Development Research Group

Study
11

FISCAL EFFICIENCY IN THE INDIAN FEDERATION

Raghbendra Jha
M. S. Mohanty
Somnath Chatterjee

Issued for Discussion

DRG Studies Series

Development Research Group (DRG) has been constituted in the Reserve Bank of India in its Department of Economic Analysis and Policy. Its objective is to undertake quick and effective policy-oriented research, backed by strong analytical and empirical basis on subjects of current interest. The DRG studies are the outcome of collaborative efforts between experts from outside the Reserve Bank and the pool of research talents within the Bank. These studies are released for wider circulation with a view to generating constructive discussion among the professional economists and policy makers.

Director
Development Research Group

Requests relating to DRG studies may be addressed to :
Director,
Development Research Group,
Department of Economic Analysis and Policy,
Reserve Bank of India,
Post Box No.1036,
Bombay-400 023.

Development Research Group

Study
11

FISCAL EFFICIENCY IN THE INDIAN FEDERATION

RAGHBENDRA JHA

M. S. MOHANTY

SOMNATH CHATTERJEE

Department of Economic Analysis and Policy
Reserve Bank of India
Bombay
June 19, 1995

CONTENTS

LIST OF TABLES

LIST OF DIAGRAMS

FISCAL EFFICIENCY IN THE INDIAN FEDERATION

Raghbendra Jha*
M. S.Mohanty
Somnath Chatterjee

I. INTRODUCTION

Economic analysis with several layers of government has a long and distinguished tradition in public finance (For a review see King (1984)). One of the most significant issues addressed in the literature is that of proper devolution of tax/expenditure authority between different levels of government. It is typically argued that the level of government which is legislatively superior should have the mandate, in some sense, to treat the lower

---

* Dr. Raghbendra Jha is professor in the Indira Gandhi Institute of Development Research, Bombay. M.S. Mohanty and Somnath Chatterjee are Director and Assistant Adviser, respectively, in the Department of Economic Analysis and Policy, Reserve Bank of India, Bombay.

Jha would like to thank Dr. C. Rangarajan and Shri S. S. Tarapore, Governor and Deputy Governor, respectively, of Reserve Bank of India for helpful conversations on the subject of this paper;and Dr. A. Vasudevan, Officer-in-charge, Department of Economic Analysis and Policy, Reserve Bank of India, for many unusually stimulating discussions on fiscal federalism and for his warm hospitality. Dr. Himanshu Joshi, Assistant Adviser in the Department of Economic Analysis and Policy, provided critical help with estimating the cointegrating relationships reported in Appendix III. Our thanks to him. The staff of the DRG at the Reserve Bank have been helpful and cooperative far beyond the call of duty. I express my gratitude to them for their help and continued friendship.All opinions expressed in this paper are of the authors alone.

levels of government as equals. Moreover, it is argued, that there are economies of scale in collecting taxes. If states, for example, were to impose income taxes there would be considerable difficulties in the treatment of the incomes of taxpayers who migrate across state boundaries. Similarly, the bulk of commodity taxation is best carried out by the central government. It is not entirely improbable that state governments, left on their own, would opt for increasing their own tax revenues even at the risk of causing considerable allocative damage at the national level. Even under present arrangements in India where the central government collects income and excise duties and states play a relatively minor role with state sales taxes, in the main, we are all familiar with instances of how these state level taxes/subsidies have, over the years, affected location of industry and factors of production.

On the other hand, it is argued that decentralization of tax and expenditure authority has innate advantages: Local governments would be more responsive to local needs. Moreover, local governments can be held accountable by residents in an easier and more transparent manner than higher level governments. This kind of reasoning, of course, does not preclude the possibility that the degrees of decentralization in tax and expenditure authority may be different. In particular, if expenditure responsibilities are decentralized to a greater extent than tax authority we would be setting up the rationale for <u>fiscal transfers</u> from higher to lower levels of government.

It is in this context, primarily, that recent literature on fiscal federalism has opened up new areas for research. On the one hand, it is argued that the fact of economies of scale in tax collection has to be established and cannot be taken for granted. Moreover, if higher and lower levels of government end up co-occupying the same tax base, the distortionary impact of the two taxes to-

gether has to be weighed against the alleged economies of scale in tax collection on the part of the central government. There is an imperfect but quite telling rule in public finance that the excess burden or deadweight loss from a tax is roughly proportional to the square of the tax rate[1]. If the economies of scale in tax collection are relatively small and the co-occupation of tax base implies that the effective tax rate rises steeply, the deadweight loss from the tax will rise even more steeply. In such situations, it is conceivable that it might be less costly for the states to levy the taxes and to make transfers to the central government. These are relatively new areas for research. Recent references include Boadway and Keen (1994).

Another important maintained hypothesis of the above argument is that state governments or, for that matter, the central government are raising taxes in an efficient manner. Again, this is an assumption whose validity has to be tested and cannot be assumed. Since local conditions are typically unknown to higher levels of government, it follows that state governments can easily conceal their tax efforts and make claims on the federal government. This information theoretic approach to local public finance has a number of serious implications. The literature on this is very sparse and recent (See Boadway, Horiba, and Jha (1995). In this paper we wish to examine the validity of this argument at the empirical level, for the case of the Indian federation[2]. It has to be understood, however, that efficiency in tax collection can only be defined in a relative sense. The performance of different states with respect to the same taxes can be compared across states as well as across time. However, the central government collects very

1. The so-called marginal cost of public funds literature argues that the cost of Re. 1 of government expenditure is considerably more than Re. 1. See the section on costs of public expenditure.

2. In the case of India the literature on empirical public finance in general, and fiscal federalism in particular, is sparse. It is easier to mention the

different taxes compared to the state governments. Hence, it is not possible to directly compare the tax performance of central and state governments. In this paper we confine ourselves, primarily, to efficiency in tax collection at the level of states; but do comment on the efficiency of the central government in tax collection.

It is also appropriate to set out here the context and relevance of a study of efficiency issues in state taxation in India, where almost every aspect of fiscal policy is influenced by the tax and expenditure policies of states. It is a well recognised fact that in a federal set up there could arise certain unavoidable difficulties in carrying out policy reforms, which places emphasis on minimising the distortionary costs of commodity taxes while, at the same time, ensuring a steady source of government income to meet the need for finances at the level of individual states. The familiar roles of optimal taxation and harmonization of fiscal goals might fail to hold in practice when each taxing authority sets its own rules of the game in the matter of tax policy and programmes. It is possible, however, to design mechanisms that will ensure that revenue mobilization by states adhere to certain norms of tax effort both in the static as well as in the dynamic sense. Without this

---

Contd...

kind of evidence that exists than to point out the lacuna in the empirical estimates. There are some estimates of effective tax rates on goods, [Ahmad and Stern (1985)], and on savings and investment, [Jha and Mittal (1990)]. Optimal mix of indirect taxes (assuming a unitary form of government) have been computed, among others, by Jha, Murty and Ray (1990). Effects of corporate taxes on the incentive to invest have been investigated by Jha and Wadhwa (1990). However, a very large number of questions remains unanswered - even unarticulated. Among these, the deadweight loss due to distortionary taxtation and tax evasion/avoidance are all univestigated. Some of the various Finance Commissions have investigated the determinants of tax collection at the level of the states. But the issue of efficiency in tax collection has not even been articulated, let alone investigated.

there could arise both spatial and temporal differences in the distribution of tax burden across states, giving rise to serious problems in allocation as well as equity. The mechanism of resource transfer is expected to play an important role in enforcing such an efficiency norm in federal finance.

In the Indian context, historically, tax effort has played a relatively minor role in resource transfer as much of the transfer is effected on the basis of need and backwardness characteristics of the recipient states. Nevertheless, there has been increasing realisation in recent years that efficiency in tax collection is an uncompromisable objective in the changing economic scene and that much of the discussion on fiscal devolution has presupposed prudent fiscal behaviour on the part of the centre and states. Such a stance has, of late, found favour with official bodies as well. The Tenth Finance Commission, for instance, in its report has suggested that 10 per cent weight be placed on tax effort in devising the formula for distribution of transfers to states. The issues concerning tax efficiency (both across states and time) in India certainly deserve a much deeper analysis than has hitherto been afforded to them.

II. ISSUES IN TAX REFORM IN A FEDERAL ECONOMY

The conditions under which the market performs well are well recognized and well appreciated. Under certain conditions the market mechanism leads to the attainment of Pareto optimality. Pareto optimality consists of three parts. (i) Optimality in production - goods and services are produced at the lowest possible cost given the existing techniques of production. (ii) Optimality in exchange - goods are exchanged such that each individual consumer is as well off as possible given his/her resources and market prices. (iii) Overall efficiency - whereby the relative price of any good in terms of any other reflected the resource and technological cost of converting that good into some other good. The market

mechanism permits the attainment of each of these types of optimality under certain conditions. Hence, if the government has to interfere in the operation of the market mechanism it must be the case that, in some sense of the term, the market has failed to deliver the goods.

This behoves us to inquire into the circumstances under which the market fails. There are two broad circumstances under which the market may be said to have failed. This pertains to inefficiency and inequity associated with the market mechanism.

1. Inefficiency of the Market Mechanism

i) Public Goods: Public goods are those that are characterized by jointness and non-rivalrous consumption. Types of public goods vary largely in practice. Some are pure in the sense of complete non-rivalry in consumption. Others may be impure necessitating the formation of clubs of consumers. Still others may be limited by the nature of the geographical region which it may serve. These are called local public goods. The wide variety of public goods requires that assignment of responsibility for public goods across different levels of government must be made carefully.

ii) Externalities: This is a special case of public goods but, nevertheless, quite common. When production and/or consumption sets are interdependent, externalities occur. Polluting industries are an obvious example. Another example is the presence of economies of scale.

iii) Imperfect information: Markets may be inefficient because of asymmetric information problems. Two of the most common information problems are moral hazard and adverse selection. Moral hazard refers to a situation in which one side of the market can take actions which affect the market outcome but which cannot be observed by the other side of the market. Adverse

selection occurs when participants on one side of the market differ systematically from participants on the other side but this fact is not observable. The presence of these information problems are known to cause problems for the market mechanism and to even preclude the attainment of equilibrium.

2. Inequity in the Market Mechanism.

One problem with the market mechanism is that the distribution of income that it leads to may not be acceptable to the ethical norms of society. The government may have to intervene in order to redress economic inequalities. A particular form of this is the provision of social security to vulnerable sections of the population.

Considerations such as these often lead people to believe that government intervention is some kind of panacea for these problems. We have to first recognize that there is a significant cost to state intervention in the market mechanism. In other words, the true cost of government intervention may be much higher than the rupee amount of public expenditure undertaken by the government to redress some of the alleged problems of the market mechanism.

What are some of the elements of the true cost of public expenditure? Over the years, there has developed a fairly large literature on this topic under the rubric of the marginal cost of public funds; see, for example, Usher (1983). In summary form we can list some of the major components of the true cost of public expenditure as follows:

i) Resource Cost: These are defined as the minimal cost of public activity to the government, abstracting from the effects of dishonesty or want of incentive on the part of public officials and ig-

noring costs associated with the private sector response to taxation, public services and transfers. Resource cost would include all purchases of goods and services, regardless of whether these are acquired by contract (when the government hires a consultant, for example), or by employment (teachers, doctors, civil servants and the like) and regardless of whether goods are bought (the air force purchases new planes) or made (when HAL produces new planes). In the standard literature on public goods this is the only cost of public funds that is recognized.

ii) Overhead costs: These may be more or less extensive in their coverage. These may include, for example, the fixed cost of running the government apparatus. These may be more specific - the cost of fertilizer subsidy, and the food subsidy, for example. These involve substantial overhead costs as the government must hire paid staff to determine criteria, review performance and so on.

iii) Deadweight loss in taxation: One of the most significant recent developments in the theory of public expenditure has been the recognition that, since taxes are rarely lump sum, funds for public expenditure must be collected through distortionary taxation which, in turn, levies costs on tax-payers in excess of the amount of revenue collected. A simple example may illustrate this point. Consider a mason whose house requires electrical work and an electrician whose house requires structural repairs. Both parties could do both jobs but each is naturally better at his own vocation. The mason can do the job of the electrician in 20 hours but the electrician can do it in 12. Similarly the electrician can do the job of the mason in 20 hours but can do his own job in 12. Any pattern of allocation of work is feasible. Clearly, the most efficient method is for each person to do the job for which he is qualified. In doing so a total of 24 hours are expended whereas the same work could have taken 40. Suppose the wages of masons and

electricians are both Rs. 20 per hour so that the cost of each job (when most efficiently done) is Rs. 240. Let us assume that the rate of income tax is 50%. Each party would now have to earn Rs. 480, pay Rs. 240 in taxes, and pay Rs. 240 to the other party. Given the wage, each party would have to work 24 hours to earn Rs. 480. Hence each party would find it in his interest to do the job himself - since this involves working for 20 hours only. The mason would do the job of the electrician and the electrician that of the mason. Allocation of work would be thoroughly inefficient. The effect of the tax is, then, for each party to waste 8 hours with a social value of Rs. 20 x 8 = Rs. 160. Total loss to society is Rs. 320. This is the deadweight loss or excess burden of the tax. It is also well known that, under certain conditions, a uniform commodity tax has the same effect as an income tax. Hence the above argument would apply to the case of commodity taxes - indeed any distortionary tax as well. It is not very hard to show that, under certain conditions, the excess burden of the tax is proportional to the square of the tax rate: the excess burden goes up ever more steeply as the tax rate rises! See Boadway and Wildasin (1984) or Jha (1987).

iv) The concealment of Taxable Income: As excess burden rises, people might be induced to reduce supply of the taxed goods and to shift their efforts from taxed to untaxed goods. A similar and additional contraction occurs when an increase in the tax rate induces taxpayers to devote extra resources to tax avoidance, which is legal, and tax evasion, which is illegal.

v) Intimidation Costs: Virtually any task that the public sector is required to perform involves the establishment of rules which, in turn, require enforcement. This entails costs which must be counted as the costs of public expenditure. Among these costs are the citizens' time and money devoted to evading the rules without getting caught, the cost to the government of identifying infractions of the rules and the cost to the government (and ulti-

mately to the taxpayers) of prosecuting rule-breakers. Intimidation costs become a latent cost of public expenditure whenever an increase in the tax rate leads to increases in public expenditure to enforce compliance with the tax laws. The greater incentive to evade tax can be expected to require a somewhat larger public expenditure to enforce the rules.

There are other elements to the true cost of public expenditure - particularly in a dynamic economy. Suffice to say here that the above arguments should temper our enthusiasm for public expenditure. Public expenditure is desirable but a careful balancing of its benefits and true costs must be done in an enlightened programme of public policy. Just because the market has failed does not imply that the government should spend money. Market failure, so to speak, must be balanced against government inadequacy.

3. Efficiency and Equity in a Federal Economy.

In a federal economy the notion of efficiency and equity have several more dimensions than the three associated with the Paretian criterion. A list of some of the important elements is as follows:

i) The Internal Common Market

If goods,services and factors of production can flow unimpeded within a country unencumbered by the geographical boundaries of lower levels of government an internal common market may be said to obtain with all the attendant advantages. When barriers to such movement occur either because of taxes and/or quantitative restrictions, the efficiency of the common market arrangement is compromised. To be sure, there are natural impediments to completely free movements such as language and transport costs but we are here concerned with conscious policy measures designed to restrict free flow of goods, services and factors of pro-

duction. If several jurisdictions impose such restrictions overall economic activity may decline significantly and all jurisdictions may be worse off. To be sure, there is a body of literature in public choice theory which suggests that inter-jurisdictional competition to woo factors of production and goods and services may be a good thing since it encourages local governments to be more and more efficient and induces them to work in the best interests of their residents.

ii) Local Public Goods and Externalities

A strong argument for decentralization is that many public goods are purely local in nature and are ideally supplied at the local level. Efficiency in a federation requires that the level of local public goods in each locality be determined by the benefits of the residents being served. A decentralized federation has the benefit that each local government is able to provide the type and mix of public services that its local residents prefer. Furthermore, if residents are relatively mobile, they should be free to move to the jurisdiction that best satisfies their need for public goods. The Tiebout Model has stressed the benefits of free migration combined with decentralized decision making in a federation in which some public goods are local in nature and persons have different preferences.

iii) Inter-jurisdictional Spillovers

A problem with the above argument for decentralization is that the benefits of different local public goods may not be limited to the geographical boundary of the locality providing them. In such cases there are inter-jurisdictional spillovers. Local governments will typically not have an incentive to consider the beneficial effects to other jurisdictions of local public goods supplied by them. In such cases, from a macro perspective, there will be an undersupply of local public goods. Such instance would require interventions from a higher level of government.

iv) Tax Harmonization

Local governments typically have some liberty to set their tax rates and structures. If this is done in an uncoordinated fashion, inefficiencies will creep in because distortions will differ across jurisdictions. This can be a result of differential tax rates on capital and labour income, or different tax rates for goods and services across jurisdictions such that production and/or consumption decisions get distorted. These distortions can be minimized if tax rates are chosen across jurisdictions in a coordinated and harmonized manner. Such harmonization can occur either at the instance of cooperation among lower level jurisdictions, or at the instance of a higher level of government. It can be argued that tax harmonization is most important for capital and income taxes and less so for indirect taxes. But this does not imply that there are no costs to not harmonizing the indirect tax structure.

