1.98	4.76	7.60
Transport Storage	24.46	26.13	15.75	0.44	-11.49	-13.14	-11.88	-3.26	-13.48	32.73	6.65
Railways	23.21	35.65	13.46	-1.32	-13.74	-30.97	-9.29	-15.19	-21.25	32.80	11.95
Communication	0.00	57.14	45.45	9.38	-28.57	40.00	-8.57	-3.13	6.45	-15.15	39.29
Transport	40.63	-20.00	12.50	4.94	16.47	41.41	-19.29	26.55	-9.09	56.92	-8.82
Trade	66.67	10.00	27.27	-7.14	623.08	-36.17	85.00	66.67	-78.92	410.26	-29.65
Transport Comm Trade	25.13	25.79	15.97	0.29	0.43	-16.26	-1.89	10.33	-32.70	67.45	- 3.52
Banking and Insurance	-40.00	0.00	-33.33	150.00	30.00	15.38	-26.67	18.18	-23.08	70.00	58.82
Public Administration	-26.79	25.52	-4.72	25.65	-8.23	-30.28	51.74	-46.47	46.53	6.08	16.99
Other Services	18.18	15.38	10.00	6.06	20.00	- 4.76	12.50	6.67	6.25	25.49	15.63
Finance,	25.27	24.52	-4.21	25.35	-6.05	-27.46	45.33	-41.48	38.74	9.31	18.12
Total	-1.59	21.37	11.00	10.08	6.79	-9.56	2.37	- 9.03	-1.00	16.86	6.64

Table 5.10 continued

(in %) At constant Prices

Industry/Year	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82
Agriculture	20.06	-0.72	-13.94	13.97	37.50	14.80	6.06	1.02	-1.16	-10.26
Forestry	-15.00	-5.88	-12.50	14.29	50.00	16.67	7.14	-3.33	20.69	- 8.57
Mining and Quarry	43.33	27.91	1.82	74.40	31.06	-3.91	-8.94	5.95	27.53	23.57
Primary	23.09	5.66	-9.55	32.7	35.15	7.43	0.77	2.48	8.93	2.90
Manufacturing	13.60	36.09	10.16	-7.54	24.21	-8.23	8.43	21.85	1.70	1.19
Construction	-71.43	725.00	87.88	-41.94	-19.44	82.76	24.53	-25.76	89.80	7.53
Electricity Gas Water	- .64	-4.03	3.52	46.19	-1.55	10.81	8.84	8.87	7.55	9.89
Secondary	4.91	17.90	19.19	12.24	10.11	1.86	9.07	13.93	6.24	5.60
Transport Storage	26.61	-13.48	2.35	1.31	- .81	- .49	15.38	1.13	16.97	.48
Railways	8.54	-11.48	-12.22	2.53	-16.46	17.24	14.71	19.78	26.91	5.54
Communication	47.44	-18.26	8.51	17.65	12.50	2.22	5.07	-5.52	6.57	34.25
Transport	45.16	-13.70	16.74	-5.88	7.81	-14.86	22.13	-13.24	9.64	-25.27
Trade	-212.14	-202.5	11.80	282.78	-87.95	-197.59	-407.41	-68.27	-222.78	-346.39
Transport Comm Trade	-22.19	42.21	4.35	65.36	-46.71	-23.96	80.00	-16.98	- 6.94	46.13
Banking and Insurance	-14.81	-17.39	21.05	-8.70	38.10	-3.45	35.71	-18.42	41.94	15.91
Public Administration	25.77	17.75	-9.82	2.97	40.38	- 2.05	16.78	7.78	11.11	1.00
Other Services	39.19	8.74	-9.82	2.97	40.38	-2.05	16.78	7.78	11.11	1.00
Finance,	25.61	15.63	-34.74	4.85	7.10	-14.12	43.62	15.54	10.72	- .55
Total	6.02	19.23	-5.91	26.04	-3.05	-3.65	21.03	5.93	5.65	9.16

Table 5.11: Decomposition of Public Investment

In Percentage

Year	PRIMARY SECTOR				SECONDARY SECTOR				TRANSPORT, COMMUNICATION, TRADE			
	Pure Growth Effect	Pure Weight Effect	Inter Action Term	Total	Pure Growth Effect	Pure Weight Effect	Inter-action term	Total	Pure Growth Effect	Pure Weight Effect	Inter action term	Total
1961-62	14.12	-0.003	0.1748	14.29	18.84	0.2152	0.8954	19.95	.5956	6.15	0.1617	6.91
1962-63*	-17.89	0.049	-0.0284	-17.86	-9.23	-2.44	-0.415	6.37	-24.94	2.38	-0.90	-23.47
1963-64*	32.88	-2.44	-0.54	29.89	-335.40	46.52	-25.09	-343.93	-462.02	21.03	-20.65	-461.64
1964-65*	-61.57	0.514	-0.629	-61.68	167.29	-1.27	-2.26	163.76	-1.23	-0.223	-0.110	0.9115
1965-66*	4.88	0.200	-0.4259	4.65	53.35	8.28	8.51	53.58	-26.51	-0.041	1.57	-24.97
1966-67	-8.96	0.44	-1.22	-9.75	-27.89	-0.23	-2.73	-30.86	29.41	2.46	-2.18	29.70
1967-68*	12.19	.4923	.88	11.80	14.59	3.77	-1.58	16.78	-24.31	-.1560	1.00	23.80
1968-69	2.45	1.01	0.35	3.82	35.47	-1.11	1.54	35.90	-116.11	5.95	24.71	-134.84
1969-70	-0.914	0.3144	-0.058	-0.658	6.55	0.140	0.19	6.89	147.40	15.40	-47.19	115.61
1970-71*	3.24	-0.79	-0.34	2.10	-12.07	-2.09	-1.24	8.72	-124.07	51.05	-53.72	-126.73
1971-72*	426.12	-0.57	-1.54	424.0	-169.97	4.31	-1.53	-167.17	-776.21	13.94	73.93	-688.34
1972-73	-20.14	4.36	-3.29	-19.40	38.59	-0.157	-0.404	38.03	112.89	10.34	-30.09	93.20
1973-74*	-10.90	-0.46	1.24	-10.12	-13.45	-0.3099	-0.1507	-13.60	- 25.59	5.05	-4.93	-25.03
1974-75	21.59	.1844	-0.81	20.51	3.66	1.77	0.58	6.03	38.71	0.3614	4.22	43.26
1975-76*	3.26	1.78	0.1746	5.22	-1.09	-3.96	0.1199	-4.94	-100.58	36.44	31.37	-101.51
1976-77*	-18.08	5.05	-4.07	-17.10	-14.82	0.1456	0.1188	-14.80	- 64.27	0.264	7.51	-56.49
1977-78	-3.64	1.02	-0.94	-3.56	5.55	0.5070	1.12	7.18	103.3	22.46	-52.91	72.89
1978-79*	3.42	-0.1659	-0.5489	2.704	-24.03	-2.59	-2.56	18.86	-88.37	36.15	-43.89	-96.06
1979-80*	491.01	-6.13	-15.98	468.91	-1202.30	-164.55	-90.89	-1128.64	694.7	254.18	-150.23	798.65
1980-81	-34.73	1.59	-1.07	-34.21	-8.3	.4554	-0.046	-7.91	225.39	3.51	-26.87	202.03

Table 5.11 continued

Year	FINANCE, COMMUNITY AND PERSONAL SERVICES				TOTAL PUBLIC SECTOR	
	Pure Growth Effect	Pure Weight Effect	Inter action term	Total	in Growth rates	in %
1961-62	66.75	8.15	-16.06	58.84	22.95	100
1962-63*	-64.78	1.43	1.68	-65.03	-10.36	100
1963-64*	765.67	14.93	-104.91	-675.68	- 9.26	100
1964-65*	-197.70	22.14	-27.42	-202.98	-3.28	100
1965-66	-30.85	1.04	3.71	-26.09	-16.34	100
1966-67	126.50	9.44	-25.03	110.91	11.92	100
1967-68*	-126.59	27.73	-53.12	-151.97	-11.40	100
1968-69	235.77	43.48	-84.03	195.67	8.03	100
1969-70	-25.02	13.22	-10.04	-21.84	17.85	100
1970-71*	18.34	-1.251	-1.18	+15.90	-10.21	100
1971-72*	242.50	63.04	26.09	331.50	-0.61	100
1972-73	-16.65	7.89	-3.07	-11.84	13.21	100
1973-74*	-52.32	-0.4910	1.58	-51.23	-25.14	100
1974-75	31.38	8.43	-9.61	30.21	31.97	100
1975-76*	2.61	.9523	-0.44	1.22	-15.05	100
1976-77*	-11.87	-14.01	0.4159	-11.59	25.94	100
1977-78	23.84	-0.06	.2690	23.48	34.79	100
1978-79*	-28.65	8.79	-5.64	-25.30	-13.86	100
1979-80*	-299.3	87.56	-27.16	-238.92	-0.27	100
1980-81	-59.73	2.72	-2.86	-59.86	3.51	100

Note: 1. It is the change in the rate of growth of public investment, $(G_2 - G_1)$, that has been decomposed.

2. A negative sign does not imply a negative growth rate, it simply means that the growth rate in the succeeding year is less than the preceeding year

3. * indicates a decline in rate of growth of total public investment

Chapter 6

FURTHER DISAGGREGATION: PUBLIC INVESTMENT IN INDUSTRIES OF USE, BY TYPE OF ASSETS

In our discussion regarding the structure of investment, Chapter 4, we divided "productive accumulation" into productive investment and changes in inventories. While Chapter 5 was devoted to a discussion on productive accumulation across industries, in this chapter we propose to take up productive investment for analysis.

The distribution of total capital formation by industries gave us an idea of the gradual transformation of composition across industries but a more disaggregated study of the structure of capital formation in terms of fixed capital formation (and its components) within each industry of use is warranted for obtaining an idea of the effect of investment on augmenting capital stock of the economy in general and of the nature of demand generated by investment in particular which might add to our understanding of the impact of public investment on industrial deceleration.

For the estimation of capital formation National Accounts Statistics identifies three important forms in which physical assets are accumulated viz. construction, machinery and equipment, and inventories. The former two are clubbed together to form fixed capital formation, which implies that fixed capital formation comprises of:

i. a material component

ii. a construction component

These two components are non-homogenous entities not only in terms of their commodity composition but also in terms of their demand generation and consequently their impact on final output. Hence they need to be treated seperately while analysing trends in fixed capital formation.

To illustrate the point about the varying impacts of construction and machinery and equipment, consider the following example:

If, I_1 & I_2 is the public investment in period 1 and 2 respectively we have:

$$I_1 = i_1^c + i_2^m$$

and

$$I_2 = i_2^c + i_2^m$$

where: i_1^c = construction component

i_1^m = material component

Assuming that in period 2 the proportion of construction component in public investment is higher than in period 1;

$$\text{i.e. } i_2^c > i_1^c$$

Since the proportion of construction component in I_2 is higher, which being labour intensive, the factor payments associated with it will be high, implying thereby that the "food-grain intensity" or "consumer good intensity" of I_2 will be higher vis-a-vis I_1. Further, since $i_1^m > i_2^m$, the implication that follows is that "capital goods intensity" or "material intensity" will be higher in I_1 as compared to that of I_2.

A distinction between the components of fixed capital formation along such lines will also help us in understanding the impact of a shift in investment consequent upon the crowding out of private investment by public investment,

observed in Chapter 2 and Chapter 5.

Another basic reason for our advocating the disaggregation of fixed capital formation into construction (buildings, roads, other construction) and producers durables (machinery and equipment, lies in the span of the economic life of units in these two categories. Buildings, roads, bridges and so on continue in use for a long time and the conversion of their original value into current product extends over two decades. As against this, machinery and equipment has a much shorter economic life span. In the Indian context, for example, it has been estimated that the average age of machinery and equipment extends from five years to 40 years and that of construction for 40 years to 100 years.[1/]

The third component of capital formation, inventories, are functionally different from both machinery and equipment as well as construction. As against these two components inventories do not directly add to productive capacity but carrying on of some inventories is vital to the maintenance of an efficient production process and other things remaining the same increase in productive capacity will ordinarily require larger inventories.

Recalling our discussion on the structure of investment in Chapter 4. For inventories the relationship with increments in national income can be:

$$S = \mu \Delta Y$$

where 'μ' is the average period of turn over (i.e. ratio between the volume of inventories and the national product), or the economic life of the inventories. Evidently the economic life of inventories will vary depending on a multitude

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1. Gothoskar, S.P. (1980)

of factors (like demand, rate of interest, forecasts) it is extremely short when compared to machinery and equipment and construction. Even compositionally inventories may differ from machinery and equipment, and construction as they are generally a conglomeration of heterogenous items which includes finished goods, semi-finished goods and raw materials, and obviously the inventories of raw material are necessary for production in a way that stocks of finished/semi finished goods are not. The heterogenous composition is variable and is dependent not only on technical factors but also on the nature of economic organisation which differs from industry to industry.

In addition to this, our interest in inventory behaviour derives from the instability that inventories might impart to long term capital formation and may prove to be an explanatory variable in the instability in public investment which we observed in the preceeding chapters.

Before looking at the empirical evidence on the rate and patterns of gross fixed capital formation and its components, a word about the data used in this chapter is in order.

The N.A.S. provides data on capital formation by type of assets only at current prices for public sector as a whole. As was discussed in Chapter 3, the Central Statistical Organisation does not provide deflators for capital formation by industrial category and type of assets and the use of overall economy's deflator is unsuitable as there are compositional differences between capital formation in public sector and the whole economy, at the aggregate level (For detailed discussion see Chapter 3). As such, we have used public sector implicit deflators for converting current prices series on fixed capital formation into a constant price series. The method adopted, which takes care of all compositional problem is as follows:

Current price estimates on type of assets by industry of use for type of authority were taken from Public Sector Transactions, CSO, 1983. These current price estimates provide data for Public sector in each industry of use on fixed capital formation, disaggregated by construction, machinery and equipment, inventories, depreciation, Gross domestic capital formation and net domestic capital formation. Alongside with this data, we had current and constant price estimates on GDCF in public sector by industry of use, from the N.A.S.

From the latter, (N.A.S. series) an implicit deflator series for public sector GDCF in each industry was computed and this deflator was used to deflate the public sector GDCF in the CSO series by their respective industries. Then proceeding on the assumption that the rate of increase in public sector GDCF and stocks for a particular industry will be the same the above derived implicit deflators were used for arriving at constant price series on GDCF and stock for each industry, the GDCF series was obtained at constant prices. Then using the proportion of construction and machinery and equipment to Gross fixed capital formation at current prices, the constant price estimates of machinery and equipment, and construction were derived.[2/]

To arrive at the type of asset classification of capital formation for the public sector as a whole all the industries were aggregated.

Capital Formation in Public Sector by Type of Assets: Aggregate Analysis

i. Construction:

As far as the scope of construction as a component of capital formation is concerned, it represents value of construction put in place including the installed value of equipment which is an integral part of a structure - a house,

2. See Chapter 3 above for details

plant, bridge, harbour etc. and including what are usually designated as major repairs.

The share of public sector construction in the aggregate economy's construction shows that its share has increased from about 22% in 1950-51 to 65% in 1979-80. However, this rise has not been secular. During the first fifteen years the share of public sector construction trebled itself reaching an all-time high of 61% in 1964-65. Thereafter the share of public sector in construction declined persistently and only a decade later, i.e. in 1973-74 was the earlier level achieved. After 1973-74 its share has been fluctuating between 46% and 64%.

As against this, the weight of construction in public sector gross fixed capital formation has followed a cyclical pattern roughly with a periodicity of 4-5 years - it declined between 1954-55 and 1959-60, increased from 1959-60 and 1964-69 then again the period 1965-66 to 1969-70 saw the share decline. The period 1969-70 to 1973-74 was a period of increase whereafter it has been fluctuating without any apparent pattern. The cycle however conceals a declining trend.

Looking at the plan period growth rates we find that the construction component of capital formation grew at a compound annual rate of more than 10% per annum during the plan periods except the second plan and the plan holiday. Though the highest growth rate of 16% was recorded during the first plan the figure appears to be inflated by a small base (Table 6.5).

It was during the plan holiday that capital formation in construction declined in absolute magnitude at a rate of 4.69% per annum thereby bearing the brunt of public investment deceleration during that period. While construction capital formation declined at -4.69%, GFCF in public sector declined at -2.30% per annum. In terms of its weighted contribution, therefore, construction

accounted for 125% of the decline in GFCF. The earlier level of growth achieved prior to the plan holiday was however restored during the fourth plan (See Table 6.5)

Contrary to such high growth rates achieved by the public sector in construction, the rate and pattern of growth in the private sector has been dismal. Only during the three years of plan holiday has the construction component grown at a rate comparable to that of the public sector. The investment in construction in the private sector has been declining in absolute magnitude during the 1st plan, 2nd plan and the fourth plan - in the fourth plan it declined at a rate of -12% per annum. Even when the rate of growth has been positive it has been low. During the third and the fifth plan, the only two periods when rate of growth was positive, it increased at about 5% and 6% respectively: It might be worth mentioning here that in the private sector (as defined by us) includes household residential construction also. To that extent one can visualise the meagre contribution of the private corporate sector to construction component of fixed capital formation. With such low growth rates, the private sector has considerably depressed the aggregate economy's investment in construction - the weight of private sector in construction investment though declining is substantial. That the reason for slow growth of capital formation in construction in the economy is almost entirely due to the private sector slow process of capital formation is evident from Table 6.6.

From the above discussion on the plan wise pattern of the rate of growth of capital formation in construction it is clear that, though it declined during the three years of the plan holiday there was no secular declining trend. Let us now see if associated with this pattern of growth was some pattern in instability.

Over the entire period, instability as measured by the coefficient of variation of annual growth rate was 1.573. If we periodise according to pre 1965 -

post 1965 periodisation we find that the instability in the post 1965 period was three times more than in that in the pre 1965 period -- 3.0581 and 0.9064 respectively. But if one looks at the plan wise instability no such conclusions can be drawn. As the table below shows, there is no trend increase in instability over time.

Instability of Public Investment in Construction

Period	Mean of Annual Growth rates $\bar{X}_g$	Standard deviation of annual growth rates σ_g	Coefficient of Variations of annual growth rate CV_g
1951-52 to 1964-65	11.594	10.50	0.9064
1965-66 to 1979-80	4.71	14.43	3.0581
1951-52 to 1979-80	8.27	13.07	1.573
Ist Plan	17.72	8.301	0.4671
2nd Plan	5.61	11.133	1.9817
3rd Plan	11.39	8.036	0.7054
Plan Holiday	-6.28	6.676	-1.0620
Fourth Plan	10.05	6.311	0.627
Fifth Plan	4.42	20.076	4.426

As to why the post 1965 period shows such a high degree of instability, it is because of an exceptionally high degree of instability, 4.42, in the fifth plan which distorts the post 1965 period estimates of instability. Once again, this shows the futility of the pre 1965 and post 1965 periodisation that has so often been used in the literature.

Machinery and Equipment:

Even though construction is a part of fixed capital formation, the demand that it generates is basically for intermediate goods like cement, steel etc. and labour, whose share is substantial in construction capital formation. As against this, machinery and equipment forms the basic core of the capital goods. Machinery and Equipment includes transport, communication equipment, agricultural machinery and other machinery and equipment.

The share of public sector machinery and equipment capital formation in the economy increased from 10% in 1950-51 to about 40% in the late 1970's. It was especially during the second plan that the share of public sector machinery and equipment in the economy doubled. The share of public sector machinery and equipment has been increasing consistently over the plans. From an average share of 17.5% in the first plan, it increased to 29% during the second plan, and 31.3% during the third plan. Even during the plan holiday when there was a severe cut back in public investment, the machinery and equipment continued to increase its share in the whole economy's capital formation in machinery and equipment and reached over 38%. By the fifth plan its share had increased to about 43%.

Within public sector also machinery and equipment has been growing at a faster rate than construction which accounts for its increased weightage in the public sector gross domestic fixed capital formation. That the fall in public investment, particularly, during the plan holiday, was more severely felt by construction is evident from the fact that between the years 1964-65 and 1969-70 the share of machinery and equipment in public sector gross fixed capital formation increased by 10% points.

This point is borne out by the growth rates in machinery and equipment also. Except during the plan holiday when the rate of growth was less than 1%

per annum, investment in machinery and equipment has never decelerated. The plan wise growth rates have been as high as 12.7% in the first plan, 17% in the second, 12% in the third, 9% in the fourth and 15.87% in the fifth plan (Table 6.5)

While comparing these growth rates across plans it needs to be borne in mind that these percentage changes are not independent of the level of capital formation. That is to say, that while a 12.7% increase in machinery meant an increase of just Rs.74 crores during the Ist plan, a 9% increase during the fourth plan reflects an increase of Rs.260 crores and that of 15% during the fifth plan an increase of over Rs.604 crores all at 1970-71 prices.

Inspite of such high growth rates of capital formation in machinery and equipment in the public sector, this component of fixed capital formation has been the slowest growing in the economy as a whole. Comparing the growth performance of capital formation in machinery and equipment between the public sector and the whole economy (See Table 6.6) we find that during the first plan while public sector investment in machinery and equipment increased at 12.77% per annum, the investment in machinery and equipment for the economy rose at a meagre 3.6% per annum. During the second plan, while machinery and equipment investment in public sector grew at a rate of 17.24% per annum, in the whole economy it declined in absolute magnitude at a rate of -3.11%. Similarly during the fifth plan the rate of growth of machinery equipment investment in the economy was half of that for the public sector.

This extreme disjuncture between the performance of public sector and the economy as a whole is obviously because of the dismal performance of the private sector. As Table 6.6 shows private sector investment in machinery and equipment grew at a rate of 1.68% during the first plan, declined at a rate of -11% in the second plan, while in the plan holiday it rose by 3.75% and in the

fifth plan at 1.25%. It was only during the 3rd and 4th plan where its growth rates were comparable to that of public sector. With such a low growth performance, the private sector has depressed the whole economy's growth of investment in the machinery and equipment.

Looking at the pattern of instability in machinery and equipment investment we find that it has been increasing over time. The degree of instability as measured by the coefficient of variation of the annual growth rates is particularly high during the fourth plan and the plan holiday. Compared to the instability in construction investment, the instability in machinery and

Instability in Machinery and Equipment Investment

Period	Mean of Average Annual growth rates	Standard deviation of Annual growth rate	Coefficient of Variation of Annual Growth rates
1st plan	23.06	27.97	1.21
2nd plan	22.93	13.58	0.59
3rd plan	8.59	10.28	1.19
Plan Holiday	1.56	6.66	4.26
4th Plan	2.85	16.69	5.84
5th Plan	16.19	33.20	2.04

equipment investment has been higher throughout the period.

Thus comparing the plan wise pattern in growth rates with that of the instability we find that though growth rate did not decline in the later period they were associated with a higher degree of instability as compared to the earlier phase and also as compared to construction..

Gross Fixed Capital Formation

As we said above gross fixed capital formation is the aggregation of machinery and equipment and construction. Since construction has a substantial weight (though declining over time) within gross fixed capital formation, on an average about 60%, the pattern of growth in GFCF in the public sector closely follows the growth pattern in construction. As can be seen from Table 6.5 the rate of growth of gross fixed capital formation has never declined except during the three years of the plan holiday. The decline during the plan holiday of the magnitude of -2.30% was reversed during the fourth plan with a growth rate of 9.35% per annum followed by a growth of 11.57% per annum during the fifth plan.

