Intergovernmental transfer rules, state fiscal policy and performance in India

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December, 2007

Abstract:

In the federal economy like India intergovernmental transfer policies affect the state revenue and expenditure policies. This paper provides a theoretical model of determining optimal fiscal policy of the state governments in India. State's optimum fiscal policy depends on the rules applied by transferring agencies in transferring funds to the sub national governments. Three important criteria revenue effort, deficit financing and distance criterion are considered to estimate the weight assigned to these criteria. The comparison of actual state own revenue and expenditure policies with the optimum policy reveals that states are spending more than estimated optimum level and collecting revenues less than the optimum level. The deviation of actual values from the optimum values also give us some idea regarding to which direction the state governments should change its existing revenue and expenditure policies. The period of analysis is 1981 to 2001 and states considered are Andhra Pradesh, Karnataka, Orissa, Tamil Nadu and West Bengal. (155 words)

1. Introduction

The constitution of India provides independent revenue raising and spending power to both the central and the state governments. It also admits the existence of vertical imbalances in taxing power. The expenditure responsibilities of the state governments on the other hand are higher. The constitution thus directs the central government to transfer resources. Transfers by the central government are meant to bridge the gap between resources required by states to meet their assigned responsibilities and the resources they can raise themselves.

Three-tier transfer mechanism exists in India. The central government transfers funds in India via Finance Commission, Planning Commission and discretionary transfers through various union ministries and agencies. Low taxing power and high expenditure responsibilities make the state governments dependent on the central government for resources. Transfer from the centre covers large part of revenue of the state governments. In this chapter we have studied the impact of intergovernmental transfer on the state fiscal performance.

The review of literature (Rao and Singh (1998a), Rao (1998b), Rao (2000), Bajpai and Sachs (1999), Sen and Trebesch (2004)) on state finances and the intergovernmental transfer mechanism in India indicates that most of the studies have examined the vertical and horizontal imbalances in the federal transfer mechanism and how the design of transfer system can be improved to distribute resources equitably. Ma (1997) evaluated the intergovernmental transfer mechanism of different countries and suggested methods of determining fiscal capacities of provinces.

On the tax side of the state finances, Coondoo et al. (2000), Rao (1979) and Oommen (1987) have estimated the tax capacity of the states and the tax effort given by the states in collecting revenue at the state level. Coondoo, Majumder, Mukherjee and Neogi (2001) examined the relative tax performance of the states in India for the period 1986-87 to 1996-97. Sen (1997) also calculated the tax effort index of various categories of taxes for 15 major states in India for the period 1991-92 to 1993-94.

Rao (2002) and Bajpai