4. Equity Considerations with layers of Government

With layers of government, an important issue that has to be addressed is: which level of government is responsible for vertical equity in a society? On the one hand, there is the argument that, since the concept of vertical equity applies to all citizens of a country,it is ideal for the central government to tackle the issue of vertical equity. On the other hand, economists who prefer a smaller amount of redistribution, typically see the central government engaging in too much redistribution. They argue that the task of redistribution should be entrusted to lower levels of government. This together with inter-jurisdictional competition, it is argued, would reduce the amount of redistribution that occurs and would provide a mix of local public goods and taxes that is consistent with maximization of the welfare of the representative resident tax-payer. Similar arguments would apply for the case of horizontal equity. But a large majority of economists would

agree that the issue of equity is appropriately addressed at the central level.

5. Assignment of Functions

The brief overview above tends to indicate that a determination of the ideal degree of decentralization remains an elusive goal. So much depends upon value judgements and empirical consequence which are hard to verify. In many cases, even though a better assignment of functions to levels of government is known, it is hard to move toward it. In countries that run the immediate risk of disintegration, a higher degree of decentralization, although desirable, may be impractical and fraught with too much danger. The extent of decentralization also depends, to some extent, upon the desired magnitude of the role of the government in the economy. Typically, economists who prefer a smaller role for the government would also favour more decentralization.

As would be expected, it is not possible to resolve these issues in a definitive manner. What one can do, however, is to outline the considerations that might be useful in approaching this question.

6. Pros and cons of Decentralizing Expenditure Responsibilities

The advantages of decentralizing public expenditure are the following:

a) The existence of local public goods requires that local preferences be given greater importance. This is facilitated with a local government.

b) Moreover, there may be local preferences for redistribution which may be insufficiently addressed by a higher level of government.

c) With local governments responsible for the provision of local public goods, political accountability is greater. This is definitely

compromised when local public goods are provided by a higher level of government.

The disadvantages of decentralizing public expenditure decisions are as follows:

a) Inter-jurisdictional spillovers means that there may be a less than optimal supply of local public goods.

b) To the extent that there are economies of scale in public expenditure, costs of local expenditures are unduly high.

c) Harmonization of expenditures across small jurisdictions is compromised with decentralized public expenditure decisions.

d) Finally, if horizontal and vertical equity across the country are highly desirable, a more centralized model of public expenditure would clearly be better; see Boadway and Keen (1992).Although the decentralization of expenditure responsibilities implies an argument for decentralizing tax responsibilities as well, the exact nature of such decentralization is by no means obvious. Decentralizing of taxing powers is desired mainly in order to induce political accountability into the federation. It might well be the case, also, that local governments may have particular preferences for certain features of the tax system, such as the degree of tax progressivity, or the system of administration. However, decentralization of tax authority can give rise to several inefficiencies and inequities; for example, if different jurisdictions choose individually to levy different tax rates on factors of production which are mobile. Since capital is highly mobile, this would suggest that local level taxes on capital can be highly distortionary and, ultimately, self-defeating.

Some may argue that tax competition may encourage jurisdictions to lower tax rates on capital to very low levels in order to attract capital. Thus there may be uniformity of taxes but at too low a level to finance the optimal level of public services desired.

The decentralization of taxation responsibilities will also generally lead to inequities from a national point of view. For example, different degrees of tax progressivity will imply that people with the same income in different parts of the country will face different tax bills. This would be horizontally inequitable. This argument would be particularly true of direct taxes, but would also be true of indirect taxes.

In sum, fiscal responsibility and political accountability require that tax and expenditure responsibilities be decentralized. However, too enthusiastic an adoption of this principle may lead to inefficiencies as well as inequities. A partial solution may lie in leaving some degree of control over lower jurisdictional tax and spending authority in the hands of the central government so that harmonization of tax and expenditure policies across jurisdictions and considerations of efficiency and equity at the national level are not unduly compromised. From a consideration of the above, it would appear that a greater degree of decentralization is required in expenditure decisions than in decisions of taxation. It would, therefore, appear that there would be a gap between the tax revenues of local governments and their expenditures. This points to the desirability of transfers from higher level governments to lower level jurisdictions. Economists usually advance the following rationale for such transfers.

a) An imbalance between the revenue-raising ability of states and their expenditure responsibilities might arise for two reasons. For one, it may be more efficient for the higher-level government to collect taxes and pass on the tax revenues to the lower level governments. This avoids tax competition and inter-jurisdictional tax spillovers and distortions.

b) Fiscal inequity arises in a federal country when citizens in two

different jurisdictions within a federal country are treated differently by the tax system. These differences can arise because of differences in tax capacities of lower level governments and differences in costs of providing public services. Federal grants can help redress some of these inequities.

c) Inter-jurisdictional spillovers exist when the benefits from the expenditures of a particular jurisdiction spill over to other jurisdictions. The former would not value the benefits to the latter and, therefore, there would be an undersupply of such public goods if federal grants or grants from higher levels of government are not present. Such possibilities provide the essential rationale for matching grants by higher levels of governments.

d) Fiscal harmonization may be important for two reasons. From the national point of view, there would be an advantage to having uniform public services across the country since this would contribute to factor and goods mobility within the boundary of the country. This may be particularly important in key areas such as power, education and health services. Expenditure harmonization can be accomplished by conditional grants. In choosing such policies there will always be a tradeoff between uniformity, which encourages the free flow of goods and services, and factors of production, and decentralization, which may encourage innovation, efficiency and accountability.

III. FISCAL EFFICIENCY IN INDIA : SOME ISSUES AND RESULTS

An implicit assumption in tax design theory has been that governments collect taxes in an efficient manner. To be sure, tax efficiency, unlike efficiency in production, can only be defined in a relative sense. If we are considering the efficiency of various

states in the Indian union in respect of tax collection[3] then we should concentrate on taxes that are collected by all the states in our sample. Since there is a clear-cut dichotomy in the Indian case, between the tax responsibilities of the central and state governments[4], this precludes any direct comparison of the tax efficiency across the central and state governments.

Under these conditions, the best course of action available to us appeared to be the following. Using some broad results from the theory of tax reform we provide an analysis of the tax performance of the central government. We then proceed to the level of states. Here the analysis takes two forms. First, we follow the approach of the erstwhile Finance Commissions to describe the determinants of tax capacity of Indian states. This analysis is conducted at two time points so that a comparison could be drawn on the position of an individual state not only with reference to its past performance but also with that of other states. We make these comparisons for two time points: 1982 and 1992. These refer to three year averages ending with 1982-83 and 1992-93, respectively.

---

3. In the theory of production or cost, efficiency can always be defined relative to a production or cost function [See Jha and Sahni (1993)]. Following this, we concentrated on tax efficiency at the level of the individual states. This problem was addressed at several levels. The first three of those come under the general rubric of the methodology adopted by the 9th. Finance Commission. These are as follows. First, we identified the tax capacity factors and related them to the state's own tax revenue through a cross-section regression equation; second, we applied the estimated regression coefficient to the individual state's tax capacity factors to obtain the projected revenue for each state; third, the projected revenue for each state was taken as its potential revenue and this was compared with the actual revenue for that period to arrive at an idea of the state's achievements on the tax effort front.

4. In some federal countries, such as Canada, even states levy income taxes. In such cases a direct comparison of the tax efficiency of the states and the centre would be possible in respect of the income tax.

We then move to a completely novel approach which considerably generalizes and improves upon the Finance Commission's approach (FCA) to tax efficiency and, at the same time, points to the shortcomings of the extant approach. For want of a better expression, we call this method tax productivity analysis (TPA). TPA attempts to measure simultaneously the variations in efficiency of tax collection across time as well as across states. This analysis, therefore, uses a panel data approach and is a considerable generalization of the approach taken by the cross section methodology of the FCA. From the viewpoint of the TPA, the results of the FCA analysis are unable to capture the total variations in tax productivity across time and states. An additional advantage of the TPA is that it permits us to compute an index of national tax productivity and to analyze its movement across time. We are, then, also in a position to analyze the patterns of causality between tax productivity and other economic variables. In particular, we are interested in the incentive-theoretic argument: If gaps in state budgets are, ultimately, to be picked up by the central government, then states can afford to be lax in their tax efforts. Furthermore, the more lax the tax effort of the states, the greater, *ceteris paribus,* would be the grants from the central to the state governments.

1. Broad Indicators of Tax Efficiency at the Central/State Levels.

The bulk of tax revenues in India is obtained from domestic indirect taxation. In 1993-94 (Budget Estimates), for example, tax revenues from domestic indirect taxes amounted to 10% of GDP and 62% of total tax revenue. Most of this tax revenue was collected from central excise and state sales taxes.Customs duties are also quite high and revenue from this source amounts to 3.5% of GDP and 21% of tax revenue. Compared to both developing and industrial countries, there is a much stronger contribution from indirect taxes. To be sure, this arises in part from the constitutional arrangement whereby state governments are assigned ex-

clusive power to levy sales taxes and the central government has had to rely on excise duties as its major instrument of indirect taxation.

At the same time, the share of income taxes in both GDP and tax revenue in India is relatively small compared both to some developing countries and the industrialized countries. In addition, there had been a definite drop in the relative share of direct taxation in the pre-reform period; the trend has however started reversing since 1991-92 with the reforms in place [(from 20% of tax revenue in 1974-75 to 14% in 1990-91 and 17.4% in 1993-94 (BE)]. Over this period the share of direct taxation in GDP was relatively constant (Figure 1). At the same time, the relative share of (state) sales taxes showed an approximately monotonic increase till the late seventies, after which it has remained almost stagnant at 20 to 21 per cent. Another point worth noting is that the relative shares of customs duties and union excises in total tax revenues show distinct and opposing trends. Between 1974-75 and 1993-94, the relative share of customs duties rose notwithstanding the decline in the post reform period (from 14% to 21% of tax revenue) while the relative share of union excises fell more or less steadily (from 35% to 26% of tax revenue).

It is to be noted that for over a considerable time the Indian tax structure was not in conformity with some important tenets of tax reform theory. Only recently a comprehensive tax reform package has been put in place to design a tax system based on the underlying theoretical principles. Moreover, the experience of some other developing countries has shown that it is possible to proceed along the lines suggested by the theory of tax reform and obtain a degree of success. The theory of tax reform typically calls for a mix of personal income taxes and indirect taxes based on final consumption, not intermediate uses. Excise taxes are to be levied on products and processes causing significant external

diseconomies. Taxes on final consumption, if administered appropriately, will not significantly alter market prices and, therefore, cause minimal distortion. To reduce the significance of these distortions the share of these indirect taxes should fall over time. The share of personal taxes in total tax revenue should rise as the economy grows since this ensures both growing redistribution from higher to lower income groups and a gradual reduction of the distortion associated with indirect taxes. It is also warranted that the share of corporate taxes falls. The justification for corporate taxes lies only in their being a tax on monopoly profits or incomes of foreigners. These need not be too high. The fact that they are so high in India until recently points to the possibility that there is widespread evasion of income taxes. Corporate taxes are easier to levy and collect than income taxes. Similarly, import duties need not be so high - since the only tenable (and that too weakly) hypothesis in favour of import duties is the infant industry argument. Typically, then, tax reform would call for a gradual reduction in the role of excise and customs duties as well as corporate taxes and an increase in the share of other direct taxes, particularly the income tax.

The above brief account of the trends in taxation in India should point clearly to the fact that there is considerable room for improvement. To be sure, the above does not directly deal with the issue of tax productivity or efficiency in tax collection, which is the main focus of this paper, but it does indicate that there is considerable room for improvement in the design and administration of central taxes. It might be worthwhile here to point out that the recommendations of the Chelliah Committee are broadly along the lines mentioned above. The successful reform of central taxes would depend on what reforms can be carried out at the level of the states and the efficiency of the central and state governments in tax collection. These are difficult, often contentious, issues, [For a review see Jha (1994)].

2. Efficiency in State Taxes: Cross-section results for 1982-83 and 1992-93

In order to examine the importance of key economic variables in the tax revenues of different states we examined tax capacity and tax effort in fifteen Indian states for the years 1982-83 and 1992-93. These states are Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. Tax capacity factors are represented by three variables: (i) state domestic product (SDP) (at 1980-81 prices) to represent the level of economic activity; (2) proportion of agricultural income to total SDP to proxy the degree of backwardness as also the low tax intensity of agricultural income; and (3) per capita real rural household consumption expenditure to proxy the state of poverty conditions and its impact on tax potential.

Raw data was obtained from various publications of CSO and NSS (32nd. to 45th. rounds). Some transformation of the above data was needed to express them in a form that would provide estimable equations.

Sources and Transformations of Data

Data on taxes collected by the states were obtained from the various issues of Finances of State Governments/ RBI Bulletin published by the Reserve Bank of India. A common set of taxes for all fifteen states was considered. This included sales taxes, entertainment taxes and the like. Data on Net State Domestic Product at constant prices were obtained from CSO documents as was the proportion of total SDP originating from agriculture. The state-wise estimates of level of poverty for the period 1980-81 to 1992-93 were proxied by state specific real annual per capita rural household consumption expenditures. Nominal per capita rural

household expenditure for 30 days are available for selected time points in CMIE publications (September 1994) corresponding to the 32nd (1977-78), 38th (1983), 42nd (1986-87), 43rd (1987-88), 44th (1988-89) and 45th (1989-90) Rounds of National Sample Survey (NSS). The expenditures for the other years were obtained in the following manner. The data for 1990-91, 1991-92 and 1992-93 were extrapolated by regressing consumption expenditures for the previous years (1986-87 to 1989-90) on time. The data for the years 1984-85 and 1985-86 were obtained by applying the observed annual growth rate of consumption expenditure between 1983 and 1986-87. Similarly, the annualized growth rates between 1977-78 and 1983-84 were used to obtain expenditure levels for 1980-81, 1981-82 and 1982-83. Having obtained the monthly data for all the years (1980-81 to 1992-93), the respective values were converted to annual nominal values and then deflated to 1980-81 prices using the state-wise Consumer Price Indices for Agricultural Labourers (Base: 1980 = 100). The resulting real consumption expenditures were converted into index numbers to measure an individual state's position relative to the all-India average.

Data on SDP were not available for 1992-93 in the case of Rajasthan and Tamil Nadu. These were obtained by regressing SDP on time (for the period 1980-81 to 1991-92) and using the regression equations to collect values for 1992-93. The ratio of agricultural income to total SDP for 1992-93 was obtained as an average of the previous three years in the case of both states. State-wise total own tax revenues, i.e., excluding their shares in central taxes were deflated to 1980-81 price levels using state-wise consumer price indices.

Some Results

The tax equations were specified in level as well as in log form and have the following estimated parameters :

(Reference Years: Average during 1980-81 to 1982-83)

Level Form

$$T82 = 182.67 + 0.063\ Y82 - 1034.41\ AY82 + 2.857\ C82$$
$$\quad\ (1.015) \quad (9.858) \quad (-3.334) \quad (4.353)$$

$\bar{R}^2 = 0.89$, DW = 1.57, SEE = 98.61

Log Form

$$\ln T82 = -8.658 + 1.129 \ln y82 - 1.630\ Ay82 + 1.183 \ln C82$$
$$\quad\ (-4.217) \quad (7.923) \quad (-3.040) \quad (5.447)$$

$\bar{R}^2 = 0.88$, DW = 1.88, SEE = 0.242

(Reference Year: Average During 1990-91 to 1992-93)

Level Form

$$T92 = 559.503 + 0.072\ Y92 - 2317.14\ AY92 + 4.150\ C92$$
$$\quad\ (0.85) \quad (12.574) \quad (-3.291) \quad (1.501)$$

$\bar{R}^2 = 0.85$, DW = 1.70, SEE = 221.86.