Though the rate of growth of fixed capital formation was maintained, an important change has taken place in the composition of GFCF. Overtime because of the higher rate of growth of investment in machinery and equipment vis-a-vis construction, the proportion of machinery and equipment in GFCF has increased substantially from .19 in 1950-51 to .42 in 1976-77. This as we argued at the start of this chapter implies that the "material intensity" or "capital goods" intensity" of GFCF has been increasing over time, which in turn affects the nature of demand generated by public investment. In other words, such a compositional shift in favour of machinery and equipment would mean that the demand for capital goods per unit of public investment has been higher in the later period i.e. after 1965-66, as compared to the earlier period.

When one looks at the instability in GFCF we find that there seems to be a higher incidence of instability after the third plan. The coefficient of variation of the annual growth rates was highest during the fifth plan. Though during this plan the higher degree of instability in GFCF is due to a very high degree of instability in construction, during all other plan periods, the source

of instability in GFCF is found in machinery and equipment.

On comparing the instability in GFCF with that of GDCF in public sector an interesting pattern emerges. As the table below shows, till the end of third

Instability in GFCF (Public Sector)

Period	Mean of Average annual growth rates	Standard deviation of Annual Average	Coefficient of variation of Annual Average Growth rates
First Plan			
i. GFCF	9.19	18.27	0.50
ii. GDCF	22.35	19.13	1.168
iii. Stocks	273.94	171.99	1.59
Second Plan			
i. GFCF	10.84	10.21	1.06
ii. GDCF	12.55	9.90	1.26
iii. Stocks	156.76	121.18	1.29
Third Plan			
i. GFCF	4.92	9.65	0.51
ii. GDCF	7.39	9.52	0.77
iii. Stocks	70.27	28.17	2.49
Plan Holiday			
i. GFCF	4.55	-3.28	-1.38
ii. GDCF	5.49	-5.40	-1.016
iii. Stocks	131.29	26.85	4.88
Fourth Plan			
i. GFCF	7.17	7.30	0.98
ii. GDCF	7.47	9.54	0.78
iii. Stocks	3205.66	6274.01	1.95
Fifth Plan			
i. GFCF	16.17	6.132	2.63
ii. GDCF	15.42	7.18	2.14
iii. Stocks	112.77	261.09	2.31

plan the instability in GDCF is higher as compared to GFCF. And the reason for this is not far to seek, as the inventories component in GDCF has been very unstable thereby imparting a higher instability to GDCF. Obviously the degree

of instability that inventories impart to GDCF will depend on their proportion in GDCF.

However after the third plan this 'role' of inventories seems to have changed. Instead of imparting instability, the inventories have played a role of dampening instability in GDCF. This implication follows from the fact that after the third plan the instability of GFCF is higher than that of GDCF, thereby reversing the pattern of instability that was observed till the third plan. Further more, this is so even though the instability in inventories is higher than that in GFCF.

An example will make the above argument clear. Consider the pattern of instability during the fourth plan. The instability in GFCF as measured by the coefficient of variation of the annual growth rates is 0.98, whereas in GDCF it is 0.78. Logically this is possible if either the instability in stocks is lower than that of GFCF (0.98 in this case) or if it is higher, the fluctuations in stocks should be contracyclical to the fluctuations in GFCF such that the fluctuations in GFCF are dampened. Table overleaf bears out that the instability in inventories is higher than in GFCF, it being 1.98. Thus the stocks have to a certain extent neutralised the fluctuations in GFCF.

Capital Formation in Public Sector By Type of Assets: Disaggregated Analysis:

Thus far our discussions regarding the structure of public investment and changes therein have been at the aggregate level.

A disaggregated study of the structure of public investment, for the reasons mentioned earlier, has been carried out at two levels:

1. Type of Authority
2. Industry of Use

1. Type of Authority:

While the functions involved in capital formation are the same, no matter who the user may be, the identity of the user does make a difference as it gives us an idea of the impacts of capital formation on the economy that emerge from the different composition of capital formation which, as we shall see below, does vary according to the type of users.

The type of authority classification divides public sector into three departments, on the basis of the functional role and organisational set up. These are:

a. Administrative Departments:

By definition, administrative department include all agencies of the central, state and local government whose function is to organise for the community those services which cannot be otherwise conveniently and economically produced. The major areas under this department are: public administration, defence, finance, community and personal services. It can be broadly considered to be the services sector.

Most of the capital formation in the administrative departments consists of office buildings, other buildings and furniture, such that, the proportion of the construction component is over 90% of the fixed capital formation. Whatever little is invested in machinery and equipment is in the form of consumer durables like typewriters rather than producer durables.

That the administrative departments are the slowest growing in terms of capital formation and the ones affected by the investment cutback is evident from their declining share in gross domestic capital formation in the public sector. This share of administrative department which was about 30% during the second plan has been almost halved over the years and stood at about 16% during

the fifth plan. Such a secular decline indicates the shift in priority, away from the general services.

The administrative departments registered a negative growth rate during the plan holdings but were more than equally compensated by a very large dose of investment during the fourth plan when the growth rates achieved were the highest compared to all the years. During the fourth plan, GFCF in Administrative departments grew at 17.4%, with machinery and equipment rising at 23% (Table 6.5)

b. Departmental Enterprises:

Capital formation in departmental enterprises comprises chiefly of investment in railways, irrigation and transport. The importance of departmental enterprises as shown by their weight in GFCF has diminished considerably over the years. The weight of departmental enterprises in public sector gross domestic capital formation has declined secularly from about 48% during the second plan to about 23.61% during the fifth plan.

The gross domestic capital formation in department enterprises has been quite erratic throughout the planning period. While the rate of growth of GFCF was about 20% in the first plan, it declined at -7.2% per annum during the second plan. Third plan was a period of high growth, about 12%, followed by an absolute decline in GFCF at the rate of -0.4% per annum. This phenomenon of high but unstable rate of growth, which is partly explainable by the nature of investment in departmental enterprises - it being lumpy and indivisible[4/] seems to have been replaced by a lower but more stable growth rate after the plan holiday. During the fourth plan fixed investment in departmental enterprises increased at a rate of 6.37% per annum whereas during the fifth plan the rate of growth was 8.33% (Table 6.5)

4. See discussion on railway investment, which is a departmental undertaking, in Chapter 5 above.

Within gross fixed capital formation, construction investment has never decelerated except during the plan holiday, whereafter the earlier trend is restored during the fourth plan. In case of machinery and equipment though the rates of growth have been higher than those of construction investment, these have been unstable. Machinery equipment declined drastically during the second plan at a rate of -15.26% per annum but during the third plan the rate of growth of capital formation in machinery and equipment increased at 11.95% per annum. The plan holdings saw the curtailment of investment in machinery and equipment at a rate of -8% per annum, but during the fourth plan it increased at about 7% per annum.

The decline during the plan holiday and a relatively slow rate of increase of about 7% per annum in capital formation during the fourth plan is due to a sharp cutback in railway investment.[5/] which forms a major part of departmental enterprises. This as we argued was the effect rather than the cause of industrial deceleration.

c. Non Departmental Enterprises:

We discussed above that both administrative departments and departmental enterprises have had a declining share in investment over time. This decline in the share of administrative departments and departmental enterprises has not been caused by a slow down in their respective rates of growth of investment but by relatively higher growth rate of capital formation in non-departmental enterprises. Consequent upon the high rates of growth of capital formation, the share of non-departmental enterprises in GDCF in public sector has increased from about 8% during the first plan and 22% during the second plan to about 60% during the fifth five year plan.

5. For details refer chapter 5 above.

This change in the orientation as reflected by the shift in distribution of investment in favour of non-departmental enterprises is a significant development. It is the non-departmental activity of the public sector which is the actual production sphere where the outlays are used for creating and expanding enterprises in manufacturing industry. And more importantly the part of GFCF that is directed to non-departmental enterprises is invested in capacity creation in the capital intensive branches of heavy industry like metal industries which include Iron and Steel, Aluminium, Engineering Industries which include heavy electrical engineering, machine tool, and chemical industries. In other words the output of non-departmental enterprises is mainly the capital goods, which makes it a crucial sphere for investment activity. Gross fixed capital formation in non departmental enterprises has been the fastest growing component of capital formation as compared to departmental and administrative enterprises. During the first plan GFCF in non departmental enterprises increased at 18.65% per annum while during the second plan the rate of growth of GFCF was about 50% per annum. These growth rate figures are unduly high, as they are distorted by the small base during the first and second plan. The third plan period was again a period of high growth which was followed by a decline in the absolute magnitude of gross fixed capital formation during the plan holiday at a rate of -2%. This trend was however halted immediately and by the fifth plan the rate of growth had returned to the earlier trend with gross fixed capital formation growing at 14.72% per annum (Table 6.5).

Within GFCF an interesting and important change has occurred, while prior to the third plan it was construction investment which was the main "source" of growth in GFCF after the third plan it is machinery and equipment which is providing the impetus to growth in GFCF. It also needs to be noted that whatever decline did

take place in GFCF in non departmental enterprises it was heavily concentrated in construction investment. During the plan holiday, when GFCF declined at -2%, construction investment registered a fall by about -14% per annum whereas investment in machinery and equipment rose by 6% per annum. Though the rate of growth of fixed capital formation in public enterprises during the first two plans is not strictly comparable, if the low initial base[6/] is accounted for we find that the rate of growth achieved during the fifth plan especially in machinery and equipment is equal to those during the first two plans.

2. Industry of Use:

We come now to the last aspect of the structure of capital formation, the distribution of capital formation among industries by the type of assets. This disaggregation is an extension of our discussion on capital formation by industry in Chapter 5. In Chapter 5 we identified the industries which were slow growing in terms of the growth of capital formation whereas in this section we intend to disaggregate capital formation further to see within these industries which component of capital formation was affected by an investment cutback.

This disaggregation will be valuable because the structure of capital formation in terms of fixed capital, including machinery and equipment and construction varies across industries and consequently may show diverse patterns of growth and different trends in their shares in total capital accumulation. Moreover, dependent on the structure of capital formation within each industry

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6. As given in Table 6.5 the compound rate of growth of capital formation in machinery and equipment during the second plan was 78.28% per annum. That this is primarily because of a very low initial base is evident from the fact that if the initial year 1956-57 is dropped the growth rate is reduced to 48.0% per annum. And if the first two years are dropped, the rate of growth for the period is reduced to 17%.

will be a pattern of investment demand that emanates from it.

Further, a disaggregation of capital formation for each industry might help us to understand in what way does the structure of investment bear on the relationship of investment to output which forms the subject matter of our next chapter. Specifically, it is important for our purpose to study the trends in the composition of investment in terms of construction and machinery investment as these trends may explain the behaviour of capital-output ratio which we shall study in Chapter 7.

Unlike in Chapter 5 we shall not discuss each industry in detail but concentrate only on the important industries and the movements of components of capital formation in these industries. The industries left out are not among the important users of fixed capital.

In the case of agriculture, GFCF mainly takes the form of construction and the machinery and equipment content is very low - about 5% of the total GFCF in Agriculture.

Contrary to the impression of some economists[7] that public investment in agriculture has declined particularly in public irrigation works which would essentially mean a decline in the construction component of fixed capital formation in agriculture, we find GFCF in agriculture has not suffered a decline in any period. Far from a decline, the rate of growth of GFCF has accelerated after the fourth plan. Even during the plan holiday when there was a substantial cutback in public investment, GFCF in agriculture maintained a rate of about 8% per annum (Table 6.7)

Due to the overwhelming share of construction in it, GFCF is but a reflection of the growth in construction. Hence the same pattern as that of

7. Patnaik & Rao (1977);

GFCF is observed in construction.

The rate of growth of machinery and equipment investment has been exceptionally high in agriculture - about 1 during the third plan, 14% during the plan holiday and 18% during the fifth plan. But these high rates of growth are not very meaningful because all through the absolute magnitude of capital formation in machinery and equipment is very low -- about 10 crores till 1973-74 however it needs to be noted that between 1973-74 and 1979-80 capital formation trebled itself in absolute terms at a rate of 19% per annum.

In forestry the entire fixed capital formation takes the form of construction which grew at a rate of 12.26% during the third plan, stagnated during the plan holidays and declined at -1.17% during the fourth plan. Fifth plan saw capital formation increase at 15.14%. Though, as is evident from the rates of growth, capital formation did decline significantly in construction within forestry this decline is not so significant when forestry is taken as a part of the public sector as a whole. This is so because forestry has a very small weight in public sector capital formation.

As against agriculture and forestry where construction component dominates the share in GFCF, in case of mining, construction and machinery and equipment are in equal proportion.

Except during the plan holiday when it declined at the rate of -17%, GFCF in mining has been one of the fastest growing across industries. The decline during the plan holiday was more than adequately compensated by a rate of growth of 12.5% per annum which was more than doubled during the fifth plan when a phenomenal rate of growth of about 27% per annum was achieved in GFCF. More or less the same pattern of growth as in GFCF is also observed in machinery and equipment and construction. Construction investment which declined at -10%

during the plan holiday continued to grow sluggishly during the fourth plan also but during the fifth plan achieved an unprecedented rate of growth of 35%.

As against this, the decline in machinery and equipment investment was restricted to the plan holiday. During the fourth and the fifth plan the rates of growth were about 20% per annum.

Within the secondary sector manufacturing and Electricity, Gas and Water are the main industries. Both these industries account for about almost 40% of the total GFCF in public sector.

The GFCF in manufacturing faced a severe cutback during the three years of the plan holiday when it declined at a rate of -10% per annum, after having grown at a rate of 20% per annum during the third plan. This decline in GFCF during the plan holiday was entirely due to a fall in its construction component which declined at a rate of over -100% per annum after having grown at 24% per annum during the 3rd plan. Even in the face of such a severe investment cutback in GFCF in manufacturing, the machinery and equipment component investment increased at a rate of 5% per annum.

Though the trend of absolute decline was reversed with the start of the fourth plan, it was also a period of relatively slow growth particularly for construction which increased at 4.61%. During the fifth plan construction declined once again at -8.67% per annum as against machinery and equipment which increased at 17.58% per annum during the same plan. This decline in construction during the fifth plan should, however, be qualified. It is because of a very steep decline during 1978-79 (of the magnitude of 75%) that construction in fifth plan shows a decline. If this is treated as an unusual year, construction investment during the rest of the plan shows a rise of about 25%.

In the case of electricity we find that during the pre 1965 period (third plan) the main 'source' of growth for GFCF has been construction investment which increased at a rate of 18.43% per annum during the third plan while machinery and equipment component was the slow growing component at 5.46% per annum. Here also, as in the case of manufacturing, the decline in GFCF during the plan holiday from 12% per annum to 6% per annum is entirely due to an absolute decline in the construction component of GFCF. Construction investment registered a fall of about -15% per annum whereas during the same period investment in machinery and equipment increased at 8.10% - a higher rate of growth as compared to the preceeding periods. It was during the fourth plan that while construction investment picked up and increased at a rate of 4.7% that machinery and equipment component declined to 0.64% per annum. However the earlier trend was restored during the fifth plan with a rate of growth of over 10%.

That the railways has been the worst affected industry in terms of the investment cut back was discussed in detail in Chapter 5. It was argued there that the decline in public investment going into railways was the effect rather than the cause of industrial stagnation. While GFCF was growing at a rate of 6.71% per annum during the third plan, it declined in absolute terms at a rate of -13% per annum during the plan holiday. Though the fourth plan did see a rise of about 7% in the capital formation in railways this growth was not sustained and it fell to about 3% in the fifth plan.

Looking at the growth patterns of components in railways once again it is evident that construction investment bore the brunt of the cutback, declining at a rate of -20% per annum during the plan holiday. But unlike other sector in the case of railways the investment in machinery and equipment also declined at a rate of about -5% per annum./ The rate of growth of investment did improve during the fifth plan when both construction and machinery and equipment increased at about

7% but it was not sustained and dropped down to earlier level during the fifth plan.

Relationship Between Public Investment and Private Investment:

It was observed in Chapter 2 at the aggregate level, and in Chapter 5 at a disaggregated level by industries, that there is a negative relationship between public investment and private investment which has become significant after the third plan i.e. mid sixties. It was argued that if a decrease in public investment is offset by an increase in private investment so that the rate of investment is maintained in the economy, the overall growth need not decline. In fact, it was shown there that in the post 1965 period the rate of public investment and more so rate of fixed capital formation in public sector, remained stable.

However there we raised the question that a fall in public investment even if compensated by a rise in private investment might shift -

a. Industrial composition of investment in a direction that may not be desirable or contrary to the overall plan.

b. the asset composition of investment such that the demand originating from it is different.

The former proposition was discussed in Chapter 5 and in this section we shall take up the latter.

The components of private gross domestic capital formation i.e. gross fixed capital formation, machinery and equipment, construction and inventories were regressed on their corresponding components of public gross domestic capital formation. This was done for entire period i.e. 1950-51 to 1979-80 and two sub periods - 1950-51 to 1964-65 and 1964-65 and 1979-80. This was done with a view to check as to what kind of relationship existed between the two and whether it had changed over time.

The results of the regression, the form of which was: $Y = a + b.x + CT + e$ are given in tables overleaf.

In the case of GFCF we find that for the period 1950-51 to 1964-65 the regression coefficient of public investment in all regressions, current or with a 1 or 2 year lag, are positive though significant (at 1% level) only in the case of 1 year lagged relationship. The strength of this positive relationship as shown by the partial correlation coefficient is 0.6906 i.e. public investment explains 47%[7] of the variation in private investment when both the variables are taken net of the time trend. This positive and significant relationship breaksdown completely when the second period is considered. The public investment coefficient in most cases is negative but insignificant.

Private sector capital formation in construction when regressed on public sector capital formation in construction did not evince a clear relationship in the sub periods even though for the entire period i.e. 1960-61 to 1981-82 it bore a significantly negative relationship having a partial correlation coefficient of -0.5062. The relationship is unlagged in nature. In the case of sub periods the relationship though generally positive in the first sub period is insignificant whereas the relationship is negative but insignificant during the second sub period.

In the case of machinery and equipment, the first sub-period does not show either a positive or negative relationship that is significant. The introduction of lags also does not improve the significance. But as against this, in the second sub period i.e. 1965-66 to 1979-80 the relationship is significantly negative, having a partial correlation coefficient of -0.7146 thereby explaining

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7. i.e. square of the partial correlation coefficient.

"Regression Results"

Component: Gross Fixed Capital Formation

Period/Lag	Regression Coefficient	T-value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\bar{R}^2$
1950-51 to 1979-80						
Unlagged	-0.100	0.4403	0.916	-0.0855	0.9091	0.9058
1 Year Lag	0.268	1.053	0.220	0.018	0.734	0.729
2 Year Lag						
1950-51 to 1964-65						
Unlagged	0.9342	1.3569	0.775	0.3583	0.6112	0.5813
1 Year Lag	1.6772	3.3459	0.898	0.6906	0.8504	0.8388
2 Year Lag	0.8750	1.1645	0.874	0.3332	0.7642	0.7446
1965-66 to 1979-80						
Unlagged	-0.0263	0.1070	0.755	-0.0327	0.7311	.7104
1 year Lag	0.1026	0.3951	0.746	0.1196	0.6815	0.6550
2 year Lag	-0.0496	0.2008	0.646	-0.0593	0.6783	0.6514

Private capital formation regressed on Public, Capital formation

Component: Construction

Period/Lag	Regression Coefficient	T-Value	Coefficient of Correlation	Partial Correlation Coefficient	R^2	$\overline{R}^2$
1950-51 to 1979-80						
Unlagged	-0.7812	3.0859	0.678	-0.5062	.7366	.7277
1 year Lag	0.1713	0.8904	0.172	0.048	.6421	.6217
2 year Lag	0.2837	1.2088	0.289	0.190	0.6842	0.6631
1950-51 to 1964-65						
Unlagged	-0.1358	0.3889	0.412	-0.1118		
1 year Lag	0.3843	1.3843	0.790	0.3671		
2 year Lag	0.4050	1.3416	0.825	0.3784		
1965-66 to 1979-80						
Unlagged	-0.6142	1.8089	-0.152	-0.4642		
1 year Lag	-0.3640	1.0213	-0.251	-0.2936		
2 year Lag	-0.2942	0.8607	-0.240	-0.2505		

Component: Machinery and Equipment

(Contd.)

Period/Lag	Regression Coefficient	T-value	Coefficient of Correlation	Partial Correlation coefficient	R^2	$\bar{R}^2$
1950-51 to 1979-80						
Unlagged	-0.4390	2.3965	0.685	-0.4139	0.604	0.587
1 year lag	0.1433	0.7644	0.643	0.151	0.463	0.398
2 year lag						
1950-51 to 1964-65						
Unlagged	0.6445	0.4718	0.754	0.1356	0.5747	0.5420
1 year Lag	-0.3519	0.2591	0.772	-0.0749	0.612	0.593
2 year Lag						
1965-66 to 1979-80						
Unlagged	-0.6386	3.5212	0.241	-0.7146	0.6801	0.6723
1 year Lag	0.5754	1.263	0.428	0.128	0.5130	0.496
2 year Lag						

more than 50% of the variance in private investment. This relationship is unlagged and with the introduction of one or two year lags the relationship breaks down.

In the above exercise, regression results revealed that a common time trend is the source of multicollinearity and in a number of cases the time trend is so significant that it distorts the results. A clear case of multicollinearity is that of construction which does not show a relationship clear in the sub periods. But if the element of time is left out by plotting growth rates in construction in the private sector against those in public sector it can be clearly seen that there exists a complete disjuncture between the two such that whenever growth rate in the public sector is high, that of private sector is low and often negative and vice versa. That there does exist a negative relationship between the two was confirmed by taking the coefficient of correlation and the rank correlation of the growth rates, which showed that the relationship was not only negative but also significant. Therefore to take account of the multicollinearity we have regressed increments to private investments by its components on increments to public investment by its components, with a varying set of lags. By doing this the multicollinearity is less "because changes are not as highly correlated as the absolute magnitude...."[8/]

The results of this exercise do not add significantly to our results except that the negative relationships become stronger and more significant. The basic pattern of relationship, however, remains unchanged. The results of the incremental regressions are given in Tables overleaf.

From our regression exercises, three significant points emerge:

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8. Maddala: Econometrics p.192.