Log Form

$$\ln T92 = -4.806 + 0.938 \ln y92 - 2.197\ Ay92 + 0.806 \ln C92$$
$$\quad\ (-1.622) \quad (5.432) \quad (-1.740) \quad (1.599)$$

$\bar{R}^2 = 0.69$, DW = 1.59, SEE = 0.36

where T82 (T92) = state's own tax revenue in real terms in 1982 (1992);

y82 (y92) = SDP in real terms in 1982 (1992);

AY82 (Ay92) = proportion of agricultural income to total state income in 1982 (1992);

C82 (C92) = index of rural household consumption in 1982 (1992); and ln stands for natural logs. Figures in parentheses below a coefficient indicate t ratios.

Thus SDP is an important determinant of state tax revenue but its significance seems to have fallen over time. The proportion of agricultural income to total income remains strongly significant in both estimations. Rural consumption is strongly significant for 1982 but far less so for 1992.

As the level form equations have higher explanatory power than the log specification we have used the former for projection purposes. The explanatory power of the equations is fairly good with high $\bar{R}^2$ values - particularly when we consider that we are dealing with cross-section data. The coefficients of the regression equations have expected signs and are statistically significant. SDP carries a positive sign and, since agricultural income is almost completely exempt from taxation, Ay carries a significant and negative coefficient. The coefficient of the consumption sign is also as per our expectations.

The income elasticity of state taxes is estimated at 0.94 for reference year 1992-93 which happens to be lower than that for the reference year 1982-83.

The state-wise projections of tax revenue obtained from the level form equations are taken to represent the tax potentials of the respective states, while tax effort is measured by the residuals of the regressions. Denoting estimated tax capacity for state i as TC_i and the average tax capacity as TC we can define an index of tax

capacity as: $ITC_i = (TC_i / TC) \times 100$. We present these results in Table 1 for the years 1982-83 and 1992-93. It would appear that smaller states will have a disadvantage with this criterion. Hence we also calculated an index of per capita tax capacity as:

$IPTC_i = (PTC_i / PTC) \times 100$. These results are also presented in Table 1.

Table 1

An Index of Tax Capacity of Major Indian States 1982 and 1992

States	Index Based on			
	Total Tax Capacity		Per Capita Tax Capacity	
	1992	1982	1992	1982
Andhra Pradesh	100	105	73	79
Assam	48	28	102	56
Bihar	83	78	46	44
Gujarat	123	110	145	129
Haryana	51	50	151	152
Karnataka	85	80	92	85
Kerala	60	84	100	132
Madhya Pradesh	82	89	60	68
Maharashtra	257	244	158	155
Orissa	48	18	74	28
Punjab	66	89	160	212
Rajasthan	67	65	73	74
Tamil Nadu	130	138	115	115
Uttar Pradesh	166	179	57	64
West Bengal	133	145	95	106

We can now define an index of tax effort (ITE_i) for state i as $ITE_i = (TA_i / TC_i) \times 100$ where TA_i is the actual tax collection by state i. With $ITE_i = 100$ tax effort just realises tax potential. We report results for tax effort in Table 2.

Table 2

Index of Tax Effort of Major Indian States: 1982 and 1992

States	1982	1992
Andhra Pradesh	122	135
Assam	59	43
Bihar	78	71
Gujarat	110	98
Haryana	111	108
Karnataka	136	136
Kerala	83	101
Madhya Pradesh	102	113
Maharashtra	106	97
Orissa	148	69
Punjab	92	101
Rajasthan	94	98
Tamil Nadu	111	124
Uttar Pradesh	90	94
West Bengal	74	79

Some major trends are indicated by Table 2. First, the relative difference in tax efforts is fairly high across the states and appears to be increasing over time. Tamil Nadu, Andhra Pradesh and Karnataka seem to have maintained a consistently high position with respect to their tax effort compared to other states. On the other hand, high performance states such as Maharashtra and Gujarat have slipped somewhat in their tax effort. Poorer states like Assam and Bihar, have low and declining tax efforts.

capacity as: $ITC_i = (TC_i / TC) \times 100$. We present these results in Table 1 for the years 1982-83 and 1992-93. It would appear that smaller states will have a disadvantage with this criterion. Hence we also calculated an index of per capita tax capacity as:

$IPTC_i = (PTC_i / PTC) \times 100$. These results are also presented in Table 1.

Table 1

An Index of Tax Capacity of Major Indian States 1982 and 1992

States	Index Based on			
	Total Tax Capacity		Per Capita Tax Capacity	
	1992	1982	1992	1982
Andhra Pradesh	100	105	73	79
Assam	48	28	102	56
Bihar	83	78	46	44
Gujarat	123	110	145	129
Haryana	51	50	151	152
Karnataka	85	80	92	85
Kerala	60	84	100	132
Madhya Pradesh	82	89	60	68
Maharashtra	257	244	158	155
Orissa	48	18	74	28
Punjab	66	89	160	212
Rajasthan	67	65	73	74
Tamil Nadu	130	138	115	115
Uttar Pradesh	166	179	57	64
West Bengal	133	145	95	106

We can now define an index of tax effort (ITE_i) for state i as $ITE_i = (TA_i / TC_i) \times 100$ where TA_i is the actual tax collection by state i. With $ITE_i = 100$ tax effort just realises tax potential. We report results for tax effort in Table 2.

Table 2

Index of Tax Effort of Major Indian States: 1982 and 1992

States	1982	1992
Andhra Pradesh	122	135
Assam	59	43
Bihar	78	71
Gujarat	110	98
Haryana	111	108
Karnataka	136	136
Kerala	83	101
Madhya Pradesh	102	113
Maharashtra	106	97
Orissa	148	69
Punjab	92	101
Rajasthan	94	98
Tamil Nadu	111	124
Uttar Pradesh	90	94
West Bengal	74	79

Some major trends are indicated by Table 2. First, the relative difference in tax efforts is fairly high across the states and appears to be increasing over time. Tamil Nadu, Andhra Pradesh and Karnataka seem to have maintained a consistently high position with respect to their tax effort compared to other states. On the other hand, high performance states such as Maharashtra and Gujarat have slipped somewhat in their tax effort. Poorer states like Assam and Bihar, have low and declining tax efforts.

It ought to be emphasised at this stage that the above results are cross-section in nature only. Making strong inferences from these results for tax effort by states in general would be an exercise fraught with too much danger. In any event, the above results point to the importance of the three determinants of tax capacity. What we are also interested in is pure tax effort put in by the states. We now turn our attention to this.

3. Tax Productivity Analysis of Fifteen Major States

We wish to model productivity in tax collection of fifteen major states. The approach taken here is to use panel data on these fifteen states for the thirteen year period 1980-81 to 1992-93. This approach would enable us to decipher variations in tax efficiency both across states as well as across time. Moreover, it would permit us to compute an aggregate index of tax productivity for each year.

The approach taken in this paper follows that pursued in studies of technical efficiency in the theory of production. We begin by briefly describing the model and the analytics of estimation. For details see Cornwell, Schmidt and Sickles (1990), Jha and Sahni (1992), Jha, Murty,and Sahni (1992), and Jha and Singh (1994).

A standard form of the panel data econometric model where variables other than the intercept vary across individuals (states) can be written as:

$$y_{it} = X'_{it}ß + Z'_{it}\tau + W'_{it}\delta_i + \varepsilon_{it} \qquad \ldots (1)$$

$$i = 1,\ldots,N; \quad t = 1,\ldots, T$$

where X_{it} is a *K*-dimensional vector of time-varying explanatory variables. Z_{it} is a *J*-dimensional vector of time varying explanatory variables, and ß and τ are confirmably dimensioned param-

eter vectors. The variables in W have individually-varying coefficients. (In our application W_{it} will contain an intercept term, time and time squared). The data set comprises of N states and T time periods per state. We write

$$\delta_i = \delta_0 + u_i \qquad \ldots(2)$$

where the u_i are assumed to be random variables with a zero mean and covariance matrix Δ. We may then write

$$y_{it} = X'_{it}\,\beta + Z'_{it}\,\tau + W'_{it}\,\delta_0 + v_{it}, \text{ with} \qquad \ldots.(3)$$

$$v_{it} = W'_{it}\,u_i + \varepsilon_{it}$$

In matrix form (1) may be written as:

$$y = X\beta + Z\tau + Q\delta + \varepsilon \qquad \ldots.(4)$$

whereas the matrix form of (3) is

$$y = X\beta + Z\tau + W\delta_0 + v, \text{ with}$$
$$v = Qu + \varepsilon \qquad \ldots.(5)$$

and where W is NTxL (L being the dimension of W_{it}) and

$$Q = \begin{bmatrix} W_1\ 0\ \ldots\ldots 0 \\ 0\ \ W_2\ 0\ \ldots 0 \\ \ldots\ldots\ldots\ldots\ldots \\ 0\ldots\ldots:\ldots\ldots W_N \end{bmatrix} \qquad \ldots.(6)$$

δ_i (or u_i), i = 1,2...,N. We assume $L \leq T$, so that Q is of full column rank. This assumption is necessary for the estimation of the

individual δ_i. There are at least three important estimators of this model.

(i) "Within" Estimation

This procedure transforms the data into deviations from individual means and then applies ordinary least squares (OLS) to the transformed data. The within estimator of ß can be written as:

$$\hat{ß}_w = (X'M_Q X)^{-1} X'M_Q y \qquad \ldots.(7)$$

We define the projection on the null space of A as $M_Q = I - P_Q = Q(Q'\ Q)^{-1}\ Q$ is the projection onto the column space of Q.

An obvious drawback of this estimation procedure is that the τ and δ cannot be estimated. Another drawback is that within estimator is not fully efficient since it ignores "between" (across individuals) variations. A desirable property of these estimates is that they are consistent.

(ii) Generalized Least Squares (GLS) Estimation

The generalized estimator of $(ß, \tau, \delta_0)$ is

$$\left[(X,Z,W)'\ \Omega^{-1}(X,Z,W)\right]^{-1} (X,Z,W)'\Omega^{-1}y \qquad \ldots.(8)$$

where $\Omega = \text{cov}(v) = \sigma^2\ I_{NT} + Q(I_N \otimes \Delta)\ Q'$ $\ldots.(9)$

Although Ω is a large matrix, it is block diagonal, with blocks of the form $\sigma^2 I_N + W_i \Delta W_i'$. Hence its inversion is practical. GLS is consistent as $N \to \infty$ if (X, Z, W) is uncorrelated with Q_u. For fixed T, it is more efficient than "within".

(iii) VARCOMP Estimation

A drawback of the within estimates is that they ignore variations across individuals. In the terminology of panel data literature, it is sometimes called a fixed effect model. An alternative is the variable effects model which is obviously a generalization of the fixed effects model. This is sometimes called the VARCOMP approach. In this approach it is assumed that the parameters vary across individuals by a random term; i.e. in the model

$$y_i = X_i \beta_i + \varepsilon_i \qquad \ldots.(10)$$

where y_i , X_i , β_i , and ε_i are appropriately defined vectors; it is the case that $\beta_i = \beta + v_i$ where v_i is a random variable with $E(v_i) = 0$ and $E(v_i v_i') = \Gamma$. The model (10) can then be written as (see Greene (1990)):

$$y_i = X_i\beta + (\varepsilon_i + X_i v_i) = X_i\beta + w_i \qquad \ldots(11)$$

One can then define a generalized least squares estimator of β provided that the GLS estimator does not depart "too much" from the consistent estimator. This can be tested for using a χ^2 test. If the computed χ^2 value is not significantly different from the critical value then the GLS estimator of the variable effect model is consistent and improves in efficiency upon the "within" estimator.

For purposes of actual estimation we define the model

$$y_{it} = X_{it}' \beta + W_{it}' \delta_i + v_{it} \qquad \ldots.(12)$$

where y_{it} is the tax collected by the ith state at time t, X_{it} are the three determinants of tax collection already discussed above, and v_{it} is statistical noise. In order to permit cross-sectional as well as temporal variation in tax productivity we define

$$W'_{it} = \left[1,\ t,\ t^2\right],\ \delta_i' = \left[\Theta_{i1},\ \Theta_{i2},\ \Theta_{i3}\right] \qquad \text{....(13)}$$

(t stands for time) so that, in effect, we are working with the model

$$y_{it} = \Theta_{i1} + \Theta_{i2}t + \Theta_{i3}t^2 + X'_{it}\beta + v_{it} \qquad \text{....(14)}$$

To analyze cross-sectional and temporal differences in inefficiency we use within and VARCOMP methods. For each case we get the residuals ($y_{it} - X'_{it}\,\beta$) and regress these residuals for each state *i* and on a constant, time and time squared thereby implying a quadratic trend to tax productivity. The fitted values from this regression provide an estimate ($\hat{\alpha}_{it}$) of α_{it} (where $\hat{\alpha}_{it} = \Theta_{i1} + \Theta_{i2}\ t + \Theta_{i3}t^2$).

The frontier estimate at time *t* is defined as:

$$\hat{\alpha}_t = \max\ (\hat{\alpha}_{it}) \qquad \text{....(15a)}$$

and the state-specific level of tax inefficiency of state *i* at time *t* as:

$$\hat{\pi}_{it} = \hat{\alpha}_t - \hat{\alpha}_{it} \qquad \text{....(15b)}$$

For any time period, t, expression (15) characterizes the state with the highest tax productivity. We call this the "frontier" estimate. The tax productivity of other states will be measured with reference to the state at the frontier.

Now, let Φ^t_i be the share of state *i* in total tax revenue of all the fifteen states in the sample in year *t*. It must be the case that

$$\sum_{i=1}^{15} \Phi^t_i = 1 \qquad \text{....(16)}$$

for all t. In that case we can define an index of tax productivity (μ^t) for year t as:

$$\mu^t = \sum_{i=1}^{15} \Phi^t_i \hat{\alpha}_{it} \qquad \ldots.(17)$$

μ^t gives us an idea of tax productivity in the aggregate in year t. We will call it a Tax Productivity Index (TPI). Its behaviour over time will give us an idea about the intertemporal behaviour of such tax productivity.

Some Results

As discussed above, the ideal estimates will be obtained from a VARCOMP method that permits random rather than fixed effects. The criterion for choosing the "right" VARCOMP regression is to examine the χ^2 statistic associated with the VARCOMP regression and see whether this predicts that the estimated equation is insignificantly different from the most efficient equation. We had data on fifteen states for thirteen years 1980-81 to 1992-93. We tried several versions of the panel data regression equation and the best results obtained were as follows:

$$\begin{array}{lll} TA = 577.622 & + 0.084269\ y_{t-2} & - 1272.98\ ay_{t-2} \\ \quad (4.97770) & \quad (17.6301) & \quad\ (-5.78043) \end{array}$$

χ^2 (two degrees of freedom) = 0.869 (Hausman Test); R^2 = 0.727881.

A few points about this regression equation are worth noting. First, there are lagged effects in taxation. TA responds to income and agricultural income two periods ago and contemporaneous effects are weak. Second, consumption is not an important determinant of tax revenues and is,hence, deleted from the final equa-

tion. Third, the signs are all expected. The Hausman χ^2 test gives good results at the 10% level of significance and is accepted.

We then proceeded to use the same independent variables in a "within" estimation. Since "within" is an estimation of deviations from respective means the constant term will drop out. The estimated equation is as follows.

$$TA = \underset{(15.9759)}{0.086333\ y_{t-2}} \quad \underset{(-4.99721)}{-\ 1205.14\ ay_{t-2}}$$

$\bar{R}^2 = 0.700$

Once again the two coefficients have expected signs and are statistically significant.

Since the independent variables have to be lagged two time periods we lose the first two observations for each state. Using the VARCOMP regression we generate the residuals for 1982-83 to 1992-93 for each state and then regress the residuals for each state (separately) on a constant, time and time squared. In Appendix I we provide the details of these equations. We undertake the same analysis for the Within residuals for each state for the same period. The details are presented in Appendix II.

We then forecast efficiency levels for each state by using equation (15a). In most of the equations the constant, time and time squared are all significant so that forecasting uses the coefficients of all these variables. In a small number of equations only a subset of these variables is significant. We use only significant coefficients for the forecast. In other words, if in a regression equation the coefficient of $(time)^2$ is insignificant, then we use only the constant and time to forecast efficiency levels. Using insignificant variables might give an inaccurate picture of tax productivity. In the case of Haryana, Gujarat, and Rajasthan none of the coeffi-

cients is significant. Hence these states are assigned efficiency values of zero. The results in Appendix I and II are, on the whole, quite satisfactory.

In Table 3 we present the rankings of the various states by tax productivity for the eleven years 1982-83 to 1992-93 using the VARCOMP method. The results for the "within" approach are not presented because VARCOMP provides superior estimates. In Figures 2 (a) to 2(k) we depict the ranking of states by efficiency when VARCOMP estimates are used and in Figure 3(a) to 3(k) we present the same results when "within" estimates are used.

We are now in a position to use equation (17) to define an aggregate tax productivity index for the various years for the fifteen states covered in this paper. In Table 4 we present the estimates for VARCOMP and in Table 5 for "within". In Figure 4 the TPI for VARCOMP is plotted for the various years and Figure 5 does the same for the "within" estimates of TPI.

The results are quite striking. The first point to be noted is that the TPI calculated using "within" methods behaves in a manner quite similar to that calculated using VARCOMP methods. Both start out being negative, but rising. They are positive between 1985-86 and 1990-91. Since 1991-92 this index has declined for the remainder of the sample period. It is also possible to fit a roughly quadratic functional form to this index in each case and this is depicted in Figures 4 and 5.

4. Correlation between Efficiency and Consumption

Given the results above, it is natural to inquire whether efficiency in tax collection is correlated with the level of development of the state concerned. It may well be argued that more prosperous states may have better tax administration machineries and may, hence, be more efficient in tax collection. We tested this propo-

sition by calculating correlation coefficients between efficiency in tax collection and per capita real rural household consumption computed earlier. Our results for VARCOMP method are noted in Table 6 and that for Within in Table 7. We present correlation coefficients as well as the respective t-values calculated according to the formula

$$t_{n-2} = \frac{r(n-2)^{0.5}}{(1-r^2)^{0.5}} \qquad \ldots.(18)$$

where r is the coefficient of correlation and n is the number of sample points (15 in our case). The distribution of the statistic in equation (18) is discussed in Hogg and Craig (1970). Under the null hypothesis that the population correlation coefficient is zero the expression in (18) is distributed as a t distribution with (n-2 = 13) degrees of freedom. The results in Tables 6 and 7 indicate that, although the sign of the correlation coefficients between real rural consumption per capita and tax effort is positive, it is hardly ever significant. It appears, therefore, that the relation between these two variables is tenuous, at best.

5. Relation between Tax Efficiency and Federal Grants

The above results make the case for incentive-theoretic arguments fairly strongly. We wish now to proceed to a related question. Does the structure of federal grants, in particular, and the central and state governments, in general, recognize this fact? In other words is there a link between federal grants and tax efficiency of states? If a positive relation exists then we could conclude that the central government recognizes and rewards tax effort in a systematic manner. If a negative relation obtains then it could be the case that the state governments are able to conceal laxity in tax effort as "backwardness" or some other criterion used by the central government in making transfers. If there is no relation be-

tween these two variables then it amounts to saying that neither the central nor the state governments recognize the incentive issues in transfers analyzed here.

To analyze this issue we resorted to cointegration relation analysis. If a cointegrating relation exists between two variables X and Y then we are assured of a long term relation between these two variables. Cointegration is also linked in a straightforward way to the earlier notion of (Granger) causality between these two variables. (See Davidson and MacKinnon (1993) or Cuthberston et. al. (1992)).

The simplest way to test for the existence of a cointegrating vector between federal grants and state tax effort is to first check whether efficiency levels of states (state specific residuals from the panel regression) and federal grants are each stationary (I(0)). If they are each I(1), i.e., their first differences are stationary or I(0), and if the residuals from a regression of say grants on tax effort are I(0) then there is a cointegrating relation between the two and the direction of causality is from tax effort to grants. If in a regression of tax effort on grants we find that the residuals are I(0) then these two variables are, again, cointegrated and the direction of causality runs from grants to tax effort. If both the above statements are true then there is bidirectional causality.

Our results are discussed in Appendix III. In general, we are not able to discover the existence of any cointegrating relation between tax efficiency and transfers. We worked with gross transfers and adjusted gross transfers (i.e. excluding loans against small savings and ways and means). The above result seems to hold good for both these cases. For only two states is there some indication of the existence of a cointegrating vector (Table A3.2 in Appendix III); but even in these cases the number of data points available to us is too low to make a definite judgement. The critical value for the ADF test is defined for a sample size of 25 (at the least)

whereas our sample size is 11. Hence, we come to the conclusion that the incentive implications of federal transfers remain largely ignored by the central and state governments.

IV. SOME POLICY CONCLUSIONS

The analysis in this paper has been quite revealing. Apart from tax capacity factors, which have a direct bearing on the amount of revenue that a state can collect at a given tax rate, the tax performance depends greatly on the state government's revenue effort manifested in terms of administrative and legislative efforts to expand the tax base, rationalise the tax structure and reduce avenues of tax avoidance and evasion etc. It is a fact that the growth process is self perpetuating in nature, more so when it posts 'fiscal dividend' to government budgets for financing the growing demands for social and economic infrastructure. However, this automatic flow of resources to government, through the growth in tax capacity factors, or what is referred to as the built-in-elasticity of tax system, is often inadequate to enable the states to embark upon the development programme of the scale envisaged by the planners. It is in this context that 'tax effort' of states assumes critical importance for garnering resources for development. This apart, a sound tax system presupposes a certain degree of efficiency in tax collection. 'Tax effort' takes on a different meaning here, not so much in terms of pure revenue raising effort as in terms of raising resources at the least possible cost to the economy.

The state governments in India, by virtue of their very diverse economic conditions, collect different proportions of their gross revenue through own sources, while the remaining part is met through transfers from the centre. These two components of the state revenues would be interdependent only to the extent of the weight placed on 'tax effort' in the devolution schemes and to the

extent the states take cognizance of this fact. If the weight on tax effort were to be reduced to zero, the incentive for a state to achieve higher tax effort, from the point of view of receiving higher levels of central transfers, would be completely absent. The state's tax effort in this case would be dictated by its own interest to raise revenue. The analysis conducted in this paper provides a framework to evaluate the temporal trend in state's tax effort, both inter-state and overall, and to see whether there is evidence of a close relation between Central transfer and state tax efforts, in either direction.

The results showed that there has been a distinct deterioration in all states' tax effort in recent years, as reflected on the declining trend in the Tax Productivity Index (TPI) beginning with the latter half of eighties. The TPI remained firmly positive during the whole of the Seventh Plan period, succeeded by a deterioration of performance by the beginning of the 1990s. The steady and substantial fall in the TPI in the beginning years of the Eighth Plan has, ironically, coincided with the commencement of fiscal adjustment exercise which placed a great deal of emphasis on improving the revenue performance of states. These results suggest that state governments as a whole have either stayed away from the mainstream of reforms, or are grappling with the problem of evasion which is quite acute (and perhaps increasingly so) at the state level.

It is also interesting to observe that the negative drift of the TPI for states in recent years has occurred precisely during the period when the weight placed on the tax effort/fiscal management criterion for distribution of central assistance for state plans was brought down from 10 to 5 per cent, consequent to the revision of the Gadgil Formula in October 1990. Although the December 1991 revision incorporating the Mukherji Formula increased the weight to 7.5 per cent, the stress on fiscal performance (the new yardstick for measuring states fiscal management, not just tax ef-

fort) has been diluted with the inclusion of "progress in respect of national objectives" within this weight. This offers evidence in support of incentive theoretic arguments of fiscal federalism in the Indian context, and makes a forceful case for a system of performance linked grants to states. In this context, the recent recommendations of the Tenth Finance Commission linking tax transfers to state tax effort should look quite appropriate.

It may also be noted that improvement in tax effort would be welfare augmenting in nature if such effort comes about in the least cost manner (measured in terms of additional distortionary costs to the economy). In other words, while improvement in tax productivity is a necessary condition for improvement of general fiscal condition it may be just one (albeit extremely significant) component of the conditions which must be satisfied to ensure overall fiscal efficiency in the economy. Achieving such efficiency might require at least two steps. First, we induce greater tax effort on the part of the state governments by increasing the weight of tax performance in the devolution formula. Second, we move towards more efficient taxes such as a properly harmonised nation-wide state and central VAT.

It is also worth noting that tax effort is not correlated with consumption per capita, implying the absence of any kind of relation - positive or negative - between tax effort and the level of development of the state. The present high level of fiscal stress of states is, partly, explained by the decline in tax productivity in recent years. Given the downward stickiness of state expenditures, improvement in tax efforts assume a crucial importance for future reforms in state finances. Expansion of tax base, rationalisation of tax rates, checking evasion and toning of state tax administration should, therefore, form the thrust areas of tax reform. Since central transfers (gross) finance about two-fifth of state expenditures, the principles governing their inter state dis-

tribution assumes critical importance for improvement of tax effort of the states. While certain norms regarding tax performance are implicitly reflected in the Finance Commission transfers, they offer little in terms of rewarding states which rise on the tax productivity scale. When these two arguments are juxtaposed against each other, it becomes clear that the incentive-theoretic argument in the theory of fiscal federalism is credible in the Indian context. Since there is no inherent link between the tax effort and the level of development of a state, a greater weight on the former in the devolution formula would not have an in-built bias against the backward states.

A larger weight to tax effort by states in the devolution formula would improve tax effort at the level of the states - thus increasing the amount of resources the states would collect on their own and, *ceteris paribus*, increasing the amount of resources to be transferred from the centre to the states. It may also be mentioned that the formula for fiscal devolution should maintain proper balance between need, backwardness, and fiscal performance. It might also be desirable to have uniform devolution rules for Finance Commission and Planning Commission transfers. Theoretically, improvement in tax productivity is consistent with tax reform. The background of overall economic reforms provides, therefore, a good opportunity for effecting improvements in tax efficiency.

REFERENCES

Ahmad, E. and N. Stern (1984) "The Theory of Tax Reform and Indian Indirect Taxes", Journal of Public Economics, vol. 25, no. 3.

Aigner, D.J., C.A.K. Lovell and P. Schmidt, (1977), "Formulation and Estimation of Stochastic Production Function Models", Journal of Econometrics, vol. 6, pp. 21-36.

Amemiya, T. and T.E. MaCurdy, (1986), "Instrument Variable Estimation of an Error Component Model", Econometrica, vol. 54, pp. 869-880.

Bhagwati, J. and T.N. Srinivasan (1993) India's Economic Reforms; Ministry of Finance, Government of India.

Boadway R., Horiba, I. and Jha,R. (1995) "The Design of Conditional Grants as a Principal-Agent Problem" Paper to be presented at The International Institute of Public Finance Meetings, 1995

Boadway,R. and Keen,M. (1994) "Co-occupation of the Tax Base by Several Levels of Government", Working Paper, Department of Economics, Queen's University, Kingston, Canada.

Boadway, R. and Keen, M. (1992) "The Distributive Effects of Public Expenditure Policy", Working Paper, Department of Economics, Queen's University, Kingston, Canada.

Boadway, R. and D. Wildasin (1984) Public Sector Economics, Boston : Little Brown and Company.

C.M.I.E. various publications.

C.S.O. Various Publications.

Christensen, L.R., D.W. Jorgenson, and L.J. Lau, (1973), "Transcendental Logarithmic Production Frontiers", Review of Economics and Statistics, vol. 55, pp. 28-45.

Cornwell, C., P. Schmidt, and R. Sickles, (1990), "Production Frontiers with Cross-Sectional and Time-Series Variation in Efficiency Levels", Journal of Econometrics, vol. 46, pp. 185-200.

Cutherberston, W. et. al. (1992) Applied Econometric Techniques, Ann Arbor: University of Michigan Press.

Davidson, R. and J. MacKinnon (1993) Estimation and Inference in Econometrics, New York: Oxford University Press.

Forsund, F.R., Lovell, C.A.K. and Schmidt, P. (1980), "A Survey of Frontier Production Functions and of Their Relationship to Efficiency Measurement, Journal of Econometrics, vol. 13, pp. 5-25.

Government of India (1988) : "First Report of the Ninth Finance Commission (for 1989-90)" July.

Government of India (1989) : "Second Report of the Ninth Finance Commission (for 1990-99)", December.

Government of India (1994) : "Report of the Tenth Finance Commission (for 1995-2000)", December.

Government of India (1992) : "Tax Reform Committee Final Report Part I (Chaired by Professor R.J. Chelliah), Ministry of Finance.

Greene, W. (1990) Econometric Analysis, MacMillan, New York.

Hausman, J.A., and Taylor, W.E. (1981), "Panel Data and Unobservable Individual Effects", Econometrica, vol.49, pp. 1377-1399.

Hogg, R. and A. Craig (1970) Introduction toMathematical Statistics, (third edition) New York: Macmillan

Jha, R. (1994) Macroeconomics for Developing Countries, London and New York: Routledge.

Jha, R. and S.P. Singh (1994) "Intertemporal and Cross- section Variations in Technical Efficiency in the Indian Railways", International Journal of Transport Economics, vol. 21, no.1

Jha, R. and B.S. Sahni (1993) Industrial Efficiency:An Indian Perspective; New Delhi:Wiley Eastern.

Jha, R. and B.S. Sahni, (1992), "Towards Measuring Airline Technical

Inefficiency: the Case of the Canadian Airline Industry", International Journal of Transport Economics, vol. 18, no. 1

Jha, R., Murty, M.N. and B.S. Sahni (1992) "Cross-section and Time Series Variations in Technical Efficiency in the Public Sector : State Electricity Boards in India", Indian Economic Review, vol.27, special number.

Jha,R., M.N. Murty, and R. Ray (1990) "Dual Pricing, Rationing and Ramsey Commodity Taxation - Theory and an Illustration" The Developing Economies, vol. 28, no.3

Jha, R. and N.Wadhwa (1990) "A Note on Private Corporate Investment and Effective Tax Rates", Public Finance Quarterly, vol. 18, no. 4

Jha, R. and S. Mittal (1990) "Savings, Investment, and Marginal Effective Tax Rates in India", International Journal of Development Banking, vol.8, no. 1.

Jha, R. (1987) Modern Theory of Public Finance, New Delhi : Wiley Eastern.

Judge, G.G., Hill, R.C., Griffiths, W., Lutkepohl, H., and T.C. Lee, (1982), Introduction to the Theory and Practice of Econometrics, New York: John Wiley.

King, David (1984): Fiscal Tiers: The Economics of Multi-Layer Government, London: Allen and Unwin.

National Sample Survey, Government of India, various publications.

Reserve Bank of India, various publications.

Swamy, P.A.V.B., (1971), Statistical Inference in Random Coefficient Regression Models, New York, Springer-Verlag.

Swamy, P.A.V.B.(1974), "Linear Models with Random Coefficients", Frontiers of Econometrics, (ed.) P. Zarembka, New York:Academic Press.

Usher, D. (1983) "The Welfare Economics of the Socialization of Commodities," Journal of Public Economics, vol.20.