Regression Results: ΔGDFC (PVT) regressed on ΔGDCF(PUB) By Type of Assets Component: Increments on GFCF

Period/Lag	Regression Coefficient	T-value	Correlation Coefficient	R^2	$\bar{R}^2$
1950-51 to 1979-80					
Unlagged	-0.1995	0.7100	-0.135	0.0183	0.0183
1 year Lag	0.3678	1.3202	0.251	0.0628	.0628
2 year Lag	0.2218	0.7590	.150	0.0225	0.225
3 year Lag	-0.6219	?.28	-0.422	.1782	.1782
1950-51 to 1964-65					
Unlagged	0.2141	0.2374	0.076	0.642	0.571
1 year Lag	2.1113	4.226	0.773	0.412	.321
2 year Lag	0.6033	0.7962	0.233	0.532	0.481
3 year Lag	-1.4988	1.9391	-0.523	0.611	0.572
1965-66 to 1979-80					
Unlagged	-0.2404	0.6727	-0.191	0.023	0.018
1 year Lag	0.1909	0.5305	0.150	0.054	0.020
2 year Lag	0.1905	0.4789	0.150	0.081	0.079
3 year Lag	-0.5601	1.4672	-0.439	0.1811	0.176
	Increments on Construction				
1950-51 to 1979-80					
Unlagged	-0.6965	3.2980	-0.536	.2871	.2871
1 Lag	-0.0267	0.1037	-0.020	.1332	.1332
2 Lag	-0.0137	0.507	-0.010	.0290	.0287
3 Lag	-0.2308	0.8202	-0.165	0.0272	0.0272
1950-51 to 1964-65					
Unlagged	-0.3698	0.08661	-0.234	0.542	0.521
1 Lag	0.7817	2.20	0.537	0.326	0.311
2 Lag	0.4429	1.17	0.335	0.421	0.42
3 Lag	-0.1443	0.2708	-0.085	0.187	0.173
1965-66 to 1979-80					
Unlagged	-0.7321	2.545	-0.578	0.442	0.417
1 lag	-0.1168	0.3134	-0.094	0.482	0.413
2 lag	-0.0439	0.1155	-0.037	0.321	0.320
3 lag	-0.3495	0.8767	-0.280	0.186	0.143

Increments on Machinery and Equipment

Period/Lag	Regression Coefficient	T Value	Coefficient of Correlation	R^2	R^2
1950-51 to 1979-80					
Unlagged	-0.9287	5.54	-0.730	0.5328	0.5328
1 Lag	0.5293	2.33	0.416	0.1729	0.1729
2 Lag	-0.2565	0.7025	-0.139	0.0192	0.0193
3 Lag	0.9462	1.4095	0.276	0.0764	0.0764
1950-51 to 1964-65					
Unlagged	1.018	0.7799	0.211	0.602	0.594
1 Lag	0.0053	0.0038	0.001	0.413	0.383
2 Lag	-0.8334	0.4961	-0.148	0.216	0.188
3 Lag	-1.0114	0.5861	-0.182	0.041	0.032
1965-66 to 1979-80					
Unlagged	-0.9633	6.0343	-0.867	0.804	0.792
1 Lag	0.5423	1.96	0.509	0.702	0.654
2 Lag	-0.2589	0.5161	-0.161	0.012	0.01
3 Lag	1.1897	1.2648	0.388	0.058	0.032

i. that there was a weak, positive and significant relationship between public investment and private investment that existed till 1964-65 which not only breaks down completely but is found to be strong and significantly negative in the later period i.e. 1965-66 to 1979-80.

ii. the negative relationships that are significant are mostly of an unlagged nature.

iii. that even though GFCF does not evince a relationship that is significant, both machinery and equipment and construction in the same period show strong and significantly negative relationship.

In explaining the pattern of relationship between private investment and public investment, which we saw above was of crowding out of private by public in the post 1965 period, the observations (ii) and (iii) are very useful.

That the relationship between public and private investment is significant (whether complimentary or crowding out) without any time lag and that it breaks off with the introduction of a time lag suggests that the relationship is operating on the supply side rather than the demand side, which by the very nature of its operation ought to have been lagged.

The strong and significantly negative relationship which exists for construction investment between the two sectors for the entire period, 1950-51 to 1979-80, is explainable in terms of a supply constraint that is exerted by the public sector on the private sector. The commodity requirements for construction investment in both public and private sectors are the same - cement, steel, timber etc. The main commodities amongst these are controlled commodities. For which public sector has a priority quota and the supply to the private sector is so to say a "residual supply". So once public sector "draws out" these commodities out of the market, the private sector facing a shortfall in

supply of these commodities is forced to curtail its investment in construction.

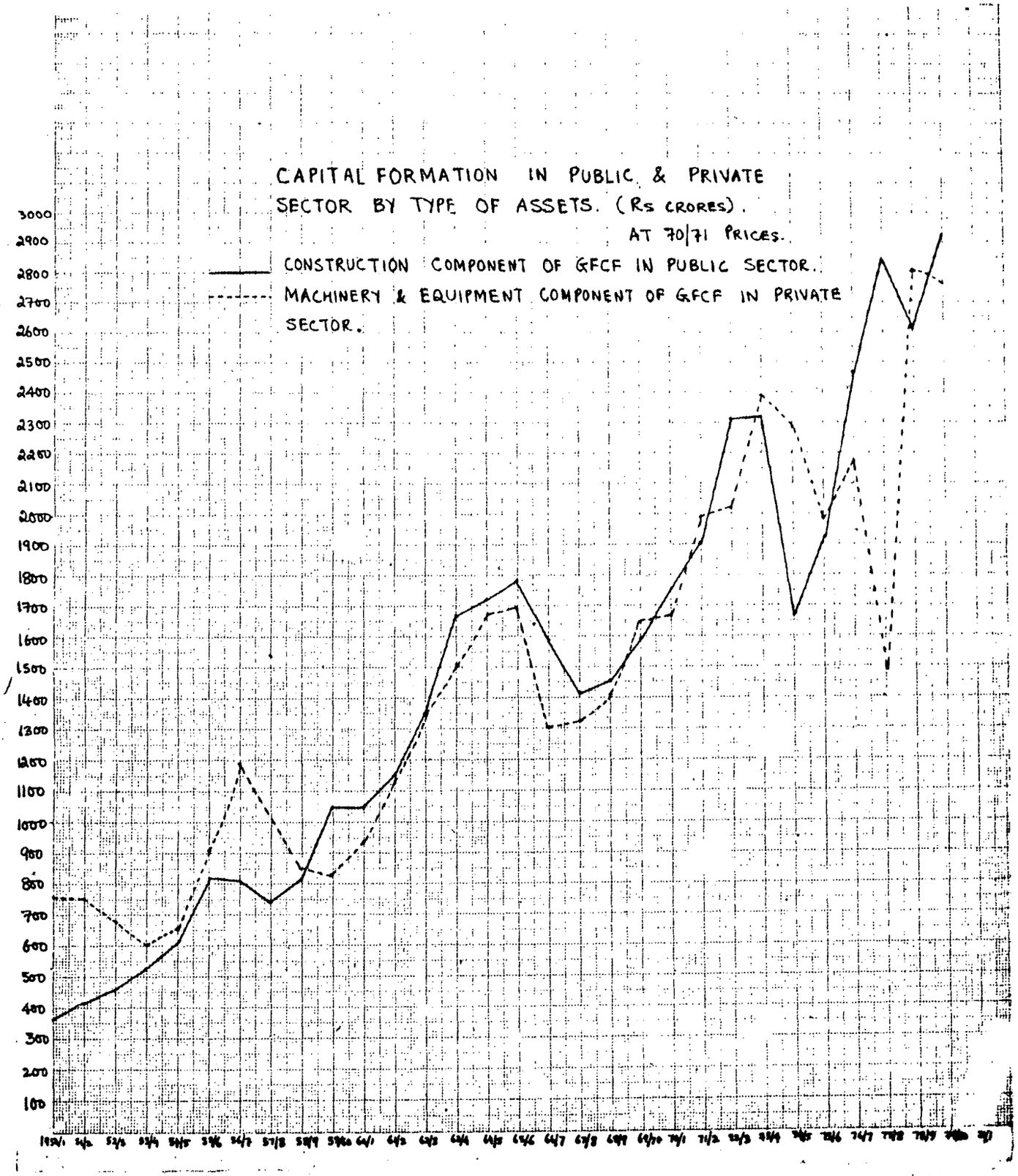
No such supply based explanations can however be forwarded to explain a significant negative relationship between machinery and equipment investment in the public sector with that of the private sector. This negative relationship which exists throughout the period 1950-51 to 1979-80 is particularly significant in the subperiod 1965-66 to 1979-80 whereas in the earlier sub period 1950-51 to 1964-65 it is positive but insignificant. The relationship, as in case of construction is of an unlagged nature, which would rule out demand factors explaining it.

Instead of interpreting this negative relationship as a case of crowding out and postulating that there is no linkage between the two sectors for machinery and equipment, which is not correct, we would argue that this negative relationship might be caused by the "time phasing" of investment in the private sector, prompted by a supply bottleneck in construction investment.

Machinery and equipment, as long as it is not replacement investment, has to follow construction investment in terms of buildings, such that if capital formation in construction takes place in period t, given a gestation lag in construction of the duration of ℓ, then the demand for machinery and equipment arises in period $(t + \ell)$.

Given the supply constraint on private sector investment in construction, the private sector time phases its investment in such a manner that machinery and equipment investment of private sector corresponds to the construction investment of public sector thereby mismatching its investment demand for construction with that in public sector and hence avoiding the supply bottlenecks.

This explains the negative relationship between public sector investment


CAPITAL FORMATION IN PUBLIC & PRIVATE SECTOR BY TYPE OF ASSETS. (Rs CRORES).
AT 70/71 PRICES.
CONSTRUCTION COMPONENT OF GFCF IN PUBLIC SECTOR.
MACHINERY & EQUIPMENT COMPONENT OF GFCF IN PRIVATE SECTOR.
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100

and private sector investment in machinery and equipment without commenting on the economic linkages of supply and demand between the two sectors.

The arguement of time phasing by the private sector of its construction investment with the machinery and equipment investment can be empirically substantiated by looking at the movements of these two components as done in Graph above. The very close correspondence between private sector capital formation in machinery and equipment and public sector capital formation in construction does suggest that the explanation forwarded above might be correct.

Another possible explanation that can be forwarded for this negative relationship is in terms of response of private sector to act as sub agents for supplying imported machinery and equipment to the public sector. In response to a demand for machinery and equipment, the private sector instead of creating capacities within the sector, may import machinery and equipment and supply it to the public sector. There are a number of examples for this at the micro level.

A relationship along such lines would mean a strong complimentarity between the two sectors, it would show up as a negative relationship in their investment behaviour since the funds used for importing are but diverted funds that could have been invested in capacity creation.

To summarise, in this chapter we analysed public investment in terms of its asset structure at an aggregate as well as at a disaggregated level. It was observed that:

a. consistent with our findings in Chapter 5, the rate of growth of gross fixed capital formation did not decelerate. During the plan holiday when there was an investment cutback, it was disproportionately borne by the construction component of fixed capital formation, at the aggregate as well as disaggregate level.

b. consequent upon the relatively faster rate of growth of the machinery and equipment component of fixed capital formation and (a) above, there is a clear shift in the asset structure of public investment in favour of machinery such that the "capital-goods intensity" of public investment has increased.

c. there is an extreme discrepancy between the rates of growth of machinery and equipment, and construction in the public sector and those in the whole economy, i.e. associated with high rates of growth in public sector are low rates of growth in the economy. The cause of this disjuncture was sought in the dismal performance of the private sector.

d. on exploring further the relationship between public and private investment, our conclusions were placed on a firmer footing. It was observed that there exists after 1965-66, a significantly negative relationship between the construction. component in public sector capital formation with that in the private sector. The other component of fixed capital formation i.e. machinery and equipment, also bore a significantly negative relationship with machinery and equipment in the private sector. The unlagged nature of the negative relationship in the case of construction indicates that the two sectors compete for scarce physical resources. In explaining the negative relationship which machinery and equipment in the public sector bears with that in the private sector no such explanation was provided. Instead, it was argued that since private sector capital formation in machinery and equipment tends to rise whenever public sector capital formation in construction rises, it would appear that private sector may be phasing the timing of its investment so as to avoid competition with public sector. An interesting feature that highlighted the fruitfulness of disaggregation was that, while both the components of fixed capital formation - construction, and machinery and equipment - were negatively related to their counterparts in the private sector, fixed capital formation did not evince a significantly

negative relationship. This can, however, be explained by the synchronised movement of machinery and equipment in the sector with that of the construction component of capital formation in the public sector.

e. in conformity with the results on the pattern of instability arrived at in the earlier chapters, the empirical analysis on instability in this chapter also clearly brought out the instability in public investment has been increasing over time.

STATISTICAL ANNEXURE

TO

CHAPTER - 6

Note: The source for all data, unless otherwise specified is:
National Accounts Statistics (Various Issues) C.S.O.
Transaction of the Public Sector, 1960-61 to 1979-80

Table 6.1: Capital Formation by Type of Assets in Public Sector

(Rs. Crores)

At 1970-71 prices

Year	GDFCF	Construction	Machinery & Equipment	Inventories	GDCF
1960-61	1642	1051	580	133	1775
1961-62	1722	1157	530	60	1782
1962-63	1966	1352	582	154	2120
1963-64	2295	1674	631	181	2476
1964-65	2475	1727	781	170	2645
1965-66	2591	1780	856	217	2808
1966-67	2446	1597	874	114	2560
1967-68	2266	1410	814	355	2621
1968-69	2336	1454	891	60	2396
1969-70	2355	1590	729	82	2437
1970-71	2392	1753	678	370	2762
1971-72	2594	1917	718	339	2933
1972-73	3128	2312	947	-4	3124
1973-74	3288	2329	963	626	3914
1974-75	2685	1678	989	833	3518
1975-76	3270	1920	1386	1195	4465
1976-77	4099	2471	1660	937	5036
1977-78	4322	2848	2613	131	4191
1978-79	4167	2612	1593	685	4852
1979-80	4478	2939	1569	797	5275

Table 6.2: Capital Formation by Type of Assets in Administrative Departments in Public Sector

(Rs. crores)
At 1970-71 prices

Year	GDCF	Construction	Machinery & Equipment	Inventories	GDCF
1960-61	447	432	15	91	538
1961-62	461	441	20	-40	421
1962-63	513	490	24	6	519
1963-64	565	538	27	-61	504
1964-65	606	570	36	14	620
1965-66	616	579	39	-32	584
1966-67	595	551	44	-175	420
1967-68	568	533	35	45	613
1968-69	569	531	43	-190	379
1969-70	574	550	40	-33	541
1970-71	611	574	37	-30	581
1971-72	786	733	53	-95	691
1972-73	971	903	73	-90	881
1973-74	1087	998	90	59	1146
1974-75	617	555	66	52	669
1975-76	642	591	75	62	704
1976-77	782	727	85	-27	755
1977-78	877	806	88	-213	664
1978-79	847	783	84	-98	749
1979-80	1124	1032	112	-18	1106

Table 6.3: Capital Formation by type of Assets in Departmental Undertakings

(Rs. crores)
At 1970-71 prices

Year	GDFCF	Construction	Machinery & Equipment	Stock	GDCF
1960-61	575	502	169	-50	525
1961-62	694	509	187	-80	614
1962-63	829	595	232	62	891
1963-64	953	705	251	-58	895
1964-65	1020	731	279	44	1064
1965-66	1136	700	310	-29	1107
1966-67	883	587	302	38	921
1967-68	828	559	218	5	833
1968-69	876	574	254	3	879
1969-70	776	567	210	-71	705
1970-71	804	583	221	38	842
1971-72	837	604	230	61	898
1972-73	907	796	273	49	956
1973-74	1005	776	266	11	1016
1974-75	928	657	271	33	961
1975-76	989	671	317	25	1014
1976-77	1195	895	321	11	1206
1977-78	1130	959	1329	-275	855
1978-79	1317	1009	307	-166	1151
1979-80	1319	945	347	46	1365

Table 6.4: Capital Formation by Type of Assets in Non-Departmental undertakings in Public Sector

(Rs. crores)
At 1970-71 prices

Year	GDFCF	Construction	Machinery & Equipment	Inventories	GDCF
1960-61	620	117	396	92	712
1961-62	567	207	323	100	667
1962-63	625	267	326	86	711
1963-64	777	431	353	178	955
1964-65	849	426	466	112	961
1965-66	1027	501	507	214	1241
1966-67	968	459	528	251	1219
1967-68	869	319	561	305	1174
1968-69	927	349	594	246	1173
1969-70	1004	473	479	119	1123
1970-71	977	596	421	362	1339
1971-72	971	580	435	373	1344
1972-73	1250	613	601	37	1287
1973-74	1195	555	608	556	1751
1974-75	1140	466	652	748	1888
1975-76	1639	657	994	1108	2747
1976-77	2122	849	1254	899	3021
1977-78	2315	1083	1197	357	2672
1978-79	2603	820	1202	753	2756
1979-80	2035	962	1111	769	2804

Table 6.5: Plan-wise Compound Annual Growth Rates of Capital Formation

at constant prices

	(1951-56) 1st Plan	(1956-61) 2nd Plan	(1961-66) 3rd Plan	(1966-69) Plan Holiday	(1969-74) 4th Plan	(1974-79) 5th Plan
Public Sector:						
i. GFCF	15.58	9.87	10.47	-2.30	9.35	11.57
ii. Construction	16.47	8.60	11.06	-4.69	10.40	12.79
iii. Machinery & Equipment	12.77	17.24	12.53	0.96	8.90	15.87
Administrative Departments						
i. GFCF	N.A	N.A	7.46	-2.23	17.40	9.45
ii. Construction	N.A	N.A	6.95	-1.84	16.44	9.98
iii. Machinery & Equipment	N.A	N.A	17.41	-1.14	23.01	6.42
Departmental Enterprises						
i. GFCF	15.73	1.46	11.92	-0.39	6.37	8.33
ii. Construction	16.57	6.30	8.43	-1.12	9.39	12.15
iii. Machinery & Equipment	13.45	-15.26	11.95	-8.65	6.84	16.82
Non Departmental Enterprises						
i. GFCF	18.65	49.92	14.94	-2.16	5.94	14.72
ii. Construction	46.94	21.92	22.34	-13.89	3.47	16.30
iii. Machinery & Equipment	14.20	78.28*	12.59	5.88	8.32	14.09

* See footnote 6, Chapter 6 above.

Note: Source of data for the period 1951 to 1960 is: R.N. Lal: Capital Formation and its financing in India, 1977. Page 124-125.

Table 6.6: Relative Rates of Growth in Components of Capital Formation

	1st Plan	2nd Plan	3rd Plan	Plan Holiday	4th Plan	5th Plan
Whole Economy						
i. GFCF	4.68	6.37	9.29	3.35	3.45	8.82
ii. Construction	5.18	3.52	8.12	4.73	-0.83	9.65
iii. Machinery & Equipment	3.65	-3.11	10.85	1.56	9.37	7.87
Private Sector						
i. GFCF						
ii. Construction	-1.52	-0.36	4.91	11.54	-12.77	6.52
iii. Machinery & Equipment	1.68	-11.12	10.06	3.75	9.56	1.25

Table 6.7: Plan wise Compound Annual Rates of Growth in Industry of Use by Type of Assets

Industry	Plan Period	GFCF	Construction	Machinery & Equipment
Agriculture	Third Plan	8.30	8.03	12.89
	Plan Holiday	7.92	7.79	14.38
	Fourth Plan	8.57	8.67	3.59
	Fifth Plan	18.04	18.01	17.34
Mining	Third Plan	11.35	21.82	16.38
	Plan Holiday	-17.45	-10.23	-24.27
	Fourth Plan	12.50	6.80	19.18
	Fifth Plan	26.69	35.38	20.70
Manufacture	Third Plan	19.50	24.84	21.07
	Plan Holiday	-10.01	-100.58	4.92
	Fourth Plan	3.94	4.61	7.76
	Fifth Plan	11.54	-8.67*	17.58
Electricity	Third Plan	12.00	18.43	5.46
	Plan Holiday	6.24	-14.67	8.10
	Fourth Plan	1.69	4.79	0.64
	Fifth Plan	13.30	15.56	10.72
Railways	Third Plan	6.71	6.25	7.51
	Plan Holiday	-13.60	-20.27	-5.39
	Fourth Plan	7.13	6.98	7.28
	Fifth Plan	2.98	4.98	0.93
Communication	Third Plan	13.89	13.49	14.27
	Plan Holiday	2.19	9.46	-11.13
	Fourth Plan	7.41	12.63	0.33
	Fifth Plan	9.00	9.77	8.43
Transport by other means	Third Plan	1.62	6.72	-1.08
	Plan Holiday	10.03	18.73	-11.59
	Fourth Plan	1.76	7.64	-2.27
	Fifth Plan	-6.48	-1.50	-12.24
Trade, Hotel & Restaurant	Third Plan	40.28	46.81	38.91
	Plan Holiday	5.88	-12.56	42.36
	Fourth Plan	-15.04	1.70	11.16
	Fifth Plan	4.73	15.19	-1.00

* This decline is exclusively due to a very sharp decline of about 75% in 1978-79. If this year is dropped the rate of growth for the rest of the plan period is 25%.

Chapter 7

INCREMENTAL CAPITAL OUTPUT RATIOS: A DISAGGREGATED ANALYSIS

If capital formation is necessary to maintain or increase the stock of capital goods required to produce a desired output, the possibilities of explaining the levels of and the trends in capital formation lie in a comparison of capital stock with output on either an aggregative or component basis. This line of reasoning is due to the dynamisation of Keynes' theory by Harrod and Domar which can be briefly stated as: Assume that technological and other requirements call for a given ratio of capital stock to desired annual output, say, the ratio of 5:1. If population and its desired level of per capita output both increase, then the required rate of growth of total output should be say, x% per annum. To maintain the required rate of capital to output of 5:1 with x% of growth of output calls for a growth in capital stock equal to 5x% of annual aggregate output. Hence under the assumptions just stated capital formation equals 5x% of national output, (which determines the level of capital formation or proportion of national income) and the rate of percentage growth in capital stock equals the rate of growth in national product. In turn the percentage rate of growth of capital stock, if observed over successive periods, will reveal the rate of capital formation. If one can either explain or assume the level and the rate of growth of population and of per capita product, one can, given a capital-output ratio (either constant or changing) derive the level and rate of growth of capital formation. While this is highly oversimplified view and certain easy extension can be made, it is sufficient to indicate the broad rationale for our interest in the capital-output

ratio as a measure that may advance our understanding of the factors that determine the volume of and/the rate of growth in capital formation.

In Chapter 4, it was discussed in detail as to how the rate of growth of output was determined by the rate of investment (i.e. capital formation as a percentage of total output) and the structure of investment. Recalling equation (9) which we derived, we have.

$$= \frac{I(t)}{Y(t)} \left\{ \frac{1}{b_1} \cdot \lambda_1 + \frac{1}{b_2} \cdot \lambda_2 + \frac{1}{b_3} \cdot \lambda_3 + \frac{1}{b_4} \lambda_4 \right\}.$$

The structure of investment, here, is essentially the sectoral allocation of investment (λ) weighted by their individual capital output ratio's (b_j) while in chapter 5 & 6 we discussed the changes in the former, in order to complete our discussion on the structure of investment, in this chapter we propose to study the movement in sectoral capital-output ratios

Capital-Output Ratio: Conceptual Issues:

Before we analyse our empirical findings we would like to discuss the conceptual and theoretical aspects underlying the capital-output ratio in some detail. This is essential because, as we shall see in the course of this chapter, the empirical estimation, and the analysis of capital-output ratio and more importantly the inferences drawn from the observed movements in the ratio are greatly marred by the lack of conceptual clarity.