TABLE 3

Rankings of Various States by Tax Productivity (1982-83 to 1992-93)

VARCOMP METHOD

1982-83 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$	1983-84 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$
Assam/1	0	Punjab/1	0
Punjab/2	-2.89	Bihar/2	-22.5880
Bihar/3	-17.67	Assam/3	-29.0458
Rajasthan/4	-62.2508	Rajasthan/4	-72.4706
Haryana/4	-62.2508	Haryana/4	-72.4706
Gujarat/4	-62.2508	Gujarat/4	-72.4706
Orissa/7	-99.2243	Orissa/7	-78.6408
Uttar Pradesh/8	-153.173	Uttar Pradesh/8	-132.185
Karnataka/9	-182.873	Karnataka/9	-132.525
Kerala/10	-189.142	Kerala/10	-158.706
Madhya Pradesh/11	-234.819	Madhya Pradesh/11	-165.464
Tamil Nadu/12	-298.904	Andhra Pradesh/12	-177.150
Andhra Pradesh/13	-305.498	Maharashtra/13	-205.827
West Bengal/14	-339.625	West Bengal/14	-245.638
Maharashtra/15	-356.003	Tamil Nadu/15	-309.124

TABLE 3 (Continued)

1984-85 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$	1985-86 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$
Punjab/1	0	Andhra Pradesh/1	0
Bihar/2	-31.6802	Punjab/2	-4.257
Assam/3	-57.6492	Maharashtra/3	-4.5817
Orissa/4	-66.1466	Bihar/4	-46.4075
Andhra Pradesh/5	-74.8629	Karnataka/5	-61.0732
Rajasthan/6	-82.2482	Orissa/6	-63.1052
Haryana/6	-82.2482	Madhya Pradesh/7	-71.1068
Gujarat/6	-82.2482	Assam/8	-87.1737
Maharashtra/9	-88.2325	Rajasthan/9	-92.9469
Karnataka/10	-91.4708	Haryana/9	-92.9469
Madhya Pradesh/11	-110.435	Gujarat/9	-92.9469
Uttar Pradesh/12	-118.401	Uttar Pradesh/12	-113.184
Kerala/13	-133.236	Kerala/13	-114.096
West Bengal/14	-170.407	West Bengal/14	-115.296
Tamil Nadu/15	-318.902	Tamil Nadu/15	-329.600

TABLE 3 (Continued)

1986-87 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$	1987-88 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$
Andhra Pradesh/1	0	Andhra Pradesh/1	0
Maharashtra/2	-2.3137	Maharashtra/2	-7.0654
Punjab/3	-60.2098	Punjab/3	-92.9953
Karnataka/4	-88.7711	Karnataka/4	-99.7011
Madhya Pradesh/5	-94.9964	Madhya Pradesh/5	-107.002
Bihar/6	-114.208	West Bengal/6	-132.886
Orissa/7	-116.955	Orissa/7	-152.833
West Bengal/8	-127.743	Bihar/8	-160.220
Kerala/9	-148.723	Kerala/9	-162.254
Rajasthan/10	-152.005	Rajasthan/10	-184.560
Haryana/10	-152.005	Haryana/10	-184.560
Gujarat/10	-152.005	Gujarat/10	-184.560
Uttar Pradesh/13	-163.972	Uttar Pradesh/13	-195.904
Assam/14	-165.057	Assam/14	-216.438
Tamil Nadu/15	-388.659	Tamil Nadu/15	-421.214

TABLE 3 (Continued)

1988-89 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$	1989-90 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$
Andhra Pradesh/1	0	Andhra Pradesh	0
Maharashtra/2	-17.3369	Maharashtra/2	-34.6282
Karnataka/3	-93.8641	Karnataka/3	-71.2591
Punjab/4	-102.613	Punjab/4	-89.0643
Madhya Pradesh/5	-107.362	Madhya Pradesh/5	-95.9993
West Bengal/6	-130.724	West Bengal/6	-121.257
Kerala/7	-154.691	Kerala/7	-126.032
Orissa/8	-170.00	Rajasthan/8	-170.160
Bihar/9	-184.443	Haryana/8	-170.160
Rajasthan/10	-190.612	Gujarat/8	-170.160
Haryana/10	-190.612	Orissa/11	-170.675
Gujarat/10	-190.612	Bihar/12	-186.876
Uttar Pradesh/13	-208.978	Uttar Pradesh/13	-203.195
Assam/14	-241.316	Assam/14	-239.690
Tamil Nadu/15	-427.266	Tamil Nadu/15	-406.814

TABLE 3 (Continued)

1990-91 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$	1991-92 State/Rank	Difference from most efficient state $(\hat{\pi}_{it})$
Andhra Pradesh/1	0	Karnataka/1	0
Karnataka/2	-31.8868	Punjab/2	-16.7174
Punjab/3	-52.3479	Andhra Pradesh/3	-24.2533
Maharashtra/4	-58.4393	Kerala/4	-29.6817
Madhya Pradesh/5	-72.9113	Madhya Pradesh/5	-62.3521
Kerala/6	-76.278	Rajasthan/6	-74.004
West Bengal/7	-104.485	Haryana/6	-74.004
Rajasthan/8	-123.205	Gujarat/6	-74.005
Haryana/8	-123.205	West Bengal/9	-104.663
Gujarat/8	-123.205	Maharashtra/10	-113.023
Orissa/11	-152.638	Orissa/11	-140.884
Bihar/12	-167.520	Bihar/12	-150.628
Uttar Pradesh/13	-178.555	Uttar Pradesh/13	-159.310
Assam/14	-211.561	Assam/14	-181.182
Tamil Nadu/15	-359.859	Tamil Nadu/15	-310.654

TABLE 3 (Continued)

State/Rank	1992-93 Difference from most efficient state $\hat{(\pi_{it})}$
Karnataka/1	0
Punjab/2	-6.57389
Kerala/3	-10.6444
Rajasthan/4	-46.9463
Haryana/4	-46.9463
Gujarat/4	-46.9463
Madhya Pradesh/7	-88.7226
Andhra Pradesh/8	-97.1609
West Bengal/9	-146.189
Orissa/10	-159.811
Bihar/11	-160.601
Uttar Pradesh/12	-169.863
Assam/13	-172.953
Maharashtra/14	-222.781
Tamil Nadu/15	-283.600

TABLE 4

Tax Productivity Index (TPI) for fifteen major Indian States

VARCOMP Estimates

Year	TPI
1982-83	-144.957
1983-84	-81.6918
1984-85	-33.9260
1985-86	5.043809
1986-87	31.37135
1987-88	48.17931
1988-89	48.54295
1989-90	33.54469
1990-91	5.080684
1991-92	-33.1929
1992-93	-82.9132

TABLE 5

Tax Productivity Index (TPI) for fifteen Major Indian States

WITHIN Estimates

1982-83	-144.981
1983-84	-81.7978
1984-85	-34.2435
1985-86	3.530053
1986-87	29.84320
1987-88	46.81860
1988-89	46.200006
1989-90	30.24037
1990-91	0.308375
1991-92	-38.3120
1992-93	-88.3219

TABLE 6

Correlations between Tax Effort and Real Rural Consumption Per Capita

VARCOMP Method

Year	r	t_{n-2}
1982-83	0.35304	1.43589*
1983-84	0.40545	1.759*
1984-85	0.27639	1.078
1985-86	0.13576	0.492
1986-87	0.067371	0.2412
1987-88	0.16259	0.5995
1988-89	0.075838	0.274
1989-90	0.13009	0.477
1990-91	0.26780	1.042
1991-92	0.31937	1.292
1992-93	0.35954	1.4808*

* = significant at 10%

TABLE 5

Tax Productivity Index (TPI) for fifteen Major Indian States

WITHIN Estimates

1982-83	-144.981
1983-84	-81.7978
1984-85	-34.2435
1985-86	3.530053
1986-87	29.84320
1987-88	46.81860
1988-89	46.200006
1989-90	30.24037
1990-91	0.308375
1991-92	-38.3120
1992-93	-88.3219

TABLE 6

Correlations between Tax Effort and Real Rural Consumption Per Capita

VARCOMP Method

Year	r	t_{n-2}
1982-83	0.35304	1.43589*
1983-84	0.40545	1.759*
1984-85	0.27639	1.078
1985-86	0.13576	0.492
1986-87	0.067371	0.2412
1987-88	0.16259	0.5995
1988-89	0.075838	0.274
1989-90	0.13009	0.477
1990-91	0.26780	1.042
1991-92	0.31937	1.292
1992-93	0.35954	1.4808*

* = significant at 10%

TABLE 7

Correlations between Tax Effort and Real Rural Consumption Per Capita

WITHIN Method

Year	r	t_{n-2}
1982-83	0.3313	1.3418
1983-84	0.39040	1.6582
1984-85	0.30640	1.216
1985-86	0.1819	0.67775
1986-87	0.13037	0.481
1987-88	0.18431	0.6877856
1988-89	0.11421	0.4172323
1989-90	0.21698	0.82095
1990-91	0.30814	1.2268875
1991-92	0.40914	1.765*
1992-93	0.45123	2.0417**

* = significant at 10%

** = significant at 5%

APPENDIX I

OLS Regressions of VARCOMP residuals on Constant, Time and Time Squared

Andhra Pradesh

Variable	Coefficient	t-Value
Constant	0.3456	0.243
Time	231.330	6.80888
Time Squared	-13.2517	-6.33507

$\bar{R}^2$ = 0.831; F = 25.5255, DW = 1.816

Assam

Variable	Coefficient	t-Value
Constant	118.728	2.27977
Time	-18.8258	-1.31541
Time Squared	0.016048	0.018213

$\bar{R}^2$ = 0.846; F = 28.4765; DW = 2.56

Bihar

Variable	Coefficient	t-Value
Constant	-52.2270	-0.814272
Time	21.8988	1.24243
Time Squared	-2.35704	-2.17196

$\bar{R}^2$ = 0.749; F = 15.9706; DW = 1.81966

Gujarat

Variable	Coefficient	t-Value
Constant	-91.0200	-0.618840
Time	16.1233	0.398905
Time Squared	-0.432151	-0.173656

$\bar{R}^2$ = -0.022; F = 0.892878; DW = 1.64712

Haryana

Variable	Coefficient	t-Value
Constant	72.1713	0.32106
Time	-7.34682	-0.489365
Time Squared	0.108045	0.116889

$\bar{R}^2$ = 0.216; F = 2.37492; DW = 1.57419

Karnataka

Variable	Coefficient	t-Value
Constant	-360.740	-4.37662
Time	94.6429	4.17837
Time Squared	-4.86788	-3.49056

$\bar{R}^2$ = 0.741561; F = 15.3469; DW = 1.7065

Kerala

Variable	Coefficient	t-Value
Constant	-281.306	-7.42672
Time	59.5835	5.72425
Time Squared	-2.70401	-4.21928

$\bar{R}^2$ = 0.908202; F = 50.4673; DW = 2.42163.

Madhya Pradesh

Variable	Coefficient	t-Value
Constant	-500.007	-6.58087
Time	131.311	6.28902
Time Squared	-7.38942	-5.74818

$\bar{R}^2$ = 0.815888; F = 23.1574; DW = 1.44

Maharashtra

Variable	Coefficient	t-Value
Constant	-973.078	-2.77200
Time	275.977	2.86083
Time Squared	-16.5116	-2.7800

$\bar{R}^2$ = 0.384; F = 4.11688; DW = 1.65093

Orissa

Variable	Coefficient	t-Value
Constant	-180.575	-2.98995
Time	60.6645	3.65524
Time Squared	-4.2658	-4.17470

$\bar{R}^2$ = 0.692307; F = 12.25; DW = 1.8156

Punjab

Variable	Coefficient	t-Value
Constant	-55.0409	-0.760278
Time	24.7897	1.24064
Time Squared	-1.66801	-1.36175

$\bar{R}^2$ = 0.015972; F = 1.08115; DW = 2.11746

Rajasthan

Variable	Coefficient	t-Value
Constant	59.8235	0.730781
Time	-1.15694	-0.051
Time Squared	-0.567934	-0.410039

$\bar{R}^2$ = 0.341277; F = 3.59045; DW = 1.929

Tamil Nadu

Variable	Coefficient	t-Value
Constant	-236.654	-1.24672
Time	25.9910	56
Time Squared	0.809474	0.252040

$\bar{R}^2$ = 0.628; F = 11.34; DW = 1.528

Uttar Pradesh

Variable	Coefficient	t-Value
Constant	0.423	0.12
Time	57.9694	1.40811
Time Squared	-3.82305	-1.50830

$\bar{R}^2$ = 0.045731; F = 1.23961; DW = 2.418

West Bengal

Variable	Coefficient	t-Value
Constant	-705.189	-9.77767
Time	171.403	8.64811
Time Squared	-9.59933	-7.86652

$\bar{R}^2$ = 0.897121; F = 44.608; DW = 1.97981

APPENDIX II

OLS Regressions of Within Residuals on Constant, Time and Time Squared

Andhra Pradesh

Variable	Coefficient	t-Value
Constant	-872.090	-7.02106
Time	232.347	6.80696
Time Squared	-13.3336	-6.34456

$\bar{R}^2$ = 0.829766; F = 25.3713; DW = 1.802

Assam

Variable	Coefficient	t-Value
Constant	143.678	2.83957
Time	-17.8392	-1.28296
Time Squared	-0.013028	-0.015218

$\bar{R}^2$ = 0.846; F = 28.4884; DW = 2.52

Bihar

Variable	Coefficient	t-Value
Constant	4.04678	0.066493
Time	20.7201	1.23889
Time Squared	-2.29470	-2.22845

$\bar{R}^2$ = 0.7722; F = 17.9498; DW = 1.84

Gujarat

Variable	Coefficient	t-Value
Constant	-105.453	-0.683576
Time	0.09	0.426
Time Squared	-0.5306	-0.203303

$\bar{R}^2$ = -0.022; F = 0.88; DW = 1.62

Haryana

Variable	Coefficient	t-Value
Constant	44.7954	0.8453
Time	-5.69	-0.3912
Time Squared	0.01063	0.011836

$\bar{R}^2$ = 0.223; F = 2.4367; DW = 1.615

Karnataka

Variable	Coefficient	t-Value
Constant	-395.075	-4.79476
Time	94.2162	4.16090
Time Squared	-4.84668	-3.47652

$\bar{R}^2$ = 0.739; F = 15.2075; DW = 1.719

Kerala

Variable	Coefficient	t-Value
Constant	-278.184	-7.18839
Time	60.3581	5.67557
Time Squared	-2.76595	-4.22432

$\bar{R}^2$ = 0.903; F = 47.6928; DW = 2.4418

Madhya Pradesh

Variable	Coefficient	t-Value
Constant	-498.106	-6.405
Time	130.437	6.105
Time Squared	-7.37014	-5.60157

$\bar{R}^2$ = 0.803; F = 21.48; DW = 1.468

Maharashtra

Variable	Coefficient	t-Value
Constant	-987.303	-2.796
Time	279.061	2.8724
Time Squared	-16.8268	-2.81311

$\bar{R}^2$ = 0.38; F = 4.12; DW = 1.64

Orissa

Variable	Coefficient	t-Value
Constant	-166.385	-2.923
Time	59.0574	3.7763
Time Squared	-4.13613	-4.29597

$\bar{R}^2$ = 0.701; F = 12.734; DW = 1.79778

Punjab

Variable	Coefficient	t-Value
Constant	-70.1878	-0.97
Time Squared	-1.66579	-1.367

$\bar{R}^2$ = 0.038; F = 1.19; DW = 2.11

Rajasthan

Variable	Coefficient	t-Value
Constant	46.0141	0.57
Time	0.621	0.028208
Time Squared	-0.688	-0.507

$\bar{R}^2$ = 0.366; F = 3.90; DW = 2.12

Tamil Nadu

Variable	Coefficient	t-Value
Constant	-262.647	-1.38
Time	25.3349	0.484
Time Squared	0.810	0.251

$\bar{R}^2$ = 0.618; F = 9.11; DW = 1.52

Uttar Pradesh

Variable	Coefficient	t-Value
Constant	-176.206	-1.17
Time	58.1619	1.409
Time Squared	-3.9066	-1.53

$\bar{R}^2$ = 0.0689; F = 1.37; DW = 2.408

West Bengal

Variable	Coefficient	t-Value
Constant	-651.662	-9.02
Time	170.232	8.57
Time Squared	-9.59721	-7.851

$\bar{R}^2$ = 0.893; F = 42.7598; DW = 2.00695

APPENDIX III

Estimating Cointegrating Relationships between Tax Efficiency and Federal Transfers

We wished to test whether the central and/or state governments exploit the incentive based characteristic of tax effort highlighted in this paper. To do this we first investigated the time series properties of tax effort α_{it}

For every state, i, we carried out unit root tests of the form:

$$\hat{\alpha}_{it} = ß_{i0} + ß_{i1}\alpha_{i(t-1)} + ß_{i2}\Delta\ \alpha_{i(t-1)} + ß_{i3}t + \varepsilon_{it}$$

where the ß's are state specific values of the parameters. The Augmented Dickey-Fuller 't' values for $ß_{i1}$ suggest that the VARCOMP residuals are I(1) for all states except Bihar. Real gross transfer are I(1) for all states except Karnataka and Madhya Pradesh. If we take real adjusted gross transfers (i.e. excluding loans against small savings and ways and means advances from the Centre) we find that each of these is I(1) except for Madhya Pradesh. These are reported in Table A3.1 below.