There is a problem of defining the capital output ratio because there are a number of alternative forms of the ratio, depending on what measure of capital is included in the numerator and what measure of output in the denominator. However there are two basic forms in which capital-output ratio is expressed viz. Average capital output ratio (hereafter ACOR) and the Incremental Capital Output Ratio

(hereafter ICOR). The former relates total capital stock to total domestic product whereas the latter is a ratio of changes in capital stock to changes in the domestic product. The ICOR is thus a ratio between two incremental flows per unit of time, investment in the numerator and change in the output resulting from that investment in the denominator whereas ACOR is of a stock to a flow ratio at a point of time. Both ratios, however, presume the existence of a stable causal relationship between investment and output expansion.

Since we are interested in capital formation which will directly get affected by changes in domestic product we shall be mainly concerned with the ICOR. Also, as we shall discuss later in the chapter ICOR's have certain estimational advantages over ACOR. However it should be obvious that whether one is commenting on ACOR or ICOR the conclusions regarding the direction of change of the capital output ratio over a period of time will be the same even though the rates of change differ-for the average to rise, the marginal should rise faster and vice versa.[1/]

The key idea underlying the ICOR is that there is a stable relationship between investment and the expansion of output. In fact, the ICOR can be viewed as one factor production function linking increments in capital stock to the increments in capacity output. The assumptions about the relation of the increments of non-capital inputs to increments of capacity are not made explicit in discussions of ICOR's. The presumed relationship between investment and output change provides a guide to choose among alternative measures of investment and output in calculating the ICOR. The four measures of aggregate output typically considered in computing aggregate capital output ratio are Gross and Net National product and Gross and

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1. See Appendix for the relationship between ICOR and ACOR

Net domestic product. Domestic product in principle is a better output measure for this purpose. National product will move with changes in the proportion of domestic capital which is owned by foreigners, even though the total amount of domestic capital is unchanged. Since the ICOR is a measure of the investment required per unit change in output, national product conceptually is a less appropriate measure of output than domestic output.

As regards using gross domestic product or net domestic product, in our view gross domestic product is a better measure of output than net domestic product because in all countries estimates of capital consumption are based almost wholly on arbitrary assumptions about average asset lifetimes and the pattern of decline in asset values over time. Consequently, it is doubtful that available estimates on capital consumption measure the decline in asset values in any useful sense at all.[2/] Accordingly differences between gross domestic product and net domestic product must be viewed with great skepticism suggesting that gross doemstic product is a more meaningful measure of output.

So far as measures of investment are concerned, in principle all expenditures which contribute to an increase in the flow of measured output ought to be counted as a part of investment. However since all the expenditure does not contribute to capacity to produce measured output this does not lead us anywhere. A more relevant argument is whether ICOR's should be calculated solely on fixed investment or total investment (i.e. fixed investment plus inventories). Though there are arguments for excluding inventory changes, it cannot be denied that the carrying of some amount of inventories is vital to the maintenance of efficient production process and that, other things remaining the same, increases in domestic

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2. For a critical review of depreciation estimates provided by C.S.O See Chapter 3 above.

capacity output, will require larger inventories.

Another issue regarding measuring investment is whether the investment term in ICOR should be measured on a gross basis or net basis. The concept of ICOR as a measure of investment required to generate a unit increase in capacity clearly suggests that in principle investment should be on a net basis. That is, the ratio should include only that investment which expands capacity as distinct from investment required to replace capacity. Theoritically the arguement is sound but the problem arises at the empirical level. The estimates of net and replacement investment are not in accordance with these concepts, nor is there any information necessary to do so.

The estimates of annual net investment are found by taking the difference between the estimates of gross investment and estimates of replacement investment (defined as capital consumption). Net investment, in other words is a residual. This would not present any problems in the measurement of ICOR provided the estimates of replacement investment adequately measured the investment required to replace capacity. For, in this case, net investment necessarily would consist only of investment required to expand capacity and that is the measure of investment called for by the concept of the capital output ratios. The fact, however, is that no country measures replacement as the investment required to replace capacity. What is being done is that provisions are made for replacement by charging depreciation in accordance with the concept of maintaining the money value of their capital intact by allocating the original cost of the asset over its assumed expected life time.

The concepts of maintaining capital intact and maintaining capacity intact are quite different. While the first concept requires no account to be taken of changes in the average productivity of investment in calculating replacement,

the second concept insists that allowance be made for such changes.

Even if replacement investment instead of depreciation provision were deducted from both the numerator and the denominator to obtain the net ratio, it would still not be operationally meaningful as the denominator in this case would include not merely the output resulting from net investment but also from the additions to productive capacity resulting from replacement of old assets by technically superior assets; productive capacity is not kept intact by replacement investment as is generally assumed but increased because of technical change.

Thus, two sets of problems crop up because of this:

(a) Failure to allow for capital productivity change. This is so because of technological change, capital productivity rises over time and replacement investment calculated in accordance with the concept of maintaining capital intact systematically overstates replacement requirement and understates net investment by an exactly equal amount. Accordingly estimates of net ICOR would understate the true ratio.

(b) Proper estimation of replacement investment requires detailed information on the age structure of different types of assets and on the time pattern of decline in asset capacities. Both types of information are virtually non-existent. The manner in which an asset's capacity declines over its life time should determine the pattern of replacement outlays on that asset. Typically replacement outlays are allocated on the basis of some alternative depreciation patterns, mainly straight line or declining balance or "one stroke" depreciation patterns. The actual pattern of decline in asset capacity is unknown.

Thus the existing estimates of all replacement investment are questionable and may vary widely from true replacement investment. This can be demonstrated

algebraically as follows:

Let replacement investment in any asset in any year t be calculated on the assumption that the asset retains its original capacity throughout its life time and that it follows a "one stroke replacement" pattern. Therefore, replacement investment is equal to gross investment, (ignoring changes in productivity of assets) in the year t - m, where m is the life of the asset; That is:

$$R_t = I'_{t-m} \qquad \ldots\ldots (1)$$

where R_t = replacement investment in year t;

I_{t-m} = gross investment in year $t - m$[3/]

If gross investment in the asset has been increasing at a constant annual proportionate rate r, then the above equation 1 can be rewritten as:

$$R_t = \frac{I'_t}{(1+r)^m} \qquad \ldots\ldots\ldots (2)$$

If $I'_t = 100$; $r = 0.04$; $m = 30$; then $R_t = 30.9$

Now suppose, however, that m = 20 years instead of 30 and that the time pattern of decline in asset capacity is described by straightline depreciation patterns rather than "one stroke patterns". Moreover suppose the average productivity of investment is increasing by 1% per annum. What then is the value of "true" replacement investment?

Let R_t be the annual replacement expenditure for a given asset, equal to the original cost of the asset divided by the number of years it is expected to

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3. An implicit assumption made here is that the replacement investment in year (t - m) is zero.

last and adjusted for changes in the average productivity of new assets. For simplicity assume salvage value is zero. The decline in asset capacity is assumed to be spread in equal annual increments over the life of the asset

I'_t = annual gross investment in the given asset

r = annual proportionate increase in I';

m = life of the asset in years.

p = annual proportionate change in the average productivity of new investment in assets, where productivity is defined as asset capacity per rupee expenditure for the asset.

Assume that r, m, and p are constant and the same for all classes of assets. Also assume r is always positive and that m is always 2 or more. Then aggregate replacement expenditure in any year is the sum of replacement expenditures on all assets installed in the previous m years.

Algebriacally:

$$R_t = \frac{I'_{t-m}}{m(1+p)^m} + \frac{I'_{t-m(1+r)}}{m(1+p)^{m-1}} + \frac{I'_{t-m(1+r)^2}}{m(1+p)\,2} + \ldots\ldots + \frac{I'_{t-m(1+r)^{m-1}}}{m(1+p)}$$

Expressing in geometric progression:

$$R_t = \frac{I'_{t-m}}{m(1+p)^m} \left\{ 1 + (1+r)(1+p) + (1+r)^2(1+p)^2 + \ldots + (1+r)^{m-1}.(1+p)^{m-1} \right\}$$

Applying the rule for G.P. and noting that

$$I'_{t-m} = \frac{I'_t}{(1+r)^m}$$ we get

$$R_t = \left\{\frac{I'_t}{m(1+p)^m\ (1+r)^m}\right\} \left\{\frac{(1+r)^m.\ (1+p)^m - 1}{(1+r)\quad (1+p) - 1}\right\}$$

Substituting $r = 0.4$; $m = 20$; $p = 0.01$ and $I'_t = 100$ in the above equation gives $R_t = 63$. "True" replacement investment in this case is more than twice as much as 'apparent' replacement investment.

We digressed above to show that replacement investment is highly sensitive to the time patterns of decline in asset capacity, to the length of asset life and to whether allowance is made for changes in the average productivity of investment. Given our virtually complete ignorance concerning patterns of decline in asset capacity, length of asset service lines and since rising investment productivity may well be a pervasive phenomenon it follows net ICOR is almost spurious and use of this ratio should be avoided.

All this suggests that perhaps the ICOR ought to be calculated with gross investment rather than net investment in the numerator. This alternative is also subject to criticism on the grounds that it defies the underlying logic of the ICOR since replacement investment in principle bears neither a behavioural nor a technical relationship to changes in capacity. Also the investment component not related to capacity change i.e. replacement investment may be very large relative to the investment component which is so related i.e. net investment. To that extent use of gross investment may inflate the ICOR. The arguments for using gross investment are not strong and to that extent it is a superior measure of investment by default. The best that can be said in its favour is that the case for using net investment is even weaker.

Another issue is with regard to influence of price changes on ICOR, specifically whether ICOR's should be calculated at current prices or constant

prices. Accepted practice holds that ICOR ought to be calculated at constant prices and rightly so. The concept of ICOR as a kind of one factor production function implies a relationship between physical quantities of capital and output and therefore the measurement and analysis ought not be influenced by price changes. Moreover, since ICOR is a ratio of two magnitudes - investment and output, a differential rate of price change in these two magnitudes will distort the ICOR. For example, a relatively faster rate of increase in the prices of capital goods as compared to output will create an illusion of increasing ICOR's, even if everything else remains the same.

So far we have implicitly assumed that the investment made is simultaneous with an increase in productive capacity i.e. output is generated as soon as expenditure on investment is incurred. This however is an artificial assumption.[4/] The logic of introducing gestation lags was discussed in Chapter 4 and since the same holds here we need not repeat it. The only point we want to make here is that since the duration of the lag is unknown one has to perforce speculate about their duration and try lags of different forms and length. We have used, in an empirical estimates lags of different durations, because investment in a given year may generate output in different years depending on its maturity period. We shall discuss the specific features of the lags we have used in our empirical section that follows.

Sectoral ICORS:

Thus far our discussions have been in terms of aggregate ICOR. But it is obvious that anything connected with a capital output ratio should be first considered at the sector level. Aggregate ICOR seeks to measure the functional

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4. Chakravarty, S.(1968) Chapter IV

relationship between investment and output during a given period of time. However in trying to measure capital and output in an aggregate manner we are missing the composition of both capital and output that is different across sectors and the weights of these as well as the relative prices. As a consequence of this all types of capital-output relationship vary greatly from one sector to another.

As a matter of arithmetic, the overall ICOR is a weighted addition of the sector ones. This can be shown algebriacally as follows:

From equation 4 in Chapter 4 we have:

$$r = \frac{1}{b} \cdot \frac{I}{y}$$

and from equation (9) in Chapter 4 we have:

$$r = \frac{1}{y}\left\{\frac{1}{b_1} \cdot \lambda_1 + \frac{1}{b_2} \cdot \lambda_2 \quad \frac{1}{b_3}\lambda_3 + \frac{1}{b_4}\lambda_4\right\}$$

combining the above two equations we get

$$\beta = \left\{\frac{1}{b_1} \cdot \lambda_1 + \frac{1}{b_2}\lambda_2 + \frac{1}{b_3}\lambda_3 + \frac{1}{b_4}\lambda_4\right\}$$

where β = Aggregate ICOR;

$b_1 \ldots\ldots b_n$ = Sectoral ICOR; (Subscripts denoting sectors)

The only difference is that coefficient β is no longer a single coefficient, but has to be regarded as the weighted average of the different sector coefficients, the weights being the allocation ratios of investment in those sectors.

To obtain an ICOR for a sector all the points discussed above for the aggregate ICOR should logically remain the same except for one qualification

that needs to be made regarding the "cross effects of sectoral investment". In Chapter 4 we discussed the existence of "cross effects of sectoral investment" which gets accounted for when one is dealing with aggregate ICOR but is not captured in the sectoral ICOR. The cross effects of sectoral investment, as we defined them lead to increased output in sectors apart from the one in which investment has been made. This, as is obvious, would lend an upward bias to the sectoral ICOR of some sectors.[5/] We shall identify such sectors in our empirical analysis.

Review of Literature:

Theoretical formulations (especially the Keynesian type of growth models) make use of the aggregate capital-output ratio as an analytical tool as if it were a simple measurable operational concept. In any empirical analysis, however, it is obvious that the theoretical concept cannot be easily translated into empirical terms. When the concept of capital is operationalised i.e. whenever it plays a role as an independent variable influencing other quantities (say output in our case) the measurement is beset with tremendous problems. Measuring of the stock of accumulated capital over time is exceedingly difficult because (during a period of time) the stock consists of items of different ages of which each item need not be comprising of homogenous units, depreciating in individual patterns, having varying rates of mortality and obsolescence depending on the technical change. The methods of measuring capital stock like the perpetual inventory method need to express all the past additions to the capital in terms of base years prices. For the adjustments for variations in prices, however one requires

5. Apriori, it can be said that these cross effects will be higher in sectors like electricity, gas and water, transport and other infrastructural sectors.

to know the age structure of the assets for each year which being invariably based on convention and not measured empirically can be the source of a substantial degree of error in the estimates. The point we are trying to make is that there are insurmountableproblems in measuring capital stock precisely and that all the alternative estimates developed are of a 'second best nature'. To that extent the estimates of capital stock need to be handled with care, pointing out the biases that it may have.

With these reservation regarding the measurement of capital stock in mind we proceed to examine the existing studies and empirical material on capital output ratios in the Indian economy, in general and the public sector in particular.

The well established fact of India's successful efforts to accumulate a high capital stock through a consistently high rate of investment coupled with less than warranted growth rates in output gives aprori reason to believe that the capital output ratios in the economy have increased. Such an indirect inferential approach of analysing the behaviour of capital output ratios in India is exemplified by the following remark by Desai, a strong proponent of the rising capital-output ratio thesis, "A persistently high rate of industrial investment combined with low rate of industrial growth must indicate high capital-output ratio".[6] (emphasis added)

As in the case of investment, capital-output ratios also have been analysed for the Indian economy mainly in the context of industrial stagnation. It has been argued that rising capital-output ratios have been associated[7] with the slowing down of the industrial growth and/or are the reason for incommensurabily of high growth rate of output with high investment rate[8]. The across the board rise

6. Desai (1981) Page 389

7. Desai (1981), (1984)

8. Ahluwalia (1984), Bardhan (1984)

in capital output ratios especially in the public sector has been seen, as conventional wisdom would suggest, "the biggest manifestation of accumulating inefficiencies of resource utilisation".[9/]

As opposed to the inefficiency argument is the aggregate demand view which also speculated on the rise in the capital output ratio's but explained it as an artifact of low performance in which case the lines of causations run in the opposite direction i.e. low aggregate demand is causing inefficiences of resource utilisation[10/]

This view of increasing capital output ratios seems to have been fostered by Martin Wolf[11/]. Estimating the ACOR and ICOR from net reproducible tangible wealth (and increments on capital) and net domestic products (and increments on net domestic product) concludes that the aggregate ACOR for the economy rose markedly between 1961 and 1971, while the ICOR remaining stable during this period registered a rise in the earlier decade 1950-51 to 1960-61. Thereby implying that a rising ICOR does not lead to a rise in the ACOR and vice versa. The rise has been explained partly by the rising sectoral capital output ratios and partly by the shift from less to more capital intensive sectors, like electricity and public administration. Given the fact that the sectors identified as the source for increasing ACOR's-electricity and public administration - are solely public sector departments one can take it that implicitly the public sector was held responsible.

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9. Ahluwalia (1984)

10. Chakravarty, S.(1984). It needs to be noted here that Chakravarty does not seem to be convinced by the "arithmetic and casual observations (which) may partially support that the capital output ratio has risen on the margin.." (emphasis added). More importantly, he explicitly states, ".....it is not clear to me what are the factors which have contributed to this process on an economy wide basis". thereby recognising the limitations of capital-output ratio as a basis for making causal inferences.

11. World Bank (1978)

Ashok Desai[12] arguing against the income distribution hypothesis of industrial deceleration put forth the view that the slowing down of the industrial growth rate was accompanied by a rise in the ICOR in most industries, especially in the public sector. Desai has calculated sector ICOR for the whole economy on the basis of GDCF and GDP at constant prices. Periodising at five year intervals, the sectoral ICOR's are calculated by cumulating GDCF over the five year period and dividing it by the rise in GDP cumulated over the same five year period. His figures show that over the period 1950-51 to 1975-76 the ICOR in the primary sector more than doubled itself while in the case of mining and quarry it increased from 3.9 in the period 1950-51 to 1955-56, to 40.9 in the period 1975-76 to 1977-78. The ICOR in the secondary sector increased from 4.4 to 12.3 and those of electricity gas and water from 17.2 to 22.34 over the two decades. Infact except construction and railways he finds the rise across the board.

Attributing such high ratios to the public sectors, he argues that apart from corruption among politicians and bureaucrats the reason for high ICOR in the public sector is underutilisation of labour concomitant with which is underutilisation of capital. Explaining the political economy of unnecessarily high ICOR's in the public sector Desai writes, "Thus the high capital-output ratios are one of the consequences of the attempt of the pretty proles to squeeze in ever growing numbers into an industrial base that is not growing fast enough and the high ratios in turn lead to grossly inadequate rates of return and ploughback"[13]. In his recent article, however, Desai feels that there is some merit in the demand argument which attributes the underutilisation of capital and consequent rise in capital-output

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12. op.cit.

13. op.cit. p.394

ratios to the lack of demand. It is also argued that the changing product mix in favour of more capital intensive goods has contributed to the rise. However neither the rising trend of ICOR's in the public sector nor the assertions regarding changing product mix have been empirically substantiated by him.

As against this changing product mix argument of Desai, Isher Ahluwalia has putforth that the rise is not simply due to a relative shift in the pattern of recent industrial involvement towards capital intensive industries like chemicals, fertiliser petrochemical etc. but all industry groups show a rise which is particularly pronounced in the public sector.[14/]

Basing her analysis on gross capital stock estimates provided by Dadi and Hashim, Ahluwalia has derived the capital output ratios at constant prices for the manufacturing sector as a whole and its twenty industry groups. Though very strong assertions are made regarding the increase being due to the very high ratios in public sector, no estimates of capital output ratios for public sector or manufacturing are provided to show the pattern and magnitude of the rise. In fact no series, whatsoever of capital output ratio is given. What has been provided is a one set of figures of capital output ratio for the years 1959-60 to 1965-66 and another relating to the years 1966-67 to 1979-80. The specific method of estimation of the two sets of capital output ratio which is essential for analysing the rise in these ratio has not been discussed. One presumes that the ACORS have been calculated for the initial year and the terminal year of the two sub periods.

On comparing the ACOR's of the pre 1965 and post 1965 period a rise is observed in both sub periods almost across all industry groups. The rise in the

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14. op.cit.

ACOR on decomposition shows that while the dominant effect on the increase in the pre 1965 period was due to increases in the capital output ratio of individual industry groups, and partly due to the increased share of more capital intensive industry groups, in the post 1965 period it was exclusively due to the former factor.

The decomposition exercise carried out by Ahluwalia is based on the end point estimates of capital output ratios i.e. in the pre 1965 period a comparison is made between ACOR for the year 1959-60 with that of 1965-66 and the change therein is decomposed. Similarly in the post 1965 period a change in the ACOR of 1976-77 over the ACOR of 1965-66 is decomposed.

Since Ahluwalia's analysis of the ACOR is with a view to examine the efficiency with which income is generated from the use of capital an increasing trend in ACOR necessarily would imply increased inefficiency.

Bardhan[15] who also believes that the capital output ratios have increased provides an explanation in terms of the power structure of the Indian polity that has emerged over the last decade and a half. The emergent power structure being coilatory was therefore conflictual with no interest group strong enough to dominate the process of resource allocation. Such plurality meant a proliferation of subsidies, grants and a culture of politics of patronage which apart from reducing the resources available with the state for capital formation reflected in the high ICOR's and low capacity utilisation in the public sector. Once again, we find that there is no empirical basis provided for these estimates.

The basic criticisms against the above summarised contributions on

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15. op.cit.

capital output ratios is the lack of empirical evidence, moreso, with regard to the public sector capital output ratios. Though there is total agreement that the source of the high and rising capital output ratios lies in the public sector no one has documented the nature, patterns and magnitude of the rise in the public sector capital-output ratios.

Apart from this general problem there are specific methodological problems with whatever estimates are provided by the above discussed contributors.

Martin Wolf[16] uses net reproducible tangible wealth for computing capital output ratios. The concept of reproducible tangible wealth is not synonymous with capital stock and needs to be differentiated from the concept of capital stock. While the concept of tangible wealth is an accounting concept, the concept of capital stock is a functional concept. Capital output ratio being a functional economic parameter reproducible tangible capital cannot be used for its computation . It needs to be realised that while reproducible tangible wealth accounting is detached from the methods and problems of estimating output, this is not so in estimating capital stock which being a factor of production necessiates its identification with the output that can be associated with it (capital stock). When reproducible tangible capital is used instead of stock of capital in capital output ratio, it is like having a notional measure of its output and then putting the two together in a functional relationship. In concrete terms, the point we are trying to make is, given that the capital output ratio is a sort of one factor production function which has implications for efficiency and productivity, consumer durables like house property etc. should not be counted as a part of capital stock.

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16. World Bank (1978)

Another serious problem with Wolf's estimates of ACOR and ICOR is that they are based on end points e.g. the growth increments in reproducible tangible wealth taken between 1951 and 1961 and applied to increment in net domestic product between these two years. This obviously is a very unsatisfactory way of calculating ICOR's which are extremely fluctuating and by following this method one will lose sight of the trend or path traversed by the ICOR's or ACOR's. Also this method relies entirely on the end points which may not be normal years particularly when no justification has been provided for selecting these particular years. His decadal periodisation is not based on any understanding of the structural factors which would warrant such a periodisation and is totally arbitrary.

Compared to Martin Wolf, Isher Ahluwalia has used data more scientifically. Her analysis of capital output ratio is in terms of ACOR and is restricted only to the manufacturing sector. Apart from the reservations which we expressed against the use of ACOR, her estimates have certain biases. These are due to the use of capital stock estimates provided by Dadi and Hashim which, as Goldar[17] has shown in detail, seriously over estimate the value of fixed capital stock. Two examples that he has provided amply illustrate the point: while the ratio of replacement value to book value of fixed assets for 1946 as estimated by Dadi and Hashim is 8.7, from the Report of Taxation Enquiry Commission Goldar finds that the ratio was only 2.4. Similarly, whereas Sinha's and Sawhneys estimates of gross capital stock for five important industries (cotton, Jute, Cement, Sugar and Paper) was Rs.671 crores in 1950 at 1950 prices the corresponding estimate provided by Dadi and Hashim place the figure at Rs.1577 crores.

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17. Goldar (1981)

More importantly, Dadi and Hashim's coverage is extremely limited. For 1960 which is the bench mark year for Isher Ahluwalia's study, Dadi and Hashim use gross-net ratios which have been computed from 1000 balance sheets of firms covered by ASI. On comparing the value of fixed assets of these 1000 firms with the corresponding ASI estimates it is clear that for aggregate manufacturing the coverage of these balance sheets is less than 50% in all cases -- about 48% in building and construction, 43% in plant and machinery and 41% in other equipment.

Another fundamental problem with Isher Ahluwalia's estimates of ACOR arises from her use of Gross fixed capital stock at <u>replacement cost</u> for the bench mark year which Dadi and Hashim have provided. The ideal method that needs to be followed in estimating replacement cost is first to estimate the cost of replacement with a equivalent new asset and second to make an allowance for age, wear tear and obsoloscence. The difficulty is that replacement if it were to take place, would not be by identical units. Capital undergoes an almost continuous process improvement and hardly any two assets produced at different times are identical . So one has to take account of the difference in profitability of the two types of assets. Consequently, it is difficult to understand how book value can be adjusted, as done by Dadi and Hashim, to equal replacement cost. Book values as a rule are at original cost and it seems to us impossible to bring them to a given level of prices, without knowing the composition of total assets by years of vintage and their depreciation pattern.

All these insurmountableproblem associated with the estimation of capital stock and hence average capital output ratios suggest that one is certainly on a surer ground while dealing with ICOR's where no such estimational problems are confronted and the data base is much more reliable. Also analysis of ACOR does not add to our understanding anything which can't be inferred from a proper

study of ICOR given the relationship between the two ratios. Moreover for our purpose of studing capital formation which will directly affected changes in domestic product, ICOR is the more relevant variable to analyse.

Empirical Evidence:

From the review of literature on the behaviour of capital output ratios we find that despite their different methodologies used for computing capital output ratios, their varying concerns and approaches, and different explanations, there is total agreement on two propositions:

i. that the capital output ratios (ACOR/ICOR) show a trend increase over time.

ii. that this increase is primarily because of an increase in the public sector ICORs.

Our concern in this study being with the public sector we shall first look at the empirical evidence on the behaviour of ICOR's in the public sector and then try to relate it to the economy's incremental capital-output ratios.

In conformity with our discussions on the ideal form of capital output ratio we have used gross domestic capital formation and gross domestic product both at constant prices for deriving the gross ICOR, at industry of use level.

For each industry within public sector we have estimated ICOR by two methods:

i. Conventional Method: i.e. change in the capital stock in relation to change in domestic product.

ii. Regression Method: i.e. regressing cumulative investment (in period t) with domestic product (in period t). The regression coefficient under this specification gives directly the estimates of period wise ICOR's , thereby avoiding all problems associated with averaging and weighting year to year ICOR's to arrive at period ICOR's.

While the conventional method has been used for working out a time series on ICOR's, the regression method has been used for calculating ICOR's for different periods.

Conventional Method:

For our estimates of annual ICOR's we have used two variants of the conventional method:

i. Simple ICOR where yearly gross domestic capital formation is related to change in gross domestic product, with varying time lags in production. symbolically,

$$ICOR_{(t+\ell)} = I_t / \Delta O(t+\ell)$$

Where I_t = GDCF in timeperiod t

ΔO = Change in gross domestic product

ℓ = duration of the lag

This single year ICOR being subject to extreme variability and fluctuations it may be difficult to discuss the trend in the Some of this variability results from the variation in the rate of capacity utilisation and ought, in principle, to be removed. To do this correctly would require detailed examination of the rate of capacity utilisation which is impossible due to lack of data. Therefore in order to roughly correct for the variations in rate of capacity utilisation and thereby even outthe fluctuations we have used:

ii. Moving average ICOR's which are based on five yearly moving averages of GDCF and change in GDP. Five yearly moving averages are probably most appropriate since five years is the length of plan periods and therefore the ratio will cover total investment and output changes over the entire plan period.

Moving averages of GDCF and ΔGDP are related with varying lags in production

Symbolically,

$$ICOR^*_{t+\ell} = \frac{\sum_{t}^{t+4} I_t/5}{\sum_{t+\ell}^{t+\ell+4} \Delta Q_{t+\ell/5}}$$

This method is better than the simple ICOR method in that it leaves scope for "distributed"[18] lags to operate. By relating the moving average of gross domestic capital formation with the moving average of gross domestic product we leave scope for the investment in period t to mature anywhere between period t and t+5, thereby effectively introducing a distributed/variable lag. And since we have also introduced a fixed lag of duration 'ℓ' years, where ℓ = 1,2,3 years, the time given to investment for maturity is increased to (t+5+ℓ). Thus for

18. The word "distributed" is used in a very specific sense. To make the meaning clear consider the following example.

Period	GDCF	ΔGDP
1	x_1	y_1
2	x_2	y_2
3	x_3	y_3
4	x_4	y_4
5	x_5	y_5
6	x_6	y_6

By taking five year moving averages, say from period 1 to 5, 2 to 6 and so on in GDCF and relating it to the corresponding moving average figure in GDP what happens is that GDCF, in say, period 1 gets related to output in period 1 to 5. Thus effectively a 'distributed lag' of 4 years gets introduced.

example if ℓ = 2 years, then effectively the lag structure of investment is between 0-7 years. Such a lag system is particularly useful since our knowledge about the duration of time lags in investment is virtually non-existent.

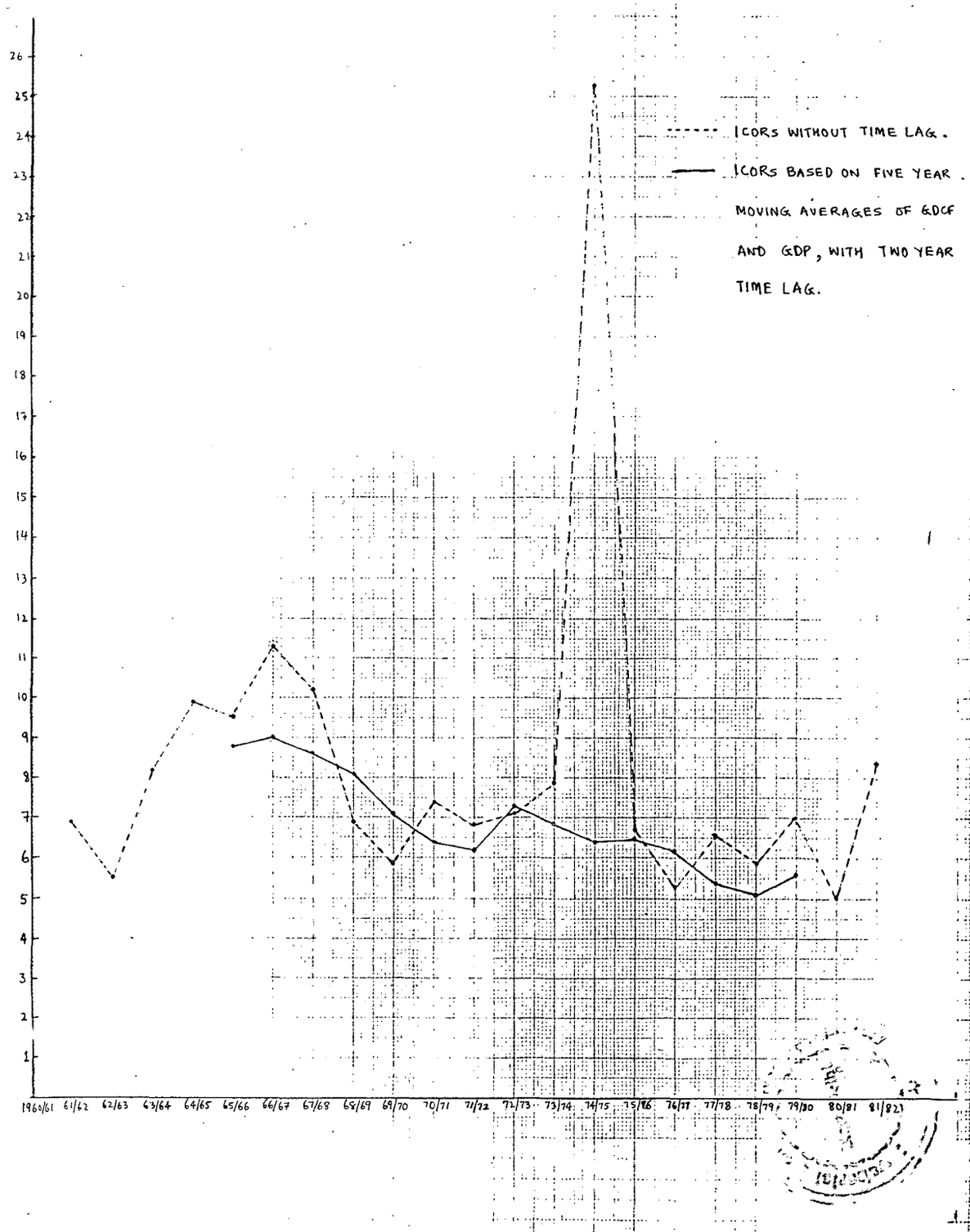
The estimates of gross ICOR at constant prices by industry of use in public sector, and public sector as a whole, are presented in the statistical annexure of this chapter (Tables 7.1 to 7.14). These tables provide time series on public sector ICOR's, both by the simple as well as the moving average methods. Both methods have been used to calculate ICOR's with and without lags. For the lagged ICOR's lags of 1 year, 2 year and 3 year duration have been used.

Contrary to the popular belief that public sector ICOR's have not only been rising but have been rising so fast that the source of high and rising ICOR's for the whole economy is the public sector, we find that ICOR's for the public sector as a whole have been declining steadily and secularly. (See Table 7.1 and graph overleaf). Though this secular decline in the public sector ICOR's is brought out very sharply by the moving average ICOR with a two year lag (column 7; Table 7.1) the declining trend is clearly discernible even with the unlagged year to year ICOR's (column 1; Table 7.1). The public sector moving average ICOR with a two year lag has been declining at a compound annual rate of -3.51% per annum.

The fact that ICOR's for the aggregate public sector have declined substantially, in itself suggests that the certain industries within public sector would either have registered a fall in their ICOR's or the weight of the capital intensive industries (in terms of output mix) would have declined which in turn would have pulled down the aggregate public sector ICOR's.

Looking at the ICOR's for public sector by industry of use we find that except for two industries -- electricity, gas and water and transport by other means in all other industries ICOR's have been declining.

INCREMENTAL CAPITAL-OUTPUT RATIOS IN PUBLIC SECTOR.



In Agriculture even though the ICOR's are high in absolute magnitude, higher than manufacturing, they have been declining consistently from 23.18 in 1965-66 to 11.48 in 1978-79 - a reduction of more than 50% (column 7; Table 2). The single year unlagged ICOR's show a declining trend of -5.25% per annum

In case of mining and quarry the ICOR's have registered a decline between 1965-66 and 1975-76 whereafter it tends to increase. However when the entire period, 1960-61 to 1981-82, is taken the rate of decline of ICOR's is -3.87% per annum (Table 7.3)

Though ICOR's in agriculture have declined secularly over time, the ICOR's in primary sector exhibit the same patterns as is observed in mining and quarry. This is so because the weight of mining and quarry in terms of share of GDP has been increasing within the primary sector.[19] As in case of mining and quarry the ICOR's is primary sector show a rising tendency after 1975-76 but till 1975-76 the ICOR's declined at a phenomenal rate of 11.06% per annum. (Table 7.4).

In the case of manufacturing it seems difficult to discuss a clear trend. The ICOR's here have been extremely erratic. fluctuating between -117 to +114. However looking at the moving average ICOR with a two year lag we find that these have been declining at a compound annual rate of 0.82%. This is also borne out by Graph overleaf. Between 1964-65 and 1968-69 the ICOR's as shown by two year lagged moving average ICOR have been increasing but thereafter it declined drastically at a compound rate of -12.52% per annum till 1974-75. Thereafter the ICOR's show an increasing trend.

The ICOR's in construction have registered an uninterrupted fall from 3.25 to 1.04 (single year unlagged ICOR column 1 (Table 7.6) and from 2.82 to 0.71 in the

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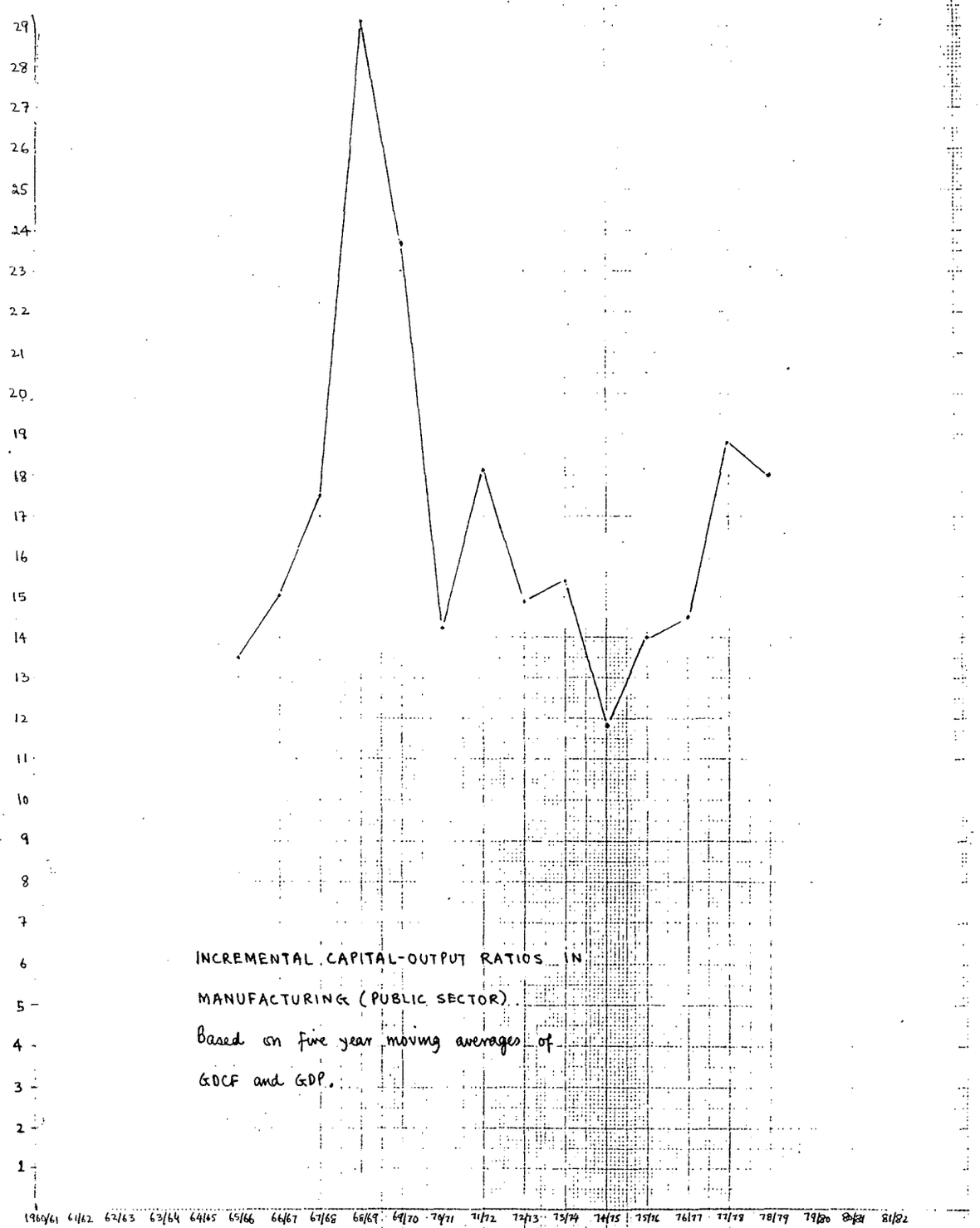
19. See Chapter 5 above



INCREMENTAL CAPITAL-OUTPUT RATIOS IN MANUFACTURING (PUBLIC SECTOR).
Based on five year moving averages of GDCF and GDP.

case of moving average ICOR with a two year lag (Table 7.6)

Electricity, gas and water and transport by other means are the only two industrial categories where not only the ICOR's are high but are also rising. The compound rate of growth of ICOR's is 2.91% and 2.51% per annum. However these high ICOR's need not reflect inefficiency as Isher Ahluwalia[20] would argue. The reason for ICOR's being high in industries like electricity, gas and water, transport, and agriculture is that these being infrastructural industries public sector capital formation in these industries is of the nature of stimulants to private investment and therefore the "cross effects of investment" in these industries are exceptionally high. That is the output resulting from these industries does not get recorded within the sector itself as it gets distributed across other industries particularly in the private sector. Our contention that investment in sectors like electricity, gas and water and transport leads to generation of output in sectors other than in their own is substantiated by the strong correlation between private investment and public investment in these sectors.[21] To that extent that these cross effects of investment are high, which in certain cases are even greater than direct effects, the ICOR's of these industries are seriously overestimated, and present a distorted picture.

Railway, the industry in which as, we saw in Chapter 5 investment had declined substantially, has had the sharpest fall in its ICOR's from 24.42 in 1965-66 to 8.67 in 1979-80 (column 7; table 7.9) at a compound annual rate of 10.20% per annum.

Similarly ICOR's for public administration and defence and finance

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20. Op.cit. 1984

21. See section on Relationship between Public Investment and Private Investment above in Chapter 5 and 6.

community and personal services have declined secularly. In case of Public Administration and Defence ICOR's declined from 8.08 to 2.24 (column1; Table 7.14) at a rate of 7.74% per annum, whereas the ICOR's in finance, community and personal services declined at a compound annual rate of -5.95%.

The above discussed behaviour of Public Sector ICOR's - aggregated and disaggregated probably gives enough evidence to suggest that the increasing capital-output ratio based inefficiency argument against capital investment in public sector is a myth.

It would perhpas be in order to point out here why our estimates are diametrically opposed to whatever scanty estimates are available for public sector ICORstill now. Desai[22], for example, using the same data as ours has shown that ICORs in government companies have been increasing over time. The basic problem with the calculations of ICOR's[23] done so far, whether they have been calculated for the economy or public sector has been periodisation. The period under study is broken up into periods, for which there may or may not be any structural considerations, and then the arithmetic mean of ICOR's is taken as the average ICOR for that particular period. Arithmetic mean of such ratios like ICORs, subject to high positive and limited negative values naturally tends to be high. If period averages of ICOR are to be taken some weightage of ratios in computing these period averages is necessary. This has not been recognised. Consequently one unusually high ICOR figure, inflates the average for the entire period thereby creating an illusion of increasing ICOR's. An example would illustrate our point.

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22. op.cit.

23. Rangarajan (1982), Sundrum (1983), Desai (1981), Raj (1984)

Desai[24] contends that ICOR's have risen phenomenally during the period 1965-76. Since his is a plan based periodisation the decade 1965-76 consists of two periods viz. 1965-66 to 1970-71 and 1970-71 to 1975-76. The latter period estimates get distorted by one year in which the ICOR is very high i.e. 1974-75[25] Trying to reason out as to why the ICOR is very high in this year, it is possible that 1974-75 being the terminal year of the fourth plan, carried over investment from previous year would have got bunched together in order to achieve the target set for the plan, which is a routine phenomenon. This undoubtedly does reflect inefficiency but of a different kind from what would be reflected by an increasing ICOR. Consider the period 1965-66 to 1970-71, the rise in this periods average ICOR is biased because in these years output fell and a rising ICOR is not the cause but effect of this.

Thus the method of computing period ICOR's employed by them is not correct.

We have also estimated period wise ICORs and in order to avoid all these averaging and weighting problems we have used regression method for estimating period ICOR's.

Regression Method:

For calculating ICORs for periods we have regressed cumulative gross domestic capital formation with gross domestic product. The regression coefficient under this specification gives directly the estimates of ICOR. Since every year's capital formation and output is taken into account with its due weight the problem arising due to an unusual year are avoided.

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24. op.cit. (1984)

25. The ICOR for the public sector in this year is an unprecedented 25.30 and for manufacturing it is 50.43.

The estimates of ICORs derived from this method are given in Table 7.14.1 for public sector as a whole and its main industrial categories. The results correspond to our conclusions arrived on the basis of the conventional method.

By the regression method we have estimated ICORs for two decadel periods 1960-61 to 1970-71 and 1971-72 to 1981-82. During the first subperiod ICOR's were higher for all subsectors as well as the aggregate public sector as compared to the second decade. The only exception to this was manufacturing where the ICORs have remained more or less constant.

Decomposition of Incremental Capital Output Ratios:

It may be recollected that in our review on the estimates of ICOR's we had discussed two assertions that have been frequently made in the literature:

a. that the source of high and increasing ICORs in public sector is attributable to an 'across the board' increase in ICORs of all industry categories within public sector.

b. that the source of increasing ICORs in the economy is the public sector.

Inspite of the fact that the evidence presented above makes these arguments look superflous, we shall nevertheless try to decompose the public sector ICORs and the decline therein into:

a. the contribution of sub-sectors to aggregate public sector ICOR

b. the contribution of a shift in the sectoral composition of output and the 'pure' ICOR to aggregate public sector.

The decomposition scheme has been structured out as follows:

Let β_1^* be the aggregate ICOR of public sector in time period 1

β_2^* be the aggregate ICOR for public sector in time period 2

Given that the public sector comprises of 4 sub sectors i.e. Primary, Secondary, Transport, Communication and Trade, and Finance Community and personal services we have:

$$\beta_1^* = \sum_{i=1}^{4} \beta_{1i} \lambda_{1i}$$

$$\beta_2^* = \sum_{i=1}^{4} \beta_{2i} \lambda_{2i}$$

where: β_i = sub-sector ICOR ($i=1$ to 4)

λ_i = i^{th} subsectors contribution to incremental output in public sector

$$\beta_2^* - \beta_1^* = \sum_{i=1}^{4} \beta_{2i} \lambda_{2i} - \sum_{i=1}^{4} \beta_{1i} \lambda_{1i}$$

$$= \sum_{i=1}^{4} \beta_{1i}(\lambda_{2i} - \lambda_{1i}) + \sum_{i=1}^{4} \lambda_{1i} (\beta_{2i} - \beta_{1i}) + \sum_{i=1}^{4} (\beta_{2i} - \beta_{1i})(\lambda_{2i} - \lambda_{1i})$$

where: $\beta_{1i}(\lambda_{2i} - \lambda_{1i})$ = change in aggregate ICOR due to change in output mix which we shall call "output mix change"

$\lambda_{1i}(\beta_{2i} - \beta_{1i})$ = change due to subsectoral ICOR which we shall call "pure ICOR change"

$(\beta_{2i} - \beta_{1i})(\lambda_{2i} - \lambda_{1i})$ = interaction term

With the help of this decomposition scheme we can arrive at not only the output mix effect, pure ICOR effect and interaction terms for the public sector as a whole but also for the subsectors.