We also carried out ADF tests on the regression residuals for each of these states, i. The specification chosen was:

$$\hat{\varepsilon}_{it} = \sigma_{i0} + \sigma_{i1}\varepsilon_{i(t-1)} + \sigma_{i2}\ \Delta\hat{\varepsilon}_{i(t-1)} + e_{it}$$

The 't' values for σ show that out of the 12 states for which both the level form residuals and real gross transfers are I(1), the residuals of regression for each state except Haryana are I(1). These results clearly show that in the case of most states tax efforts are not cointegrated with real gross transfers.

For the sake of completeness, we tried to investigate the existence of cointegrating vectors between transfers and tax effort. These results are depicted in Table A3.2 below. It is again clear that there is not much of a long-run relation between states' tax efforts and federal transfers.

TABLE A3.1

Dickey-Fuller Tests with One Lag

State	VARCOMP RESIDUALS	GROSS TRANSFERS	ADJUSTED GROSS TRANSFERS
Andhra Pradesh	-0.84825	-3.81677	-2.72261
Assam	-2.50708	-1.08821	-2.05043
Bihar	-4.49813*	3.87553	-4.23984
Gujarat	-2.37117	-1.50216	-1.82728
Haryana	-4.21278	-3.04037	-2.56241
Karnataka	-0.57182	-6.12994*	-3.34128
Kerala	-2.52895	-3.34563	-3.34791
Madhya Pradesh	0.34108	-4.90171*	-4.56334*
Maharashtra	-1.07658	-3.929095	-3.4098
Orissa	-1.81289	-3.86461	-2.88209
Punjab	-1.99823	-2.74556	-2.17738
Rajasthan	-2.27066	-1.84776	-2.23709
Tamil Nadu	-3.49469	-1.59275	-1.64618
Uttar Pradesh	-1.77892	-2.52893	-0.76957
West Bengal	-1.28245	-3.10944	-2.96128

NOTE: Critical value with trend and one lag at 1 per cent level of significance for 25 observations is -4.38.
* denotes I(0).

TABLE A3.2

Cointegrating Tests between Tax Efficiency and Central Transfers

State	Gross Transfers (G)	Adjusted Gross Transfers (AG)
Andhra Pradesh	-0.4758	-0.48817
Assam	-2.13577	-2.42925
Bihar	-7.87291*	-5.21085*
Gujarat	-2.50718	-2.0363
Haryana	-4.91468*	-5.66778*
Karnataka	0.95745	0.21209
Kerala	-0.70911	-0.44949
Madhya Pradesh	0.33651	0.38485
Maharashtra	-1.56714	-2.42665
Orissa	-1.95815	-1.91791
Punjab	-1.98036	-2.01394
Rajasthan	-2.44952	-2.44839
Tamil Nadu	-2.6735	-2.78339
Uttar Pradesh	-1.79685	-1.83507
West Bengal	-0.69501	-0.29591

NOTE: Critical value with trend and one lag at 1 per cent level of significance for 25 observations is -4.38.
* denotes I(0) & denotes original series are I(0).

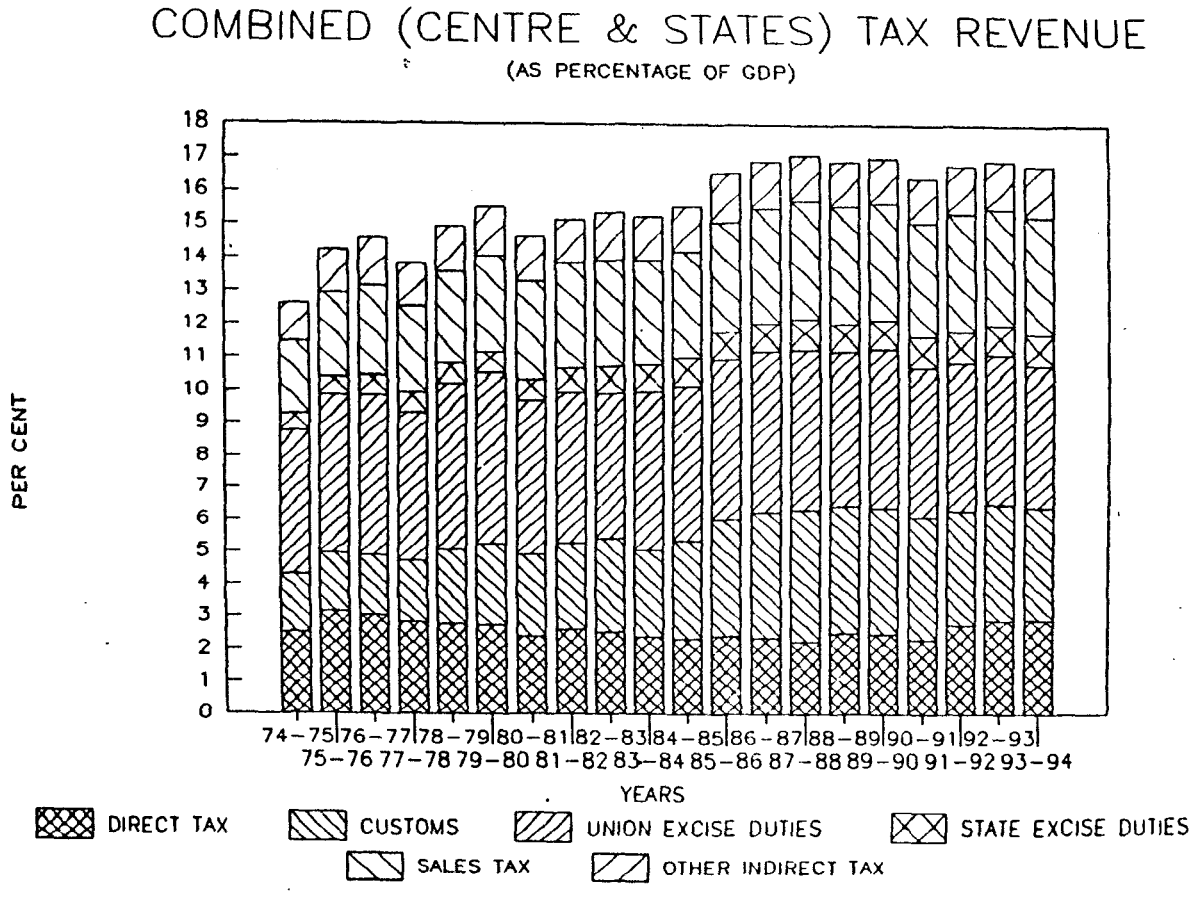
COMBINED (CENTRE & STATES) TAX REVENUE
(AS PERCENTAGE OF GDP)
PER CENT
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
74-75 76-77 78-79 80-81 82-83 84-85 86-87 88-89 90-91 92-93
75-76 77-78 79-80 81-82 83-84 85-86 87-88 89-90 91-92 93-94
YEARS
DIRECT TAX
CUSTOMS
UNION EXCISE DUTIES
STATE EXCISE DUTIES
SALES TAX
OTHER INDIRECT TAX

Figure 1

VARCOMP 82

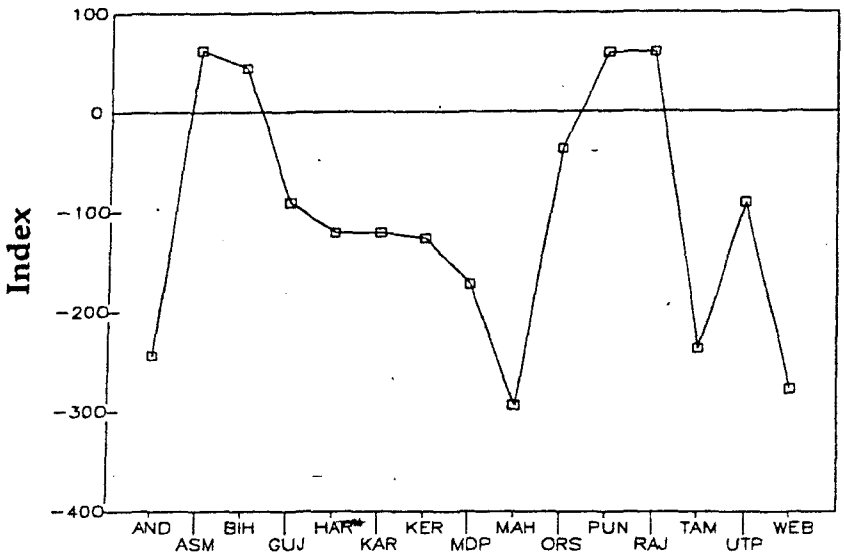

Figure 2a

VARCOMP 83

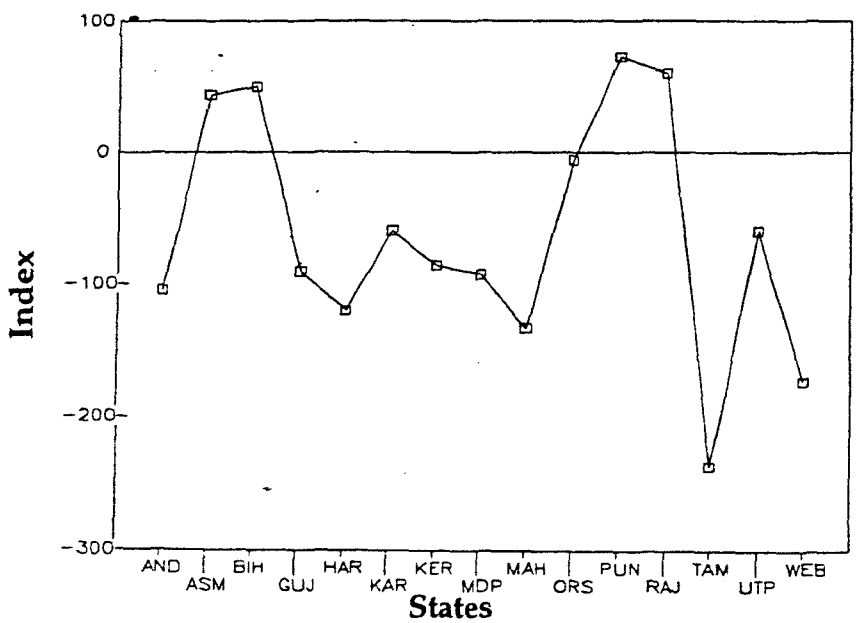

Figure 2b

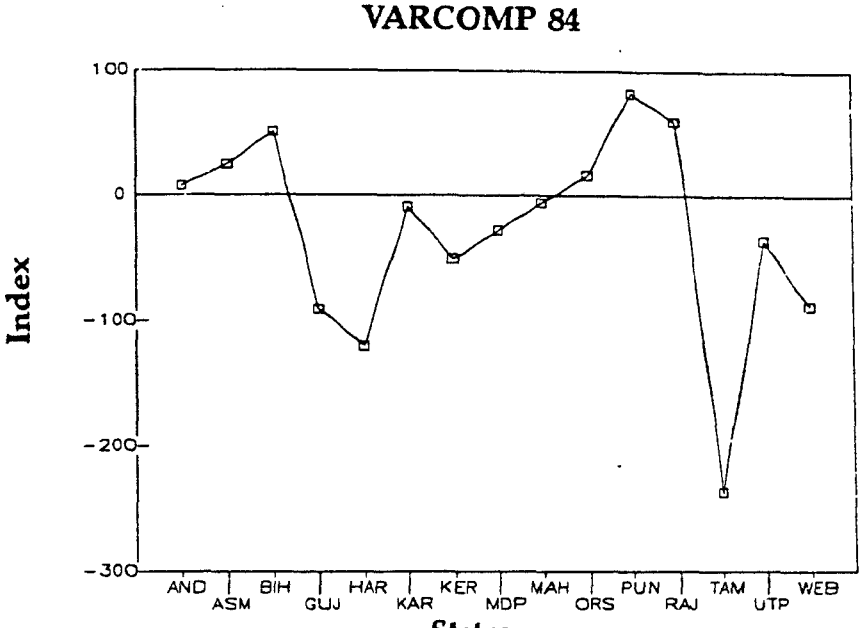

Figure 2c

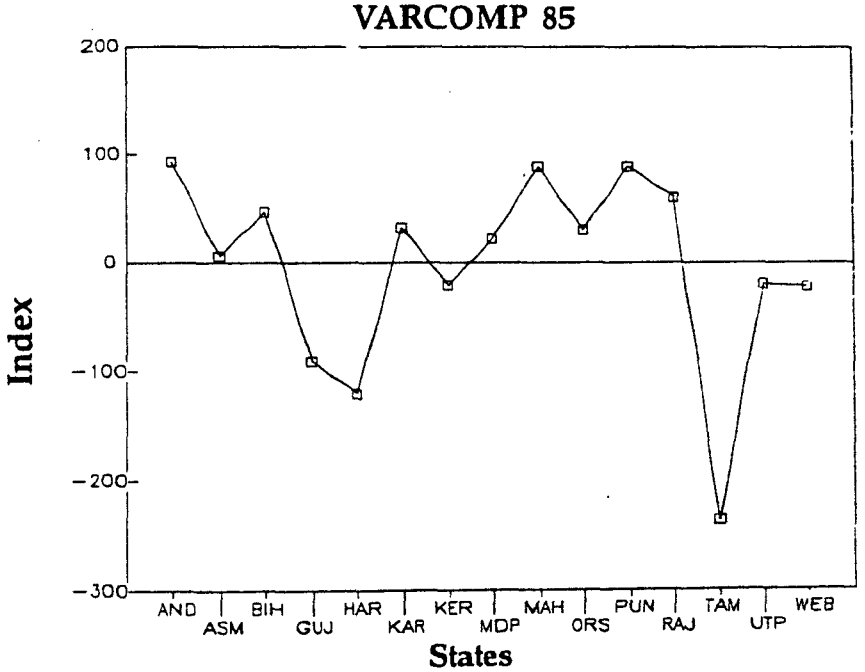

Figure 2d

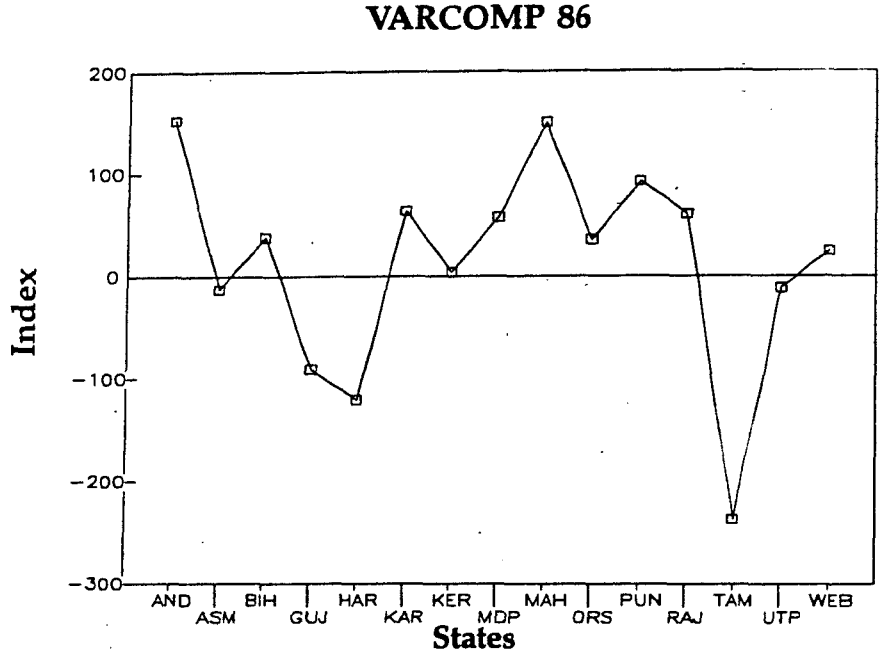

Figure 2e

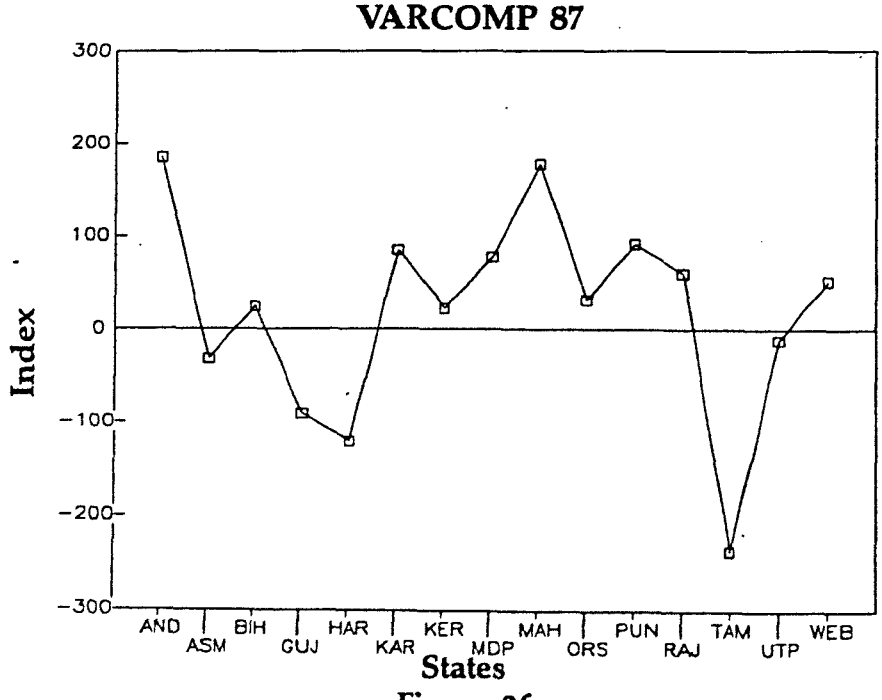

Figure 2f

VARCOMP 88

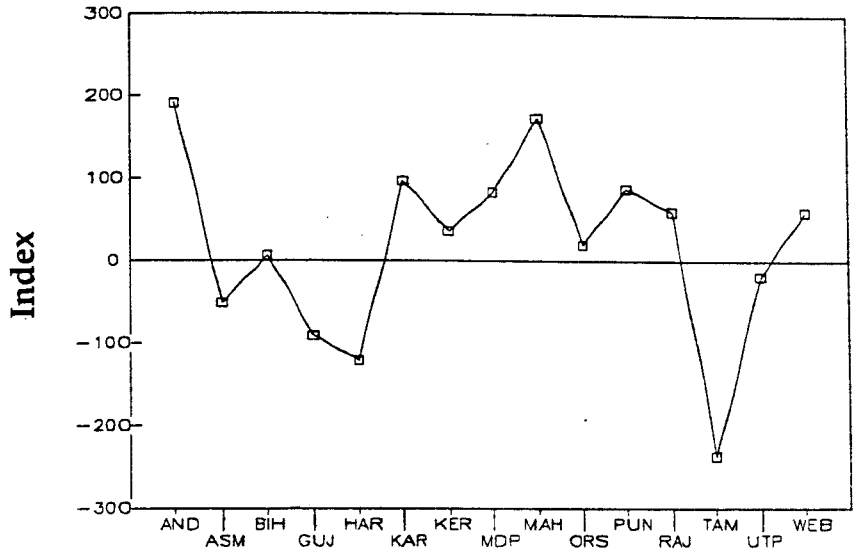

Figure 2g

VARCOMP 89

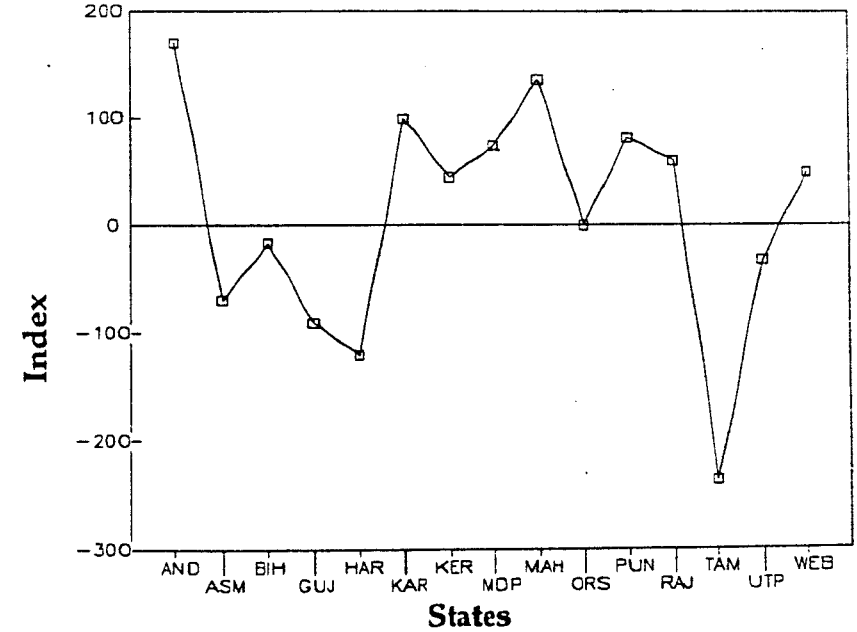

Figure 2h

VARCOMP 90

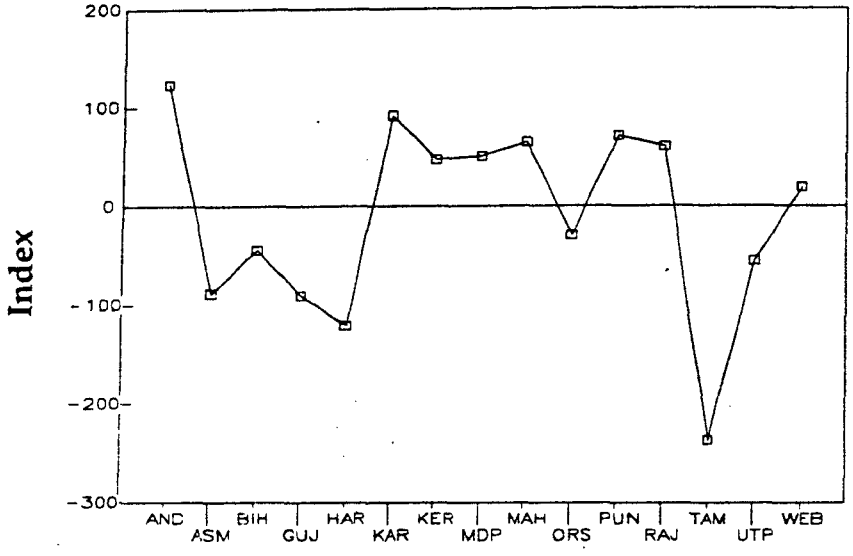

Figure 2i

VARCOMP 91

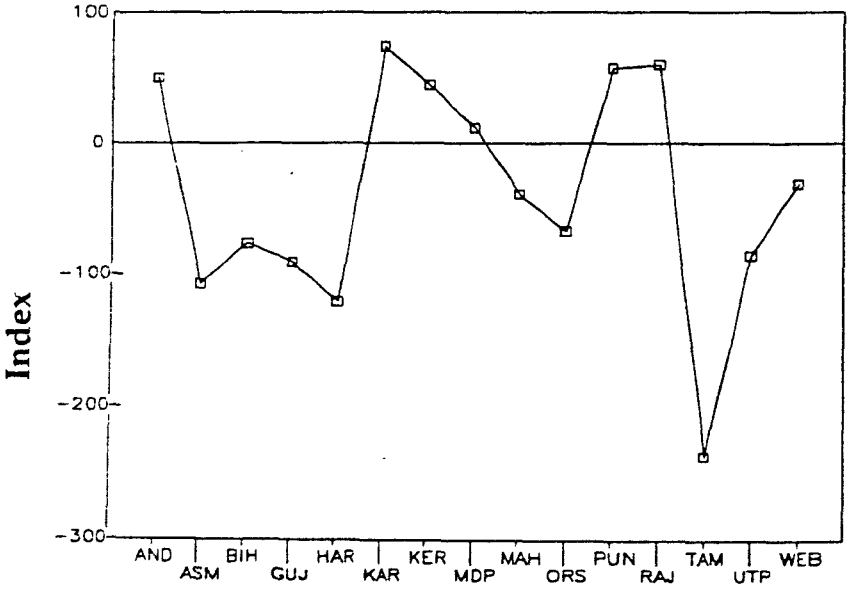

Figure 2j

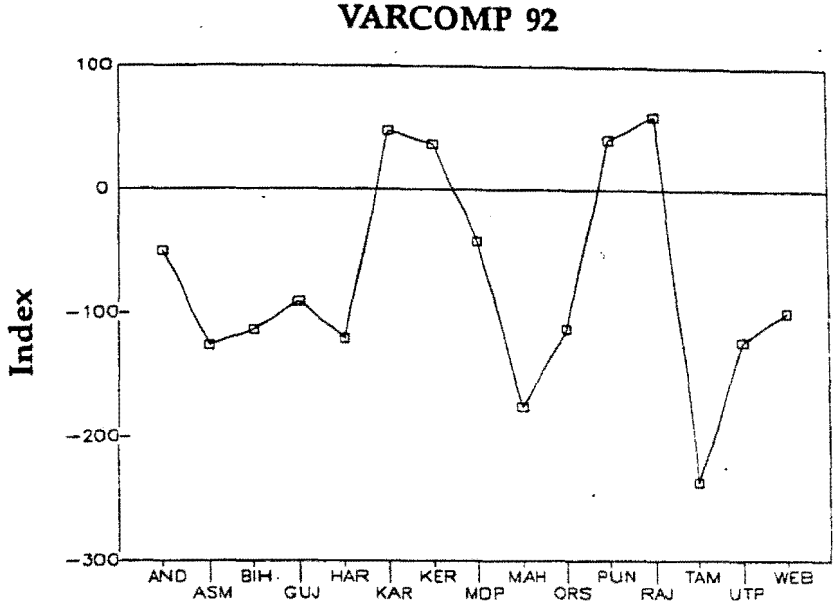

Figure 2k

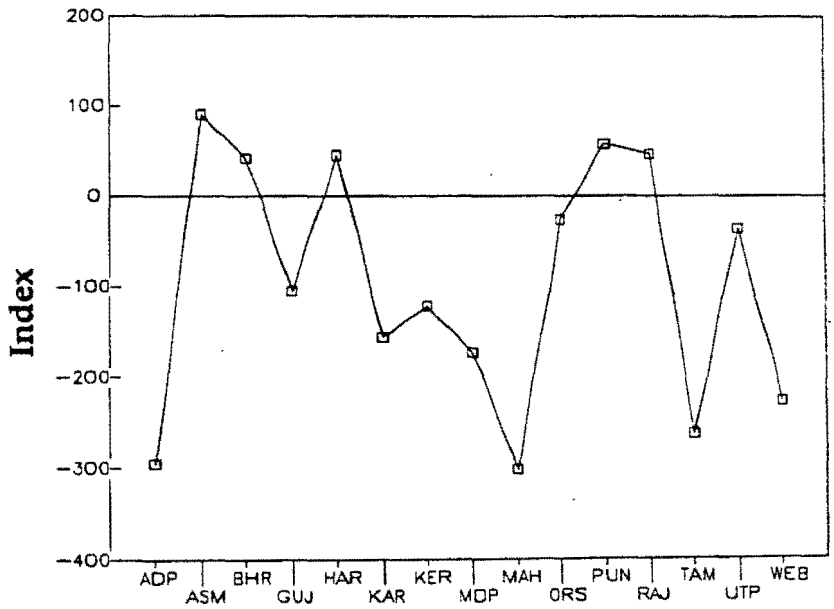

Figure 3a

WITHIN 83

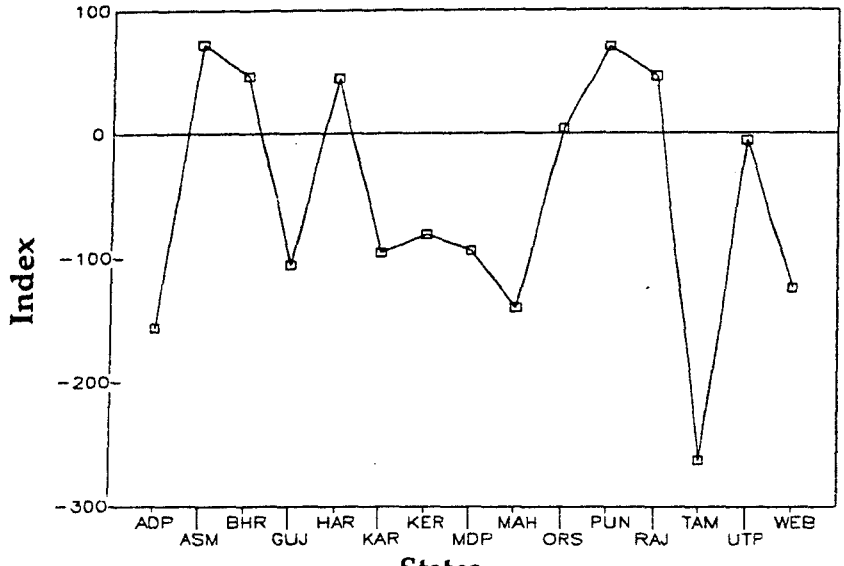

Figure 3b

WITHIN 84

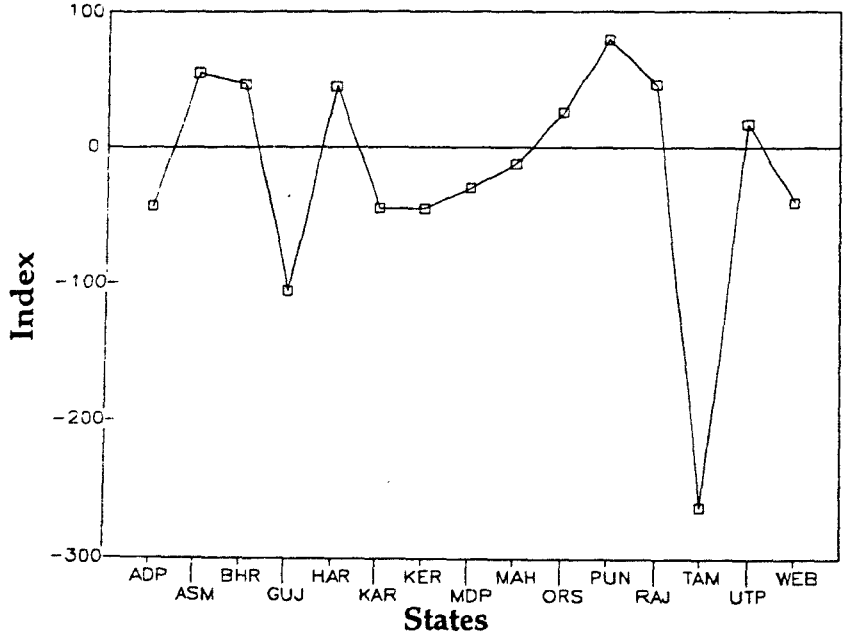

Figure 3c

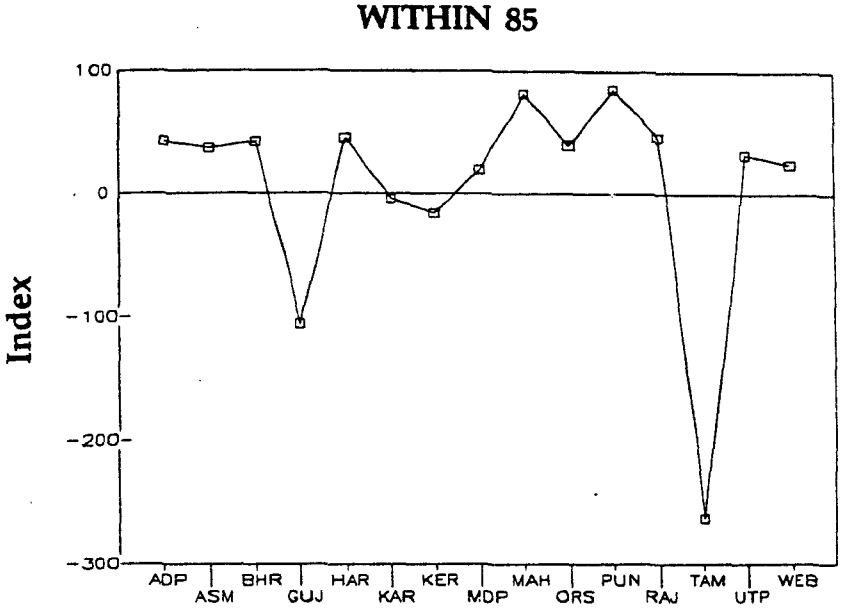

Figure 3d

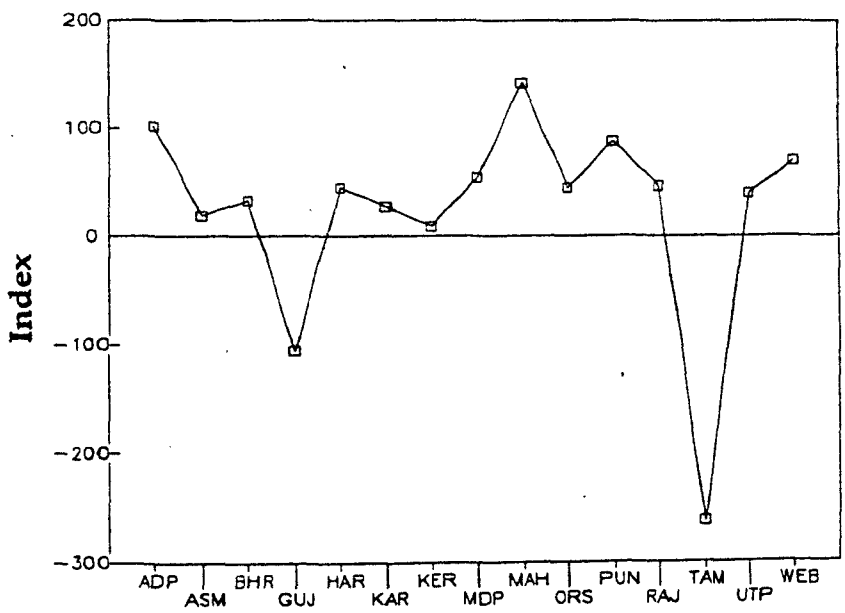

Figure 3e

WITHIN 87

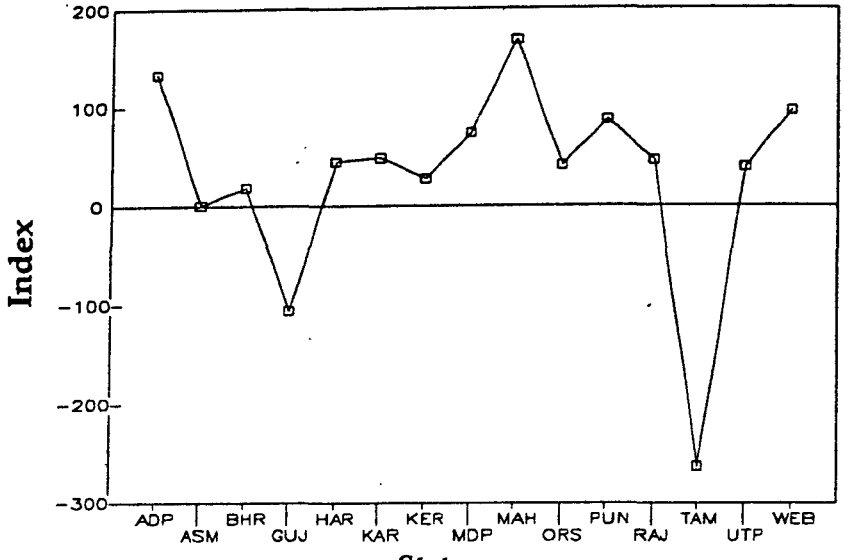

Figure 3f

WITHIN 88

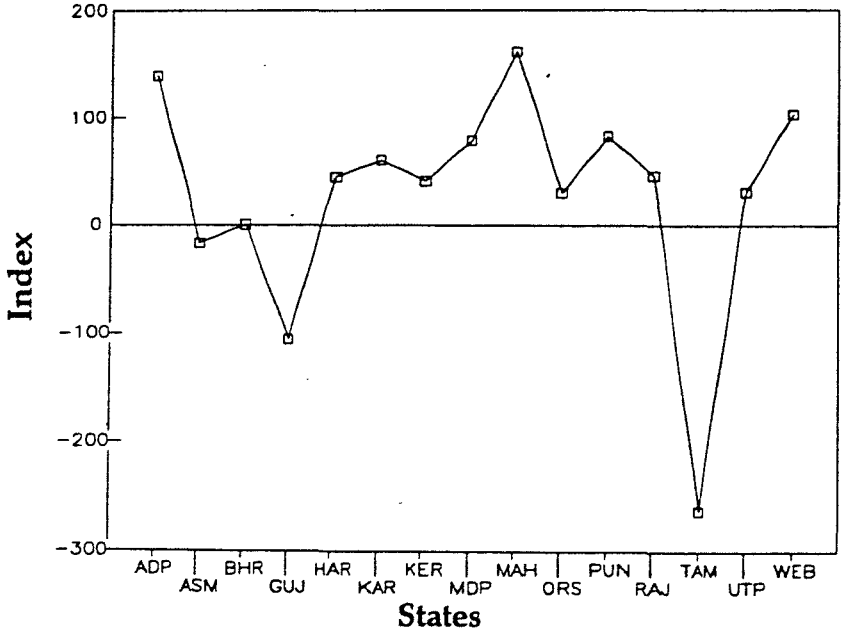

Figure 3g

WITHIN 89

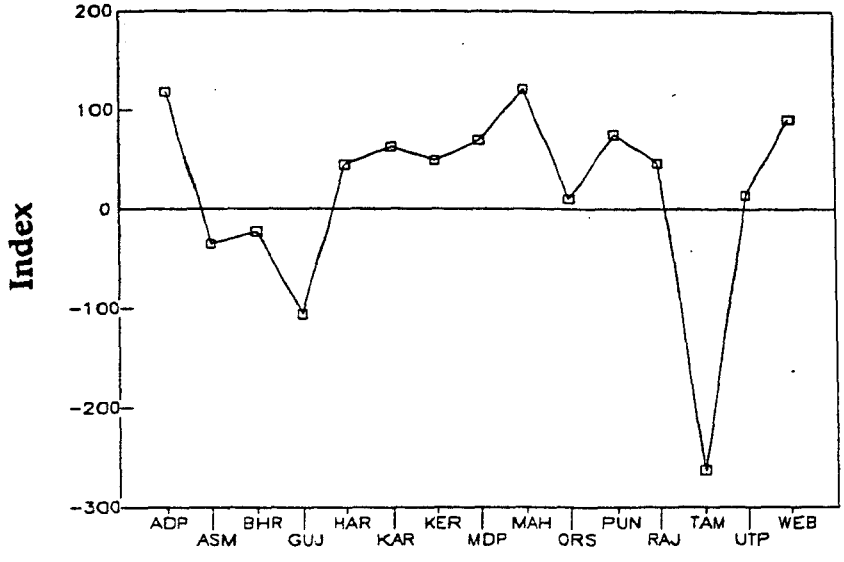

Figure 3h

WITHIN 90

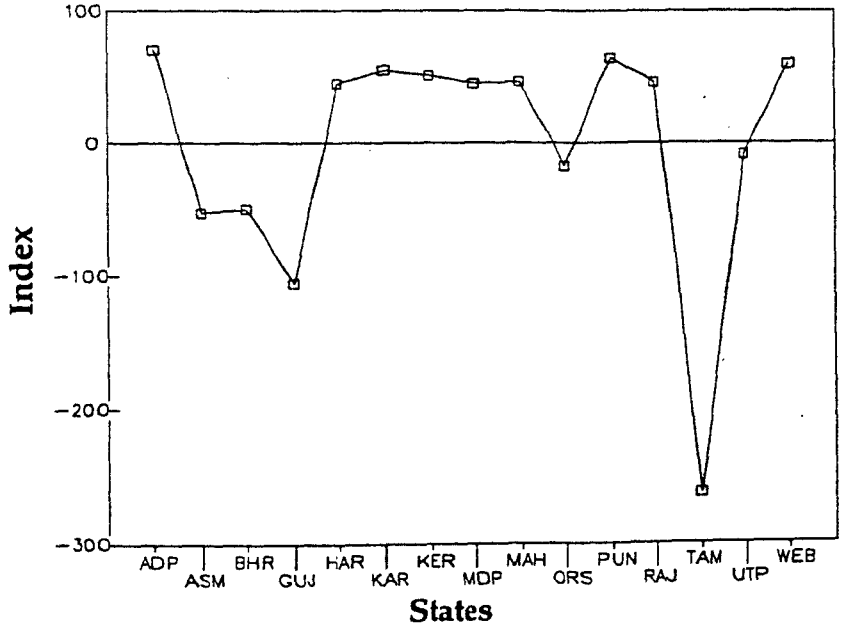