Taking five year moving average ICOR around the year 1966-67 (i.e. 1964-65 to 1968-69) and the same for 1978-79 (1976-77 to 1980-81) we have tried to examine the contribution of each of these factors as well as the subsectors to a decline in the aggregate public sector ICOR. The table given below gives the results of the decomposition exercise. Between the period 1964-65 to 1968-69 and 1976-77 to 1980-81 the ICOR in public sector declined from 8.51 to 4.87. This decline, of 3.64, can be attributed to

a. changes in output mix

b. change in pure subsectoral ICORs.

c. interaction terms.

As the table overleaf shows, only 27% of this observed decline was due to a shift in the sectoral composition of public sector output whereas 71% is due to a decline in the pure subsectoral ICOR. The interaction is negligible.

At the subsectoral level, the primary sector has contributed 8.34% to the decline whereas the secondary sector accounted for about 28% of the decline. The highest contribution of 35% to the decline in aggregate public sector ICORs comes from transport, communication and trade.

Table . : Decomposition of changes in Public Sector ICOR: Contributions of Subsectors, Sectoral ICOR's and output mix

(1966-67 to 1978-79)

Sub Sector										Total	%
Primary	15.64	0.0793	11.39	0.0822	-4.25	0.00286	0.04473	-0.3370	-0.01215	-.30442	8.34
Secondary	12.33	0.2532	10.72	0.1961	-1.61	-0.05713	-0.70441	-0.4076	+0.09197	-1.02004	28.02
Transport and Communication	11. ?	0.1967	8.28	0.1195	-3.15	-0.07722	-0.88262	-0.6196	+0.2432	-1.25902	34.58
Finance C&P.S	4.04	0.4706	1.40	0.6022	- 2.64	0.13167	0.53194	-1.2423	-0.34760	-1.05796	29.06
Public Sector	8.51	1.0	4.87	1.0	-3.64	0.00	-1.01036	-2.6065	-0.02458	-3.64	100
% contribution	-	-	-	-	-	-	27.75	71.60	0.6752	100	

Note : ICOR of public sector based on 5 year average for the period (1964-65 to 1968-69), which is time period 1

: ICOR of public sector based on 5 year average for the period (1976-77 to 1980-81), which is time period 2

: Share of subsectors in increment to aggregate public sector gross domestic product in time period 1

: Share of subsectors in increment to aggregate public sector gross doemstic product in time period 2

: Contribution because of a shift in subsectoral incremental output i.e. output mix change.

: pure ICOR effect

: Interaction terms

Thus we find that the main contributor to the decline of ICOR has not been a change in the sector composition of output (i.e. output mix effect) but the decline is due to a decline in the individual ICORs of subsectors (i.e. pure ICOR effect).

As regards the source of high and increasing ICORs for the economy which, it is argued,[25] is the public sector we have used the same decomposition as above to arrive at the contribution of each sector to the aggregate economy's ICORs.

However before we decompose the ICOR for the economy, let us enquire whether they have increased at all. The same method as was used for calculating public sector ICORs was used to estimate the ICORs - lagged and unlagged for the whole economy. The results are presented in tables 7.15 to 7.22.

The yearly ICOR for the whole economy is widely fluctuating with no apparent trend (See Graph overleaf). Introduction of time lags of the duration of one to three years also does not help in evincing a trend. However when we look at the ICORs calculated on the basis of five yearly moving averages in gross domestic capital formation and change in gross domestic product we find that over the period of two decades i.e. 1960-61 to 1981-82 there is a declining trend - though not as clear as in the public sector which we observed above. The decline in the ICOR for the whole economy is particularly sharp after 1972-73, when it declined from 9.36 to 5.67 in 1979-80 (column 5, Table 7.15).

As regards manufacturing in the economy, no trend is discernible when a straight comparison is made between investment and increment in output. The ICORs are fluctuating widely between -36 and 44. After evening out the fluctu-

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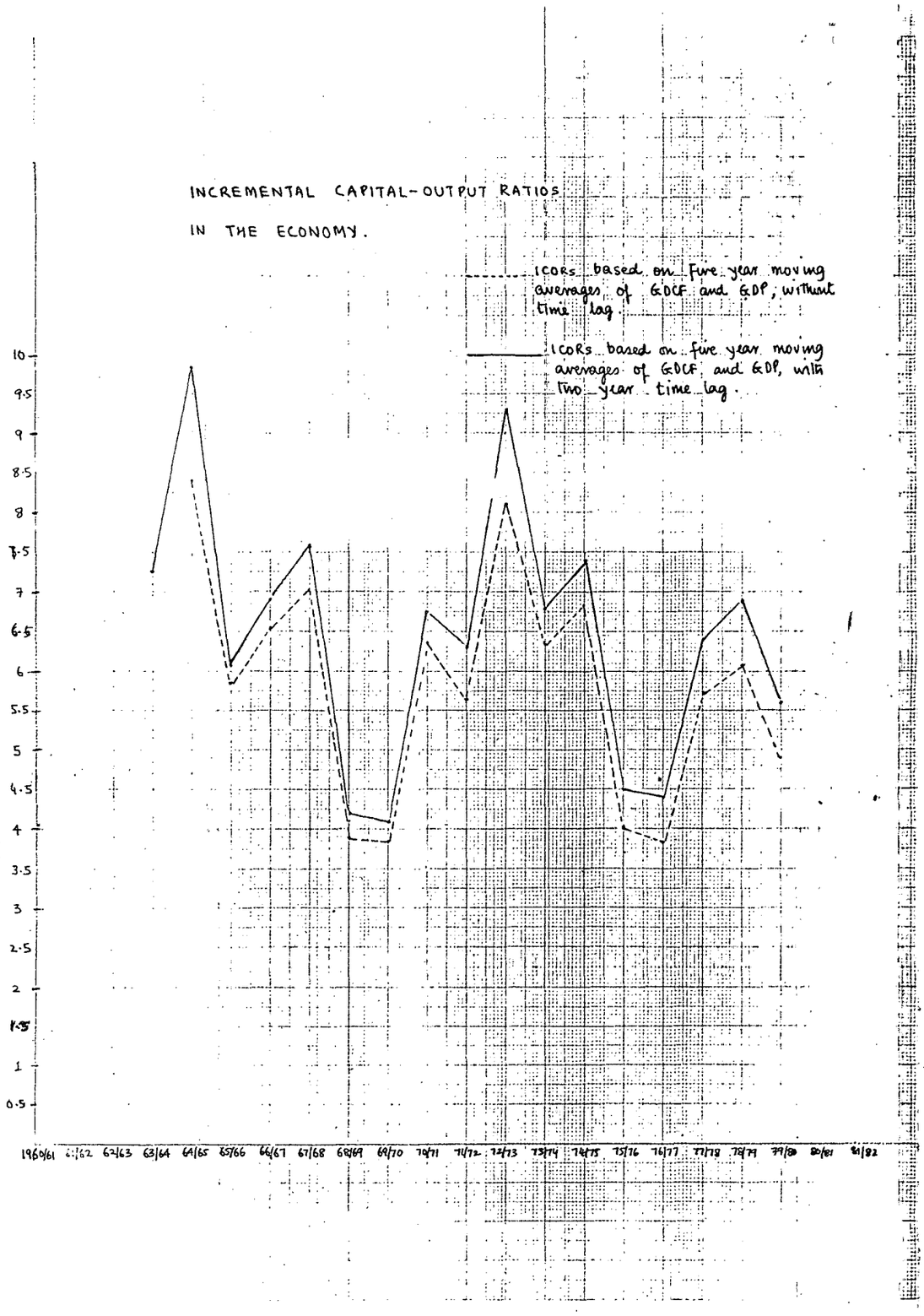
25. Desai op.cit.
Ahluwalia op.cit.


INCREMENTAL CAPITAL-OUTPUT RATIOS
IN THE ECONOMY.
ICORs based on five year moving averages of GDCF and GDP, without time lag.
ICORs based on five year moving averages of GDCF and GDP, with two-year time lag.
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
1960/61
61/62
62/63
63/64
64/65
65/66
66/67
67/68
68/69
69/70
70/71
71/72
72/73
73/74
74/75
75/76
76/77
77/78
78/79
79/80
80/81
81/82

ations by considering moving average based ICORs, one can demarcate a pattern in these fluctuations. Till 1969-70 the ICOR (with and without a time lag) declined; thereafter it increased till 1972-73 and then declined quite sharply till 1979-80 (See Graph overleaf and table 7.18 column 5 and 6). Considering the overall period there does seem to be a declining trend.

In the subsector transport, communication and trade, ICORs remained more or less constant till 1970-71 but thereafter show a distinct declining trend. The moving average ICOR without a time lag declined from 6.52 in 1972-73 to 3.95 in 1979-80.

In the case of finance, community and personal services the ICORs have registered a secular decline which is clear even with year to year simple ICORs with or without lags (Table 7.21). The magnitude of the decline is also substantial - the ICORs having decreased from 7.93 in 1961-62 to 2.21 in 1981-82.

A slight (but perceptible) declining tendency in the whole economy ICORs observed above when counterposed with a sub stantial decline in the public sector ICORs established earlier in the chapter, give us apriori reason to speculate that the decline which should have occurred in the whole economy ICORs consequent upon a fall in the public sector ICORs is being nullified by the movements of the ICORs in the private sector. Therefore it should be interesting to estimate the contribution of public sector and private sector to the ICORs and the changes in the ICORs of the economy.

This was done by weighting the public sector and private sector ICORs, which make up the aggregate economy's ICOR, by their share in the incremental gross domestic product of the economy. Both, the absolute ICOR for the economy as well as the change in the ICOR was decomposed. For the purpose of decomposition

year to year simple ICOR with a two year lag was taken. The results are presented in table overleaf.

From the results it becomes clear that except for two years i.e. 1977-78 and 1980-81 it is the private sector and not the public sector which contributes a major part to the absolute ICOR and the change in the ICOR of the economy. The contribution of private sector has been more than 50% except for the two above mentioned years.

This should not, however, be taken to mean that the private sector ICORs are higher than that of public sector - it may not be so and also it need not be so. For, the reason behind the higher contribution of private sector (to the aggregate ICOR) is its higher weight in the incremental gross domestic product. On the other hand, even if public sector ICORs are very high they will not get reflected in the aggregate economy's ICOR because theweight of public sector in the incremental gross domestic product of the economy is low. This point has not been recognised by those who attribute the "rise" in ICORs of the economy to a "rise" in the ICORs of the public sector. To illustrate our point let us consider the following example. In 1967-68 the public sector ICOR was 11.03 while its weight in incremental gross domestic product was 0.1006. When weighted, the "actual" contribution of the public sector to the ICOR of the economy for the same year was just 1.11. Given this fact that for the sectoral ICOR to inflate the aggregate ICOR it is essential not only to have a high ICOR but more importantly to have a higher weight in output, its seems to us that locating the source of "increased" ICORs of the economy as done by Desai, Bardhan and Ahluwalia[26] is based on preconieved notions rather than facts.

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26. op.cit.

Table : Decomposition of Aggregate ICORs into the contribution of public sector and private sector

Year	WHOLE ECONOMY		CONTRIBUTION OF PUBLIC SECTOR TO WHOLE ECONOMY ICOR		CONTRIBUTION OF PUBLIC SECTOR TO WHOLE ECONOMY ΔICOR		CONTRIBUTION OF PRIVATE SECTOR TO WHOLE ECONOMY ICOR		CONTRIBUTION OF PRIVATE SECTOR TO WHOLE ECONOMY ΔICOR	
	ICOR	ΔICOR	Absolute	(%)	Absolute	(%)	Absolute	(%)	Absolute	(%)
1960-61										
1961-62										
1962-63	8.03	-	3.24	40.34			4.79	59.66		
1963-64	3.00	-5.03	1.30	43.33	-1.94	38.56	1.7	56.67	-3.09	61.43
1964-65	2.14	-0.86	0.97	45.32	-0.33	38.37	1.17	54.68	-0.53	61.63
1965-66	-3.18	-5.32	-1.51	47.48	- 2.48	46.61	-4.69	52.52	2.84	53.39
1966-67	19.65	16.47	9.38	47.73	10.89	66.12	10.27	52.27	5.58	33.88
1967-68	2.40	-17.25	1.11	46.25	- 8.27	47.94	1.29	53.75	-8.98	52.06
1968-69	7.78	+5.38	3.0	38.56	1.89	35.13	4.78	61.44	3.49	64.87
1969-70	2.95	-4.83	1.26	42.71	- 1.74	36.02	1.69	57.29	-3.09	63.98
1970-71	2.97	0.02	1.23	41.41	-0.03	66.67	1.74	58.59	0.05	33.34
1971-72	9.15	6.18	4.10	44.80	2.87	46.44	5.05	55.2	3.31	53.56
1972-73	-14.49	-23.64	-5.6	38.64	1.5	-6.34	20.09	61.36	-25.41	106.34
1973-74	4.32	18.18	1.70	39.35	7.3	38.80	2.62	60.65	11.51	61.2
1974-75	21.24	16.92	9.39	46.75	7.69	45.44	11.85	53.25	9.23	54.56
1975-76	2.46	-18.78	1.01	41.05	-8.38	44.62	1.45	58.95	-10.4	55.38
1976-77	25.32	22.86	10.84	42.81	9.83	43.00	14.48	57.19	13.03	57.00
1977-78	2.22	-23.1	1.17	52.70	-9.67	41.86	1.05	47.30	-13.43	58.14
1978-79	3.43	1.21	1.59	46.35	0.42	34.71	1.84	53.65	0.79	65.29
1979-80	-3.81	-7.24	-1.25	32.80	2.84	39.22	5.06	67.20	10.08	60.78
1980-81	3.34	0.47	2.22	66.46	3.47	738.29	1.12	33.54	-3.0	-638.29

Note: All ICORs have been calculated with a two year time lag in production

$$\Delta \text{ICOR} = \text{ICOR}_{t+1} - \text{ICOR}_{t}$$

To recapitulate then, in this chapter, we started by clarifying certain basic theoretical and conceptual issues which we felt had impaired the estimation of capital output ratios and the inferences drawn from such estimates.

From the review of literature, which highlighted the need for moving away from making inferential statements and casual empiricism, two main arguments were dilenated:

a. that the capital-output ratios (ACOR/ICOR) in the public sector are increasing.

b. that these increasing ICORs in the public sector have led to increasing ICORs in the economy.

Both these conclusions, it was argued, had not been empirically substantiated and consequently the empirical section of this chapter was devoted to document the trend in ICORs in the public sector, at an aggregate as well as a disaggregated level. We also, with the help of a decomposition framework, arrived at the contribution of public sector ICORs to the ICORs in the economy.

On the basis of our detailed analysis of the ICORs in the public sector, it was observed:

a. the ICORs in the public sector, far from increasing, have been actually declining

b. except in the case of electricity, gas and water, and transport by other means, ICORs in all other industrial categories have registered a decline, the magnitude of which varies

The decomposition exercise carried out to assess:

i. the contribution of a shift in the 'output mix' towards less capital intensive industries to the decline in the ICORS.

ii. the contribution of public sector ICORs to the ICORs in the economy.

On the basis of the decomposition framework we concluded:

c. consistent with (b) above, the decline in ICORs cannot be attributed to a shift in the sectoral composition of output in favour of less capital intensive industrial categories. The decline in the aggregate public sector ICORs, it was shown, was predominantly due a decline in the "pure ICORs" at the industry of use level.

d. contributions of public sector ICORs to the aggregate ICORs in the economy does not depend only on the magnitude of the public sector ICORs but also on the weight of public sector ICORs but also on the weight of : blic sector in the incremental output of the economy. Consequently, even if the ICORs in the public sector are high they cannot 'inflate' the whole economy ICORs, primarily because of the low weight of public sector in total output. It was empirically shown that the contribution of public sector to the absolute ICOR and the change in the ICORs of the economy has always been less than that of the public sector.

APPENDIX

A METHOD FOR CALCULATING AVERAGE CAPITAL OUTPUT RATIOS FROM INCREMENTAL CAPITAL OUTPUT RATIOS:

The relationship between average and incremental capital output ratio can be used to arrive at the average capital output ratio from the incremental capital output ratio. This can be done as follows:

Let,

K_1 = capital stock in time period 1

K_2 = capital stock in time period 2

By definition,

$\Delta K = K_2 - K_1$ = capital formation in period 2

P_1 = Output in time period 1

P_2 = Output in time period 2

Conceptually,

ICOR = Capital formation/change in output

Therefore, $ICOR_2 = \frac{K_2 - K_1}{P_2 - P_1} = \frac{\Delta K_2}{\Delta P_2}$

where $ICOR_2$ = Incremental capital-output ratio in period 2

By definition:

ACOR = capital stock/output

Therefore; $ACOR_1 = \frac{K_1}{P_1}$

where: $ACOR_1$ = Average Capital output ratio in time period 1

Similarly $ACOR_2 = \frac{K_2}{P_2}$

$$= \frac{K_1 + \Delta K}{P_1 + \Delta P}$$

substracting and adding $\frac{K_1}{P_1}$ from the right hand side, we have

$$ACOR_2 = \frac{K_1 + \Delta K}{P_1 + \Delta P} - \frac{K_1}{P_1} + \frac{K_1}{P_1}$$

$$= \frac{P_1K_1 + P_1\Delta K - K_1P_1 - K_1\Delta P}{P_1(P_1 + \Delta P)} + \frac{K_1}{P_1}$$

$$= \frac{P_1\Delta K}{P_1(P_1 + \Delta P)} - \frac{K_1\Delta P}{P_1(P_1 + \Delta P)} + \frac{K_1}{P_1}$$

$$= \frac{\Delta K}{P_1 + \Delta P} - \frac{K_1}{P_1}\left\{\frac{\Delta P}{P_1 + \Delta P} - 1\right\}$$

$$= \frac{\Delta K}{P_1 + \Delta P} + \frac{K_1}{P_1}\left\{1 - \frac{\Delta P}{P_1 + \Delta P}\right\}$$

$$= \frac{\Delta K}{P_1 + \Delta P} \cdot \frac{\Delta P}{\Delta P} + \frac{K_1}{P_1}\left\{1 - \frac{\Delta P}{P_1 + \Delta P}\right\}$$

$$ACOR_2 = \frac{\Delta K}{\Delta P} \cdot \frac{\Delta P}{P_1 + \Delta P} + \frac{K_1}{P_1}\left\{1 - \frac{\Delta P}{P_1 + \Delta P}\right\}$$

By definition; $\frac{\Delta K}{\Delta P}$ = incremental capital output ratio

$\frac{K_1}{P_1}$ = Average capital output ratio;

Therefore:

$$ACOR_2 = ICOR_2 \frac{\Delta P}{P_1 + \Delta P} + ACOR_1 \frac{P_1}{P_1 + \Delta P}$$

$$ACOR_2 = ICOR_2 \left\{\frac{\Delta P}{P_2}\right\} + ACOR_1 \left\{\frac{P_1}{P_2}\right\} \quad \ldots\ldots\ldots (1)$$

Equation 1, can therefore be interpreted to mean that the current average capital output ratio is a sum of the weighted incremental capital output ratio in the current period and the weighted average capital output ratio of the previous period.

This method of calculating ACORs avoids the computation of year to year capital stock, which as was discussed in the chapter, is subject to numerous problems. All that is required to arrive at an ACOR series, following the above method, is the net capital stock in the initial year and capital formation figures thereafter.

STATISTICAL ANNEXURE

TO

CHAPTER 7

Note: The source for all data, unless otherwise specified, is:
National Accounts Statistics, C.S.O. (Various Issues)

Table 7.1: Incremental Capital Output Ratios in Public Sector (Aggregate)

At Constant Prices

Year	Simple ICORS				ICOR's based on five year moving averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	6.93	7.05						
1962-63	5.59	4.60	4.68					
1963-64	8.20	7.39	6.09	6.18	7.88			
1964-65	9.90	9.00	8.10	6.68	8.58	8.05		
1965-66	9.58	8.97	8.15	7.34	9.76	9.42	8.84	
1966-67	11.33	12.53	11.74	10.66	9.38	9.39	9.07	8.51
1967-68	10.21	9.97	11.03	10.32	8.40	8.60	8.61	8.31
1968-69	6.90	7.59	7.41	8.20	7.97	8.01	8.19	8.21
1969-70	5.99	6.05	6.65	6.50	7.26	7.05	7.09	7.25
1970-71	7.45	6.37	6.44	7.08	6.85	6.60	6.41	6.44
1971-72	6.81	6.38	5.46	5.52	7.09	6.45	6.21	6.03
1972-73	7.12	6.72	6.30	5.39	8.69	8.07	7.35	7.08
1973-74	7.95	6.67	6.29	5.90	8.30	7.52	6.99	6.36
1974-75	25.30	26.89	22.54	21.27	7.63	7.10	6.43	5.98
1975-76	6.73	5.34	5.68	4.76	7.50	7.12	6.62	6.00
1976-77	5.39	5.56	4.41	4.69	6.99	6.57	6.25	5.81
1977-78	6.68	6.94	7.16	5.68	6.31	5.82	5.48	5.20
1978-79	5.92	4.89	5.08	5.24	5.90	5.62	5.18	4.87
1979-80	7.06	6.67	5.51	5.72	6.46	6.01	5.72	5.28
1980-81	5.03	4.77	4.50	3.72				
1981-82	8.46	7.75	7.34	6.93				

Notes: $ICOR_0$: Incremental Capital Output Ratio estimated with no time lag in production

$ICOR_1$: Incremental Capital Output Ratio estimated with one year time lag in production

$ICOR_2$: Incremental Capital Output Ratio estimated with two year lag in production

$ICOR_3$: Incremental Capital Output Ratio, estimated with a three year lag in production.

$ICOR^*$: Incremental Capital Output Ratio estimated on the basis of 5 year moving averages in GDCF and GDP. Subscripts refer to length of time lag in production as in case of simple ICORs

Table 7.2: Incremental Capital Output Ratios in Public Sector By Industry of Use

1. Agriculture

At Constant Prices

Year	Simple ICORS				ICOR's based on five year moving averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	17.5	17.16						
1962-63	240.0	207.0	211.0					
1963-64	22.36	21.54	19.09	19.18	24.51			
1964-65	21.38	18.69	18.46	16.15	26.17	25.0		
1965-66	20.06	18.40	16.40	16.00	24.81	24.27	23.18	
1966-67	24.54	27.00	25.27	22.36	23.81	22.75	22.25	21.25
1967-68	54.0	52.40	60.20	55.60	34.0	33.23	31.74	31.04
1968-69	19.37	17.20	16.87	18.81	27.09	26.58	25.98	24.81
1969-70	-77.75	-49.50	-67.50	-67.50	26.15	24.83	24.36	23.81
1970-71	12.18	10.27	11.48	10.00	22.31	20.37	19.35	18.98
1971-72	21.81	21.80	19.43	19.37	24.98	23.53	21.49	20.41
1972-73	19.04	115.66	14.95	14.13	18.34	17.88	16.84	15.38
1973-74	34.66	13.86	29.08	27.41	19.89	19.09	18.61	17.53
1974-75	14.32	17.08	16.76	13.96	19.37	17.25	16.55	16.14
1975-76	17.73	16.76	18.08	18.21	17.29	15.66	14.13	13.55
1976-77	18.09	13.23	11.54	13.41	13.96	12.56	11.37	10.26
1977-78	13.70	12.06	8.68	7.61	15.96	14.19	12.76	11.56
1978-79	10.67	11.19	8.76	6.37	14.11	12.92	11.48	10.33
1979-80	31.36	35.57	29.27	25.50	14.21	13.99	12.81	11.39
1980-81	10.17	9.75	10.19	9.61				
1981-82	18.54	21.09	20.09	20.69				

Note: Same as Table 7.1

Table 7.3: Incremental Capital Output Ratios in Public Sector By Industry of Use

2. Mining and Quarrying

At constant prices

Year	Simple ICORS				ICOR's based on five year Moving Averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	- 4.80	-4.70						
1962-63	1.92	1.26	1.23					
1963-64	14.0	10.42	6.85	6.71	8.64			
1964-65	-51.50	-49.0	-36.50	-24.0	7.67	6.59		
1965-66	5.58	8.58	8.16	6.08	15.09	14.61	12.54	
1966-67	28.0	16.75	25.75	24.50	15.03	16.13	15.62	13.41
1967-68	8.80	11.20	6.70	10.30	11.32	11.78	12.64	12.24
1968-69	13.20	17.60	22.40	13.4-	17.44	16.76	17.44	18.72
1969-70	14.33	11.00	14.66	18.66	15.92	16.76	16.11	16.76
1970-71	0	0.0	0.0	0.0	9.89	9.0	9.47	9.10
1971-72	18.0	16.80	17.20	13.20	3.69	3.03	2.76	2.90
1972-73	4.30	3.0	2.80	2.86	4.71	4.10	3.37	3.06
1973-74	1.51	1.18	0.825	0.77	4.35	3.24	2.85	2.34
1974-75	-18.67	-18.33	-14.33	-10.0	5.22	3.87	2.91	2.54
1975-76	4.96	2.84	2.79	2.18	7.45	6.15	4.56	3.43
1976-77	13.24	10.10	5.79	5.68	17.41	15.49	12.79	9.49
1977-78	-123.0	-128.0	-97.66	-56	10.34	9.22	8.20	6.77
1978-79	25.84	28.38	29.53	22.53	13.86	12.68	11.31	10.06
1979-80	5.08	4.80	5.27	5.48	16.74	15.31	14.01	12.50
1980-81	16.21	12.71	12.0	13.17				
1981-82	35.06	28.37	22.25	21.00				

Notes: Same as Table 7.1

Table 7.4: Incremental Capital Output Ratios in Public Sector by Industry of Use

3. Primary Sector

At Constant Prices

Year	Simple ICORS				ICOR's based on five year Moving Averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	89.66	90.0						
1962-63	7.43	6.11	6.13					
1963-64	21.00	19.23	15.82	15.88	15.37			
1964-65	36.09	32.45	29.72	24.45	14.13	13.15		
1965-66	10.18	10.44	9.39	8.60	17.91	17.43	16.23	
1966-67	18.09	17.59	18.04	16.22	17.59	17.27	16.81	15.64
1967-68	19.87	20.94	20.36	20.89	18.58	18.42	18.08	17.60
1968-69	18.71	18.00	18.95	18.42	20.56	20.10	19.92	19.56
1969-70	69.0	65.50	63.0	66.33	19.04	18.48	18.07	17.91
1970-71	14.40	13.80	13.10	12.60	14.98	13.74	13.34	13.04
1971-72	13.90	13.09	12.54	11.90	9.78	8.98	8.23	7.99
1972-73	9.26	7.52	7.08	6.78	9.26	8.81	8.08	7.41
1973-74	4.89	4.63	3.76	3.54	8.48	7.64	7.27	6.67
1974-75	15.88	17.55	16.61	13.50	9.15	7.77	7.00	6.66
1975-76	8.05	6.06	6.70	6.34	11.16	9.79	8.31	7.49
1976-77	15.14	11.20	8.43	9.32	14.19	12.71	11.14	9.46
1977-78	28.13	26.18	19.37	14.59	14.22	12.65	11.33	9.93
1978-79	13.11	13.01	12.11	8.96	15.64	14.30	12.73	11.39
1979-80	15.14	14.77	14.66	13.64	17.10	16.37	14.97	13.32
1980-81	13.45	12.35	12.05	11.96				
1981-82	24.59	23.89	21.93	21.40				

Notes: Same as Table 7.1

Table 7.5: Incremental Capital Output Ratics in Public Sector by Industry of Use

4. Manufacturing

At Constant Prices

Year	Simple ICORS				ICOR's based on five year Moving Averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	3.20	4.28						
1962-63	3.82	3.30	4.42					
1963-64	7.12	6.36	5.50	7.36	6.70			
1964-65	11.80	9.90	8.85	7.65	10.86	9.29		
1965-66	16.53	12.4	10.41	9.30	17.26	15.87	13.57	
1966-67	114.83	107.5	80.66	67.66	16.95	16.36	15.04	12.86
1967-68	29.50	34.45	32.25	24.20	18.10	18.23	17.58	16.16
1968-69	7.71	8.93	10.43	9.77	26.87	28.96	29.17	28.14
1969-70	15.96	17.55	20.34	23.75	20.65	22.02	23.73	23.90
1970-71	-20.76	-22.04	-24.23	-28.09	13.34	13.33	14.21	15.32
1971-72	18.64	15.57	16.53	18.17	20.29	18.15	18.12	19.33
1972-73	6.81	6.00	5.01	5.32	19.21	16.69	14.92	14.91
1973-74	50.43	37.06	32.62	27.25	19.85	17.74	15.41	13.78
1974-75	15.06	13.67	10.05	8.84	15.13	13.30	11.89	10.33
1975-76	-117.42	-127.0	-115.28	-84.17	17.28	15.95	14.02	12.53
1976-77	8.65	6.96	7.53	6.83	16.49	15.76	14.54	12.79
1977-78	12.83	13.98	11.26	12.17	21.24	19.76	18.88	17.43
1978-79	24.78	22.85	24.90	20.04	21.12	19.43	18.08	17.28
1979-80	103.16	84.66	78.08	85.08	-357.75	-341.93	-314.62	-292.81
1980-81	83.93	82.53	67.73	62.46				
1981-82	-8.11	-8.01	-7.88	-6.47				

Note: Same as Table 7.1

Table 7.6: Incremental Capital Output Ratios in Public Sector by Industry of Use

5. Construction

At Constant Prices

Year	Simple ICORS				ICORS based on five year moving Averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	3.25	2.75						
1962-63	1.80	1.30	1.10					
1963-64	2.75	2.25	1.62	1.37	2.74			
1964-65	-10.00	-11.00	-9.0	-6.5	3.35	3.09		
1965-66	1.53	1.33	1.46	1.20	3.41	3.05	2.82	
1966-67	0.0	0.0	0.0	0.0	3.07	2.82	2.53	2.34
1967-68	2.30	1.61	1.76	1.53	3.06	2.80	2.57	2.31
1968-69	2.13	2.0	1.40	1.53	3.10	3.63	3.31	3.05
1969-70	16.00	16.0	15.0	10.50	1.91	2.03	2.37	2.17
1970-71	0.37	4.0	4.0	3.75	1.60	2.09	2.22	2.60
1971-72	0.70	15.0	1.6	1.6	1.11	1.10	1.44	1.53
1972-73	0.50	1.75	6.37	4.0	1.23	0.91	0.90	1.18
1973-74	0.84	0.10	0.35	0.07	1.93	1.50	1.11	1.10
1974-75	3.26	1.73	0.21	0.73	1.60	1.46	1.13	0.84
1975-76	-4.0	-6.88	-3.66	-0.44	1.50	1.15	1.04	0.81
1976-77	0.64	0.80	1.37	0.73	1.66	1.43	1.10	1.00
1977-78	1.10	0.60	0.75	1.29	0.85	0.90	0.78	0.60
1978-79	1.46	1.17	0.64	0.80	0.78	0.63	0.66	0.57
1979-80	0.34	0.46	0.37	0.20	1.11	0.89	0.71	0.75
1980-81	1.04	0.55	0.74	0.59				
1981-82	0.0	0.0	0.0	0.0				

Note: Same as Table 7.1

Table 7.7: Incremental Capital Output Ratios in Public Sector by Industry of Use

6. Electricity, Gas, and Water

At Constant Prices

Year	Simple ICORS				ICORS based on five year moving averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	17.11	10.27						
1962-63	17.75	15.4	9.25					
1963-64	15.89	12.67	11.0	6.60	19.60			
1964-65	27.75	27.81	22.18	19.25	20.05	18.70		
1965-66	22.0	19.30	19.34	15.43	18.36	17.54	16.46	
1966-67	19.82	22.0	19.30	19.34	16.44	16.27	15.64	14.59
1967-68	12.68	13.02	14.45	12.68	15.35	14.77	14.61	14.05
1968-69	10.65	10.09	10.36	11.50	17.07	16.17	15.56	15.40
1969-70	16.71	14.65	13.87	14.25	17.73	16.62	15.75	15.15
1970-71	42.66	35.66	31.26	29.60	21.25	19.94	18.70	17.72
1971-72	23.14	23.70	19.81	17.37	29.00	27.78	26.05	24.46
1972-73	34.50	34.72	35.55	29.72	34.43	33.52	32.11	30.14
1973-74	49.66	51.75	52.08	53.33	24.89	22.95	22.34	21.40
1974-75	34.27	33.11	34.50	34.72	22.65	21.06	19.36	18.85
1975-76	15.03	10.28	9.93	10.35	24.31	22.09	20.49	18.89
1976-77	17.07	17.34	11.86	11.46	20.65	18.45	16.77	15.56
1977-78	44.72	40.36	41.00	28.04	24.32	21.66	19.35	17.59
1978-79	16.73	15.37	13.87	14.09	29.62	27.68	24.65	22.02
1979-80	145.75	133.87	123.0	111.0	29.56	27.08	25.30	22.53
1980-81	35.82	33.31	36.60	28.11				
1981-82	19.97	18.17	16.89	15.52				

Note: Same as Table 7.1

Table 7.8: Incremental Capital Output Ratios in Public Sector by Industry of Use

7. Secondary Sector

At Constant Prices

Year	Simple ICORS				ICORS Based on five year moving averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	5.29	5.13						
1962-63	5.88	5.08	4.92					
1963-64	9.38	7.91	6.82	6.62	9.28			
1964-65	17.23	15.87	13.38	11.54	12.92	11.51		
1965-66	15.24	12.31	11.33	9.55	16.22	15.20	13.55	
1966-67	40.20	40.48	32.68	30.10	15.14	14.75	13.83	12.33
1967-68	15.64	17.14	17.26	13.94	15.03	14.81	14.43	13.52
1968-69	8.08	8.51	9.32	9.39	18.63	18.96	18.68	18.20
1969-70	16.34	16.03	16.88	18.50	16.04	16.06	16.34	16.10
1970-71	539.50	515.0	505.0	532.0	14.54	14.13	14.15	14.40
1971-72	15.48	14.38	13.73	13.46	18.51	17.18	16.70	16.71
1972-73	10.77	10.27	9.54	9.11	18.30	16.78	15.57	15.13
1973-74	21.43	18.17	17.32	16.10	18.08	16.35	14.99	13.91
1974-75	16.33	14.95	12.68	12.09	14.80	13.31	12.07	11.07
1975-76	40.0	35.63	32.63	27.68	15.35	14.01	12.64	11.43
1976-77	9.01	8.18	7.29	6.67	14.49	13.38	12.22	11.02
1977-78	13.80	13.55	12.30	10.96	14.39	13.15	12.15	11.09
1978-79	14.53	13.16	12.92	11.73	13.75	12.70	11.61	10.72
1979-80	15.14	13.29	12.18	11.96	23.59	21.98	20.31	18.56
1980-81	18.74	17.64	15.48	14.20				
1981-82	31.27	-29.61	-27.87	-24.46				

Note: Same as Table 7.1

Table 7.9: Incremental Capital Output Ratios in Public Sector by Industry of Use

8. Railways

At Constant Prices

Year	Simple ICORS				ICOR's based on five year moving averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	19.16	15.56						
1962-63	13.76	10.14	8.23					
1963-64	19.66	17.33	12.77	10.37	18.86			
1964-65	74.85	75.85	66.85	49.28	20.06	20.35		
1965-66	12.21	14.16	14.	12.64	22.12	24.07	24.42	
1966-67	34.67	50.22	58.22	59.0	20.57	23.88	25.98	26.36
1967-68	18.86	20.80	30.13	34.93	14.61	17.93	20.81	22.64
1968-69	12.00	14.15	15.60	22.60	18.47	21.39	26.24	30.46
1969-70	9.45	12.00	14.15	15.60	13.82	14.16	16.40	20.12
1970-71	50.20	37.80	48.0	56.60	12.78	12.56	12.87	14.90
1971-72	9.36	8.36	6.30	8.00	34.10	33.31	32.73	33.55
1972-73	12.70	11.70	10.45	7.87	33.60	32.4	31.65	31.10
1973-74	-6.58	-7.43	-6.85	-6.12	11.51	11.58	11.17	10.91
1974-75	10.77	12.27	13.86	12.77	9.11	9.68	9.73	9.39
1975-76	3.00	2.92	3.33	3.76	7.78	8.22	8.73	8.78
1976-77	3.90	4.67	4.55	5.19	6.09	6.07	6.41	6.81
1977-78	6.10	5.20	6.23	6.07	6.86	6.38	6.36	6.72
1978-79	136.5	119.0	101.5	121.50	11.20	9.87	9.18	9.16
1979-80	25.15	21.0	18.30	15.61	11.42	9.83	8.67	8.06
1980-81	17.29	13.62	11.37	9.91				
1981-82	6.25	5.92	4.67	3.90				

Note: Same as Table 7.1

Table 7.10: Incremental Capital Output Ratios in Public Sector by Industry of Use

9. Communication

At constant prices

Year	Simple ICORS				ICORS based on five year moving Averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	2.54	2.54						
1962-63	3.38	2.15	2.15					
1963-64	3.76	2.58	1.64	1.64	3.93			
1964-65	5.38	4.9'	3.38	2.15	4.58	3.93		
1965-66	4.54	6.36	5.81	4.0	5.21	4.88	4.19	
1966-67	6.36	4.54	6.36	5.81	6.07	6.11	5.73	4.92
1967-68	7.11	7.77	5.55	7.77	6.24	6.32	6.36	5.96
1968-69	7.75	8.0	8.75	6.25	6.11	6.00	6.07	6.11
1969-70	6.0	5.63	5.81	6.36	5.92	5.78	5.67	5.74
1970-71	4.30	5.07	4.76	4.92	6.28	5.43	5.30	5.20
1971-72	5.57	4.0	4.71	4.42	5.76	5.30	4.59	4.47
1972-73	8.21	5.57	4.0	4.71	6.09	5.60	5.16'	4.46
1973-74	4.94	6.05	4.10	2.94	6.28	5.49	5.04	4.65
1974-75	7.84	7.23	8.84	6.0	6.08	5.47	4.78	4.39
1975-76	5.71	4.85	4.47	5.47	5.94	5.71	5.14	4.49
1976-77	5.19	4.61	3.92	3.61	6.03	5.55	5.33	4.80
1977-78	6.90	6.75	6.0	5.10	5.35	5.07	4.67	4.49
1978-79	5.57	5.30	5.19	4.61	5.11	4.92	4.67	4.29
1979-80	4.15	4.39	4.18	4.09	5.14	4.73	4.56	4.32
1980-81	4.56	4.28	4.53	4.31				
1981-82	5.29	3.94	3.70	3.91				

Note: Same as Table 7.1

Table 7.11: Incremental Capital Output Ratios in Public Sector by Industry of Use

10. Transport by Other means

At Constant Prices

Year	Simple ICORS				ICOR's Based on Five year moving Averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	6.42	4.57						
1962-63	14.40	18.00	12.80					
1963-64	11.57	10.28	12.85	9.14	9.08			
1964-65	10.62	10.12	9.0	11.25	9.00	8.05		
1965-66	7.61	6.53	6.23	5.53	7.73	7.11	6.37	
1966-67	7.0	4.95	4.25	4.05	6.74	6.02	5.54	4.96
1967-68	5.94	7.36	5.21	4.47	7.53	6.98	6.24	5.74
1968-69	5.50	4.34	5.38	3.80	7.93	6.79	6.30	5.63
1969-70	26.0	28.60	22.60	28.00	10.21	9.60	8.22	7.63
1970-71	9.27	5.90	6.50	5.13	10.48	8.71	8.20	7.02
1971-72	46.50	51.0	32.50	35.75	11.89	10.84	9.02	8.48
1972-73	8.43	5.81	6.37	4.06	13.86	12.17	11.10	9.23
1973-74	10.13	11.73	8.08	8.86	10.96	10.49	9.21	8.40
1974-75	96.66	77.66	90.0	62.0	6.60	6.14	5.88	5.16
1975-76	5.22	5.55	4.75	5.51	7.48	7.68	7.1-	6.85
1976-77	3.03	2.81	2.98	2.56	8.33	8.0	8.22	7.65
1977-78	58.75	69.00	64.0	68.0	6.64	6.76	6.48	6.66
1978-79	23.91	19.58	23.0	21.33	6.94	6.85	6.97	6.69
1979-80	6.22	7.17	5.87	6.90	11.77	12.45	12.29	12.50
1980-81	6.34	5.79	6.67	5.46				
1981-82	29.14	39.0	35.57	41.00				

Note: Same as Table 7.1

Table 7.12: Incremental Capital Output Ratios in Public Sector by Industry of Use

14. Transport, Communication and Trade

At Constant Prices

	Simple ICORS				ICOR's based on five year moving averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	10.06	8.04						
1962-63	10.43	8.29	6.36					
1963-64	13.26	11.44	9.09	7.26	11.91			
1964-65	19.22	19.16	16.52	13.13	11.83	11.43		
1965-66	.65	9.61	9.58	8.26	12.71	12.81	12.38	
1966-67	10.03	11.98	11.93	11.89	11.52	11.74	11.83	11.43
1967-68	15.86	16.16	19.30	19.22	10.07	11.00	11.21	11.29
1968-69	8.63	7.82	7.97	9.52	11.30	11.24	12.28	12.51
1969-70	8.65	12.85	11.65	11.87	11.43	11.04	10.99	12.00
1970-71	16.90	10.09	15.0	13.59	9.43	9.55	9.23	9.18
1971-72	10.70	11.09	6.62	9.84	10.47	10.04	10.16	9.82
1972-73	6.05	7.78	8.06	4.81	14.13	12.64	12.12	12.27
1973-74	14.03	9.87	12.68	13.41	10.58	9.03	8.07	7.74
1974-75	-395.5	-379.0	-266.50	-342.5	8.23	8.21	7.01	6.27
1975-76	7.22	4.37	4.18	2.94	8.49	8.49	8.47	7.22
1976-77	3.98	7.47	4.52	4.33	9.18	8.76	8.77	8.74
1977-78	7.26	9.54	17.91	10.83	7.74	7.73	7.38	7.39
1978-79	24.46	13.58	17.87	33.53	7.52	8.68	8.68	8.28
1979-80	9.31	11.22	6.23	8.20	9.511	8.62	9.95	9.95
1980-81	6.09	6.54	7.88	4.38				
1981-82	9.61	6.58	7.07	8.51				

Note: Same as Table 7.1

Table 7.13: Incremental Capital Output Ratios in Public Sector

12. Public Administration and Defence

At Constant Price

Year	Simple ICORS				ICORS Based on five year moving averages of GDCF and DP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	8.08	11.04						
1962-63	4.50	3.59	4.90					
1963-64	4.41	4.63	3.69	5.04				
1964-65	5.25	4.18	4.38	3.49	6.03			
1965-66	15.28	16.65	13.25	13.91	5.65	5.68		
1966-67	5.10	7.32	7.98	6.35	6.72	6.51	6.55	
1967-68	11.09	7.31	10.49	11.43	6.66	7.12	6.89	6.94
1968-69	3.60	6.73	4.44	6.36	6.05	6.43	6.86	6.65
1969-70	3.58	2.44	4.56	3.00	4.69	4.83	5.14	5.49
1970-71	3.70	3.49	2.38	4.45	4.35	4.02	4.14	4.40
1971-72	3.67	3.14	2.96	2.02	4.37	4.14	3.83	3.94
1972-73	8.88	7.06	6.03	5.69	4.99	4.13	3.91	3.61
1973-74	6.97	5.92	4.70	4.02	5.23	5.14	4.25	4.03
1974-75	4.66	7.69	6.53	5.19	5.10	5.01	4.93	4.08
1975-76	3.44	3.25	5.36	4.55	5.20	5.25	5.17	5.08
1976-77	3.93	3.96	3.74	6.18	4.13	4.53	4.57	4.50
1977-78	2.57	3.14	3.16	2.99	3.11	3.30	3.62	3.66
1978-79	2.29	1.49	1.82	1.84	2.73	2.47	2.62	2.88
1979-80	2.40	2.00	1.31	1.60	2.38	2.14	1.93	2.05
1980-81	1.91	1.74	1.46	0.95	2.25	2.02	1.82	1.67
1981-82	2.24	2.28	2.08	1.745				

Note: Same as Table 7.1

Table 7.14: Incremental Capital Output Ratios in Public Sector

13. Finance, Community and Personal Services

At constant prices

Year	Simple ICORS				ICOR's based on five year moving averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	4.71	6.31						
1962-63	3.18	2.56	3.42					
1963-64	3.76	3.93	3.15	4.22	4.01			
1964-65	3.76	3.0	3.13	2.51	3.85	3.84		
1965-66	5.36	5.70	4.55	4.75	4.17	4.02	4.01	
1966-67	3.62	5.0	5.32	4.24	4.0	4.20	4.05	4.04
1967-68	4.60	3.17	4.37	4.65	3.26	3.42	3.60	3.47
1968-69	2.84	4.85	3.34	4.60	2.58	2.62	2.75	2.89
1969-70	1.81	1.30	2.23	1.53	2.44	2.24	2.27	2.39
1970-71	1.85	1.69	1.22	2.08	2.52	2.35	2.16	2.19
1971-72	2.48	2.10	1.92	1.38	2.79	2.32	2.16	1.98
1972-73	4.60	3.66	3.10	2.83	3.67	3.56	2.96	2.76
1973-74	4.17	3.60	2.87	2.43	3.60	3.51	3.40	2.82
1974-75	56.18	86.09	74.45	59.27	3.20	3.16	3.08	2.98
1975-76	1.88	1.79	2.75	2.38	2.71	2.88	2.85	2.77
1976-77	1.72	1.60	1.53	2.34	2.07	2.13	2.27	2.24
1977-78	1.94	2.26	2.11	2.01	1.83	1.65	1.69	1.80
1978-79	1.48	1.03	1.20	1.12	1.70	1.52	1.37	1.40
1979-80	2.28	1.97	1.37	1.60	1.69	1.54	1.38	1.24
1980-81	1.42	1.29	1.11	0.77				
1981-82	1.67	1.68	1.52	1.31				