Figure 3i

WITHIN 91

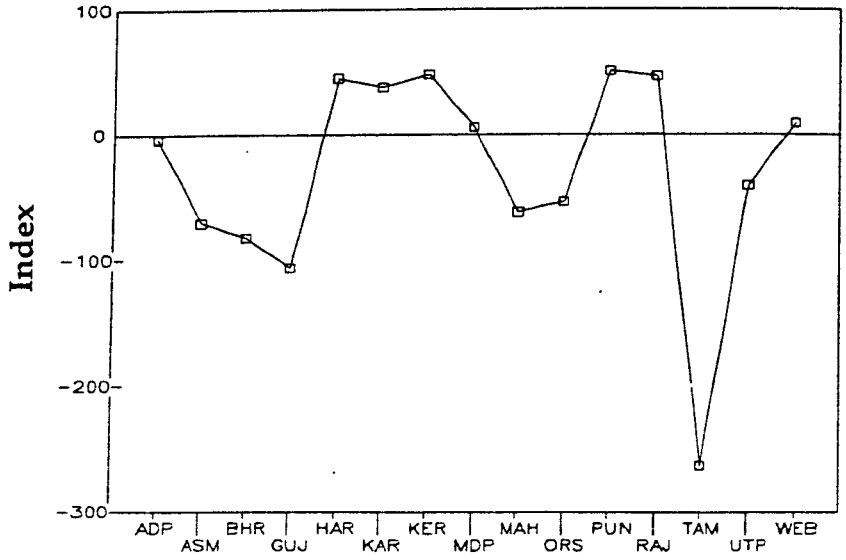

Figure 3j

WITHIN 92

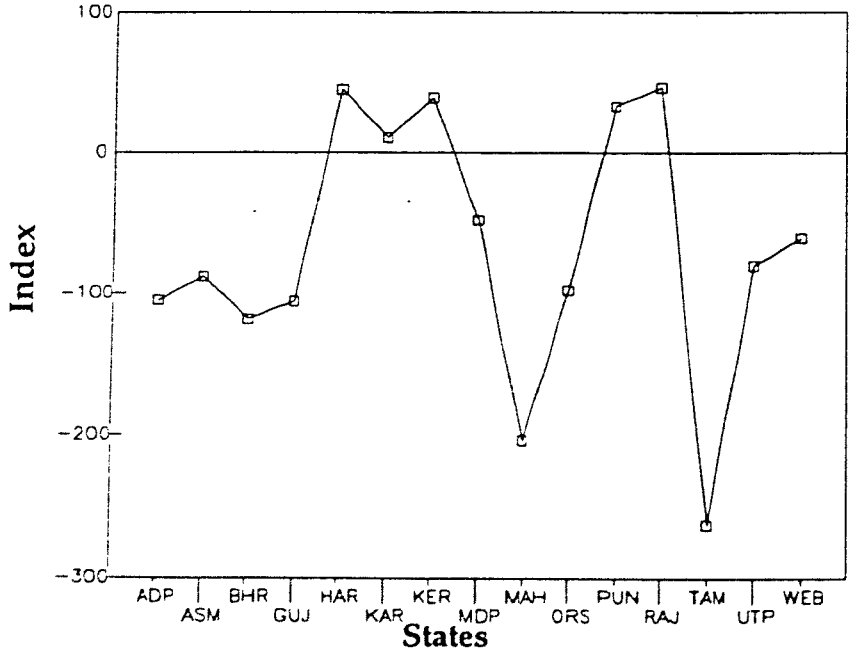

Figure 3k

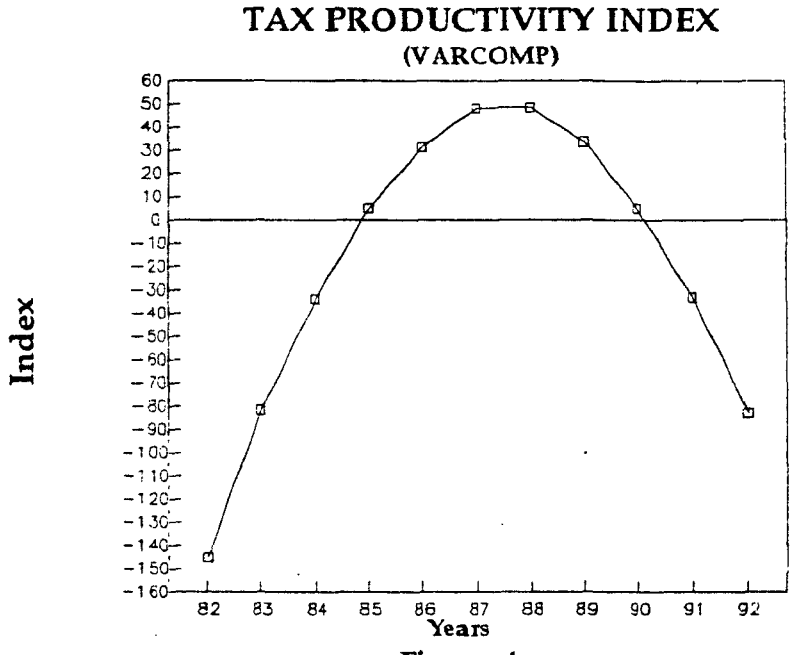

Figure 4

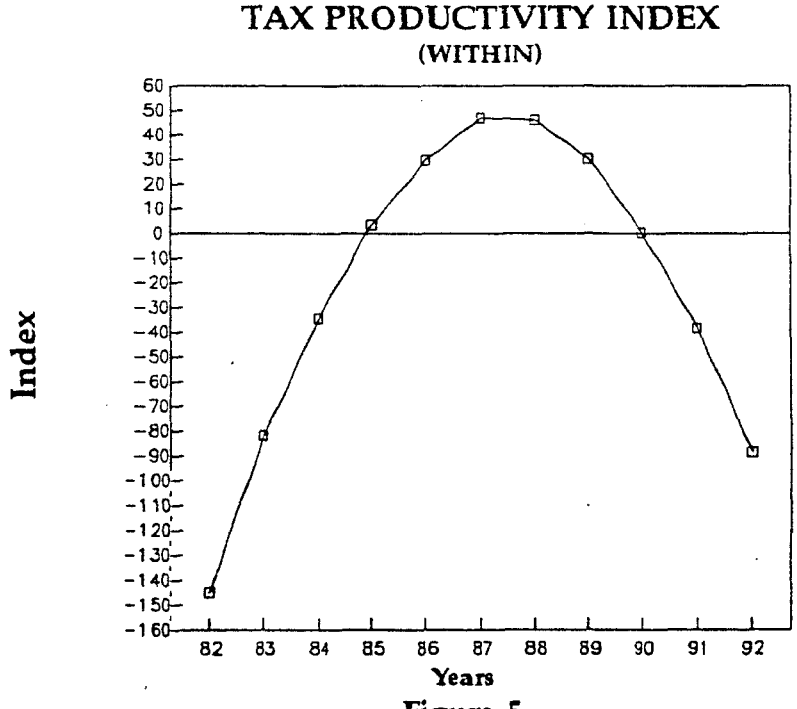

Figure 5

Xeroxed by PHOTO ART PROCESS, Wadia Building, Fort, Bombay. Tel. : 204 6751

DRG Studies Series

No.	Title	Date
1.	On the Guidelines Relating to Valuation of Shares	February 19, 1992
2.	Monetary Policy, Inflation and Activity in India	April 07, 1992
3.	Gold Mobilisation as an Instrument of External Adjustment	April 21, 1992
4.	The Changing Monetary Process in the Indian Economy	September 14, 1992
5.	Agricultural Policy In India - Context, Issues and Instruments	February 10, 1993
6.	Social Sector Expenditures and Human Development : A Study of Indian States	May 27, 1993
7.	Bridging the Technology-Gap : How Dynamic and far-sighted is the Indian Corporate Sector?	July 23, 1993
8.	Stabilisation Policy Options : A Macro-Econometric Analysis	April 20, 1994
9.	An Approach To Monetary Targeting In India	October 21, 1994
10.	Analytical Foundations of Financial Programming and Growth Oriented Adjustment	January 18, 1995