Note: Same as Table 7.1

7.14.1: Periodwise Incremental Capital Output Ratios for the public Sector

Regression Method

Public Sector	1960-61 to 1970-71	1971-72 to 1981-82	1960-61 to 1981-82
i. Agriculture: (lag 0)	26.42	11.52	18.21
ii. Primary Sector: (lag 0)	17.23	10.75	12.89
iii. Manufacturing: (lag 0)	11.30	13.97	13.51
(lag 2)	15.83	15.73	(15.51)
iv. Secondary (lag 0)	12.97	16.19	15.52
v. Transport, Communication Trade (lag 0)	11.54	9.45	10.32
vi. Finance, C& PS (lag 0)	3.34	1.99	2.51
vii Agriculture Public Sector (Lag 0)	8.37	6.82	7.38
viii. Whole Economy	5.33	5.6	5.48

Table 7.15: Incremental Capital Output Ratios in the Economy

At Constant Prices

	Simple ICOR's				ICOR's based on five year moving averages of GDCF and DP			
	ICOR	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	4.57	4.99						
1962-63	8.53	7.35	8.03					
1963-64	3.69	3.49	3.01	3.28	7.29	6.92		
1964-65	2.49	2.27	2.15	1.85	9.88	8.99	8.42	
1965-66	-3.87	-3.50	-3.19	3.02	6.09	5.82	5.30	4.96
1966-67	23.50	21.70	18.65	17.89	6.98	6.82	6.52	5.93
1967-68	2.40	2.61	2.41	2.18	7.51	7.25	7.08	6.77
1968-69	6.72	7.16	7.79	7.20	4.20	4.07	3.93	3.84
1969-70	3.21	2.77	2.96	3.21	4.16	4.05	3.92	3.79
1970-71	3.71	3.45	2.98	3.17	6.79	6.60	6.43	6.23
1971-72	13.08	12.44	11.57	9.98	6.34	5.78	5.62	5.48
1972-73	-17.56	12.43	-17.01	-16.5	9.36	8.99	8.20	7.97
1973-74	5.23	4.08	4.35	4.13	6.80	6.59	6.34	5.78
1974-75	24.64	27.24	21.25	22.66	7.41	7.11	6.89	6.62
1975-76	2.29	2.23	2.46	1.92	4.55	4.26	4.09	3.96
1976-77	28.55	25.99	25.32	28.00	4.45	4.15	3.88	3.73
1977-78	2.63	2.44	2.22	2.17	6.48	6.11	5.70	5.34
1978-79	4.57	3.70	3.44	3.13	6.96	6.49	6.12	5.71
1979-80	4.27	-4.71	-3.82	-3.55	5.67	5.35	4.98	4.70
1980-81	3.31	3.03	3.34	2.71				
1981-82	4.63	4.49	4.12	4.54				

Note: Same as Table 7.1

Table 7.16: Incremental Capital Output Ratios in the Economy by Industry of Use

1. Agriculture

At constant price

Year	Simple ICOR'S				ICOR'S based on five year moving averages of GDCF and GDP			
	ICOR	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	6.29	7.01						
1962-63	-2.31	-1.99	-2.22					
1963-64	2.39	2.31	1.99	2.22	-5.65	5.16		
1964-65	0.74	0.63	0.61	0.53	-4.42	-4.14	-3.78	
1965-66	-0.52	-0.44	-0.37	-0.36	3.72	3.57	3.34	3.05
1966-67	-5.63	-6.53	-5.49	-4.68	4.80	4.55	4.37	4.09
1967-68	0.49	0.48	0.56	0.47	7.23	6.89	6.53	6.27
1968-69	10.70	9.74	9.70	11.27	1.31	1.27	1.21	1.14
1969-70	1.26	1.12	1.02	1.01	1.39	1.36	1.25	1.19
1970-71	1.00	0.91	0.81	0.73	5.43	5.00	4.68	4.52
1971-72	-11.31	-11.09	-10.08	-8.97	2.98	2.78	2.56	2.40
1972-73	-1.36	-1.25	-1.22	1.11	6.92	6.87	6.39	5.89
1973-74	1.26	1.20	1.10	1.08	3.67	3.71	3.69	3.43
1974-75	-3.59	-4.43	-4.21	-3.86	9.95	9.29	9.40	9.33
1975-76	0.57	0.57	0.71	0.67	1.93	1.81	1.69	1.71
1976-77	-1.47	-0.99	-1.00	-1.24	2.57	2.30	2.16	2.02
1977-78	0.87	0.82	0.55	0.56	9.24	8.51	7.62	7.17
1978-79	4.31	3.40	3.23	2.17	9.36	8.49	7.82	7.00
1979-80	-0.73	-0.90	-0.71	-0.68	3.53	3.44	3.12	2.87
1980-81	0.97	0.88	1.08	0.85				
1981-82	3.12	3.30	2.98	3.66				

Note: Same as Table 7.1

Table 7.17: Incremental Capital Output Ratios in the Economy by Industry of Use

2. Primary Sector

At Constant Prices

Year	Simple ICOR'S				ICOR'S based on five year moving averages of GDCF and GDP			
	$ICOR_0$	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	5.58	6.16						
1962-63	-2.96	-2.57	-2.84					
1963-64	2.48	2.34	2.04	2.25	-9.68	-8.89		
1964-65	0.90	0.74	0.70	0.61	-6.85	-6.39	-5.87	
1965-66	-0.63	-0.57	-0.47	-0.44	3.76	3.62	3.37	3.10
1966-67	-8.88	-9.90	-8.97	-7.37	4.84	4.63	4.45	4.15
1967-68	0.56	0.58	0.64	0.58	6.75	6.49	6.21	5.96
1968-69	11.82	11.00	11.25	12.54	1.48	1.44	1.38	1.32
1969-70	1.43	1.24	1.15	1.18	1.56	1.46	1.42	1.36
1970-71	1.10	1.04	0.90	0.84	5.60	5.20	4.89	4.74
1971-72	-19.67	-18.68	-17.76	-15.31	3.26	3.01	2.80	2.63
1972-73	-1.58	-1.48	1.41	-1.34	7.02	6.91	6.39	5.93
1973-74	1.48	1.35	1.27	1.21	3.99	3.90	3.84	3.55
1974-75	-5.10	-6.01	-5.51	-5.18	10.19	9.27	9.07	8.93
1975-76	0.73	0.68	0.80	0.73	2.39	2.19	1.99	1.94
1976-77	-1.90	-1.32	-1.22	-1.44	3.10	2.97	2.56	2.33
1977-78	1.13	1.08	0.75	0.70	10.95	10.10	9.10	8.33
1978-79	4.66	4.00	3.83	2.67	11.89	10.83	9.97	8.99
1979-80	-0.90	-1.05	-0.90	-0.86	4.36	4.23	3.86	3.55
1980-81	1.24	1.09	1.27	1.09				
1981-82	3.79	3.86	3.39	3.96				

Note: Same as Table 7.1

Table 7.18: Incremental Capital Output Ratios in the Economy by Industry of Use

3. Manufacturing

At Constant Prices

	Simple ICOR's				ICOR'S based on five year moving averages of GDCF and GDP			
	ICOR	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	3.67	3.94						
1962-63	3.62	3.27	3.52					
1963-64	3.68	3.94	3.56	3.83	4.94	4.59		
1964-65	4.42	3.53	3.78	3.42	7.83	6.78	6.29	
1965-66	30.63	26.33	21.07	22.52	11.27	10.69	9.25	8.58
1966-67	-36.45	-28.52	-24.52	-19.62	13.57	13.31	12.62	10.92
1967-68	20.65	26.76	20.94	18.00	10.90	10.45	10.24	9.71
1968-69	6.45	8.11	10.52	8.23	11.46	11.04	10.58	10.38
1969-70	3.54	2.59	3.26	4.22	8.98	9.07	8.74	8.38
1970-71	44.91	40.32	29.45	37.07	7.85	7.82	7.90	7.61
1971-72	14.09	13.72	12.32	9.00	8.36	7.38	7.36	7.43
1972-73	7.44	9.10	8.86	7.96	13.30	12.06	10.65	10.62
1973-74	9.04	6.13	7.49	7.29	12.47	12.05	10.93	9.65
1974-75	20.22	17.75	12.03	14.70	8.62	8.67	8.38	7.60
1975-76	18.24	21.64	18.99	12.87	7.98	7.43	7.47	7.22
1976-77	3.64	4.36	5.17	4.54	6.49	5.97	5.55	5.59
1977-78	5.77	4.54	5.45	6.46	8.03	7.53	6.94	6.46
1978-79	4.66	3.19	2.51	3.01	8.58	8.02	7.53	6.93
1979-80	-25.03	-23.84	-17.08	-13.45	10.39	9.32	8.71	8.18
1980-81	25.39	27.89	26.56	10.03				
1981-82	9.14	8.27	9.09	8.66				

Note: Same as Table 7.1

Table 7.19: Increment Capital Output Ratios in the Economy by Industry of Use

Secondary Sector

a At Constant Prices

Year	Simple ICOR's				ICOR's based on five year moving averages of GDCF and GDP			
	ICOR	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	4.16	4.37						
1962-63	4.50	3.75	3.94					
1963-64	3.76	3.67	3.05	3.21	5.10	4.67		
1964-65	4.56	4.09	3.98	3.32	6.71	5.94	5.44	
1965-66	13.50	11.68	10.46	10.20	7.79	7.48	6.63	6.07
1966-67	28.91	25.16	21.76	19.48	8.98	8.92	8.57	7.59
1967-68	9.60	11.74	10.21	8.83	8.37	8.08	8.03	7.71
1968-69	6.25	7.30	8.92	7.76	9.35	9.09	8.77	8.71
1969-70	4.17	3.24	3.78	4.62	8.71	8.67	8.42	8.13
1970-71	41.44	37.56	29.17	34.05	8.58	8.47	8.42	8.18
1971-72	14.21	13.81	12.52	9.72	10.90	9.89	9.75	9.70
1972-73	8.79	10.23	9.95	9.01	19.66	18.20	16.58	16.29
1973-74		20.48	23.85	23.18	13.50	12.94	11.98	10.87
1974-75			26.27	30.59	8.83	8.68	8.32	7.70
1975-76	7.41			5.31	7.73	7.08	6.96	6.67
1976-77	3.71	4.06			6.54	5.96	5.46	5.37
1977-78	5.41	4.33	4.74		8.21	7.62	6.95	6.37
1978-79	6.24	4.97	3.98	4.36	9.48	8.81	8.17	7.45
1979-80	-15.90	-15.29	-12.18	-9.74	11.70	10.58	9.83	9.12
1980-81	16.92	17.32	16.67	13.27				
1981-82	9.08	8.30	8.50	8.18				

Note: Same As Table 7.1

Table 7.20: Incremental Capital Output Ratios in the Economy by Industry of Use

Transport, Communication and Trade

At Constant Prices

Year	Simple ICOR's				ICOR's based on five year moving averages of GDCF and GDP			
	ICOR	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR^*_0$	$ICOR^*_1$	$ICOR^*_2$	$ICOR^*_3$
1960-61								
1961-62	2.79	3.33						
1962-63	3.65	2.81	3.36					
1963-64	3.81	3.01	2.32	2.27	3.87	3.79		
1964-65	3.40	3.71	2.93	2.26	4.60	4.24	4.14	
1965-66	8.17	9.13	9.95	7.87	4.65	4.6	4.29	4.20
1966-67	7.61	6.47	7.23	7.88	4.63	4.89	4.90	4.51
1967-68	3.83	4.72	4.01	4.49	4.38	4.62	4.89	4.89
1968-69	3.51	3.63	4.47	3.80	4.29	3.88	4.09	4.33
1969-70	2.56	2.8	2.90	3.57	4.60	4.25	3.84	4.06
1970-71	5.69	3.15	3.46	3.57	5.29	4.94	4.57	4.13
1971-72	9.73	9.14	5.06	5.55	6.25	5.31	4.97	4.59
1972-73	8.53	10.19	9.57	5.30	6.52	5.86	4.98	4.66
1973-74	7.88	5.27	6.28	5.90	5.28	4.39	4.43	3.77
1974-75	4.10	4.99	3.34	3.98	4.95	4.72	4.41	3.96
1975-76	3.12	2.48	3.01	2.02	4.20	4.03	3.85	3.59
1976-77	5.64	5.8	4.60	5.59	3.55	3.42	3.29	3.13
1977-78	2.99	3.52	3.62	2.87	4.31	4.24	4.09	3.93
1978-79	3.07	2.23	2.63	2.71	4.60	4.50	4.43	4.27
1979-80	-36.93	-48.39	-35.17	-41.41	3.95	3.85	3.76	3.71
1980-81	4.07	3.19	4.18	3.04				
1981-82	2.87	2.89	2.27	2.97				

Note: Same as Table 7.1

Table 7.21: Incremental Capital Output Ratios in the Economy by Industry of Use

Finance and Community and Personal Services

At Constant prices

Year	Simple ICOR's				ICOR's based on five year moving averages of GDCF and GDP			
	ICOR	$ICOR_1$	$ICOR_2$	$ICOR_3$	$ICOR_0^*$	$ICOR_1^*$	$ICOR_2^*$	$ICOR_3^*$
1960-61								
1961-62	7.93	9.72						
1962-63	4.69	3.82	4.69					
1963-64	4.82	5.16	4.21	5.16	6.01	5.91		
1964-65	5.12	4.26	4.56	3.72	5.67	5.69	5.60	
1965-66	11.35	11.78	9.79	10.49	6.59	6.50	6.53	6.43
1966-67	5.35	7.30	7.57	6.30	6.68	7.04	6.95	6.98
1967-68	10.49	7.82	10.67	11.07	6.71	7.01	7.38	7.29
1968-69	4.70	7.32	5.46	7.45	5.28	5.54	5.79	6.10
1969-70	4.93	3.67	5.72	4.26	4.69	4.48	4.70	4.91
1970-71	3.65	3.86	2.87	4.48	4.47	4.29	4.10	4.30
1971-72	3.37	2.94	3.11	2.31	4.99	4.28	4.11	3.92
1972-73	6.59	5.21	4.55	4.81	4.62	4.61	3.95	3.79
1973-74	7.64	6.54	5.17	4.51	4.50	4.42	4.41	3.78
1974-75	3.35	5.27	4.51	3.57	4.70	4.67	4.59	4.57
1975-76	3.31	3.19	5.03	4.30	4.06	4.30	4.28	4.20
1976-77	4.12	3.87	3.73	5.88	3.18	3.28	3.47	3.45
1977-78	3.14	3.41	3.21	3.10	2.83	2.57	2.65	2.81
1978-79	2.58	1.87	2.03	1.91	2.51	2.25	2.05	2.11
1979-80	2.18	1.87	1.42	1.55	2.31	2.12	1.90	1.73
1980-81	2.02	1.79	1.61	1.17				
1981-82	2.21	2.27	2.01	1.81				

Note: Same as Table 7.1

Chapter 8

SUMMARY AND IMPLICATIONS OF THE STUDY

This study started on the premise that the role of public investment needs to be thought of in two dimensions: The first is extensive and focuses on scale: the absolute expansion of investment in public sector and its growth relative to total output. The second is intensive: the structure of public investment.

In this context, it was theoretically shown in Chapter 4 (equation 9) that:

$$\frac{\sum_{j=1}^{n} \Delta Y_j(t)}{\sum_{j=1}^{n} Y_j(t)} = \frac{I(t)}{Y(t)} \cdot \sum_{j=1}^{n} \beta_j \lambda_j - na$$

which was interpreted to mean that the rate of growth of output depends on the rate of investment and the structure of investment. The structure of investment, it was discussed, is the sectoral composition of investment weighted by the respective sectoral incremental capital-output ratios.

An analysis of the structure of investment in India assumes significance, given the fact that the rate of investment has remained, more or less, constant over time (Chapter 2) such that the rate of growth of output would, to a large extent, be determined by the structure of investment and the changes therein.

Within the theoretical framework laid out in Chapter 4, it was observed that a change in the structure of investment can emanate from either a change in the allocation of investment across sectors or from a change in the incremental

capital-output ratios. Consequently, our discussions on the structure of investment started with an analysis of the composition of public investment by industry of use (Chapter 5) and that by type of asset structure (Chapter 6), followed by a discussion on the incremental capital relationship of public investment to output (Chapter 7).

To the extent that public investment across sectors, sub-sectors and industrial categories, not only has different patterns of growth but also different impacts on the economy in general and industrial sector in particular, with varying degrees of directness, a disaggregated study of public investment becomes important. Further, the differential rates of growth of public investment across sectors might change the structure of investment which, in turn, has a bearing on the rate of growth.

A disaggregated analysis of public investment by industry of use indicated that there has not been a secular decline in public investment at the sectoral level. Though most industrial categories did face an investment cutback during the plan holiday, it was disproportionately borne by the tertiary sector.

Industrial categories having a direct bearing on the performance of the industrial sector like agriculture and infrastructure (which includes Electricity, Gas and Water, Mining and Quarrying, Railway and Transport by other means) have never faced an investment slowdown. In fact the rates of growth in these sectors have been increasing over time. Even during the plan holidays, public investment in agriculture grew at a rate of about 7% per annum. Consequent upon its relatively high rates of growth the share of infrastructural investment in total public investment has increased from 33% in 1960-61 to 45% in 1981-82.

The differential rates of growth of public investment across industrial categories have resulted in a shift in the composition of public investment over

time. The shift is such, that there is a movement away from the subsector transport, communication and trade, and towards the subsector finance, community and personal services. Of the two other sub-sectors viz. Primary and Secondary, while the former's contribution to the growth in public investment has remained constant, that of secondary sector has increased by about 10 percentage points. The decline in the share of transport, communication and trade in public investment is entirely due to a fall in the investment in railways, and trade, hotel and restaurant. The decline in the investment in railways, it was argued, was the effect rather than the cause of industrial deceleration.

At another level of disaggregation we analysed the changes in the asset structure of public investment (Chapter 6) by industry of use and also the type of authority with a view to obtain an idea of the effect of investment an augmenting capital stock of the economy in general and the nature of demand generated by public investment in particular. It was observed that the cutback in investment during the plan holiday was disproportionately borne by the construction component of fixed capital formation.

More important, however, is the change that has taken place in the asset composition of public investment. Consequent upon the relatively faster rate of growth of the machinery and equipment component of capital formation there has been a clear shift in the asset structure of public investment, such that the proportion of machinery and equipment in public investment has more than doubled. It has increased from 19% in 1950-51 to 40% in 1981-82. This, it was argued, meant that the "capital goods intensity" of public investment has been increasing which will have implications on the nature of demand generated by public investment and its impact on growth of the industrial sector.

Another aspect of public investment, largely neglected, which has a bearing

on the growth performance of the economy is its instability. From our analysis of the instability of public investment it would appear that more than the decline (during the plan holiday) and relatively slower rate of growth in some sectors after the plan holiday, it was the increased instability of public investment which would have hampered the growth of the economy.

An analysis of the instability of public investment by industry of use and type of assets revealed that the instability has increased, over time, in almost all the industrial categories. This increase in the instability of public investmnet, it was argued, could have had generalised growth retarding effects. Public Investment apart from inducing is also a medium of transmitting instability (the precise mechanism of which needs to be worked out) to various other sectors which could have created imbalances in the intersectoral relationships leading to various types of constraints and bottleneck on growth.

As to what would be impact of the pattern of growth and instability in public investment on the growth performance of the economy will also be determined by the relationship it bears with private investment.

On the basis of empirical evidence, it was argued (Chapter 2,5 and 6) that there does not seem to be a positive relationship between public and private investment in the period after the plan holiday, whereas prior to it there is evidence of such a relationship. It was shown that, not only does the positive relationship become statistically insignificant but in certain sectors (like transport, communication and trade) it becomes significantly negative while in other sectors (like manufacturing) it is negative. The 'breaking-off' of the relationship at the aggregate level, as was observed in Chapter 2, could be attributed to a shift in the composition of public investment in favour of finance, community and personal services, particularly after 1975-76.

A significant feature of the positive/negative relationship between public and private investment in general, is its unlagged nature. This would indicate that the relationship between the two is supply side based rather than demand based, which by the very nature of its operation ought to have been lagged.

A similar unlagged negative relationship, which is statistically significant was observed between the construction components of public sector capital formation and that in the private sector. This negative relationship was sought to be explained in terms of a competition between the two sectors for scarce physical resources that go into construction capital formation.

An interesting picture emerges when we posit these empirically observed relationships between public and private investment, with the above summarised findings regarding the pattern of growth of public investment. The sub-sector which has borne the brunt of the investment cutback after 1965-66 i.e. transport, communication and trade is the one in which public investment bears a significantly negative relationship to private sector investment, during the same period. This would mean that a decline in public investment would be compensated, adequately or more than adequately, by a rise in the private investment depending on the elasticity of private investment with respect to public investment. A consequence of such a shift would be a change in the composition of aggregate investment in this sector, to the extent the composition of public investment differs from private investment.

The same situation exists in the case of construction component of capital formation. As was discussed in detail in Chapter 6, in terms of the asset structure of public investment the decline slow growth in public investment has been concentrated in construction capital formation, which is the component that bears a significantly negative relationship to private sector capital formation in construction. Here, as

above, a decline in public investment would be compensated by a rise in the private sector investment. However, in this case there need not be a shift in the composition as the materials going into capital formation in construction are essentially the same, though the proportions may vary.

To generalise, if a fall in public investment is compensated by a rise in private sector investment and vice versa, the level of aggregate investment will be maintained, though its composition may change.

The possibility of explaining as to whether it was required to maintain the same level of capital formation as in the pre 1965-66 period for achieving a desired rate of growth, lies in a comparison of capital stock (or flow) with output. Such an comparison was carried out in Chapter 7.

Our analysis of the incremental relationship of public investment to output revealed that there has been a substantial decline in the incremental capital-output ratio of the public sector. This decline, it was empirically established, is due to a decline in the individual incremental capital output ratios in all the industrial categories, with the exception of electricity, gas, and water, and transport by other means. The decline in the aggregate and individual incremental capital-output ratios can be attributed to a decline in the proportion of construction component of capital formation in the public sector. Construction capital formation in public sector tends to raise the incremental capital-output ratio because it has long gestation lags, does not give direct returns in terms of output (e.g. Roads and bridges) though it increases the income generating capacity of many sector, and also in certain cases (e.g. irrigation projects) its ouput cannot be accounted for.

This finding questions the "increasing inefficiency hypothesis" of capital investment in India based on the mythical rise of the incremental capital-output ratios in the public sector.

The 'increasing' incremental capital-output ratios in the public sector, it has been argued, has led to a dissipation of the gains of increased aggregate capital formation.

As against this, viewing the growth rate as a product of the incremental capital-output ratio and the rate of investment, in a simplistic accounting framework, it is implied that with a decline in the public sector incremental capital output ratio (from 8.84 in 1965-66 to 5.74 in 1981-82) the rate of investment required to maintain the same growth rate of output would be much less (11%) in the later period, as compared to that (19%) in the earlier period.

To conclude, it was argued in this study, in order to understand the impact of public investment on industrial growth, one has to go beyond the notion of aggregate public investment as a homogenous magnitude. In relating public investment to growth, we emphasized, the importance -- theoretically and empirically of analysing the structure of public investment.

A study along these lines was attempted. The empirical results arrived at would seem to have a direct bearing on two explanations of industrial deceleration viz. the public investment based hypothesis and the increasing inefficiency of capital investment hypothesis. Both these explanations do not seem to get validated by the available empirical evidence.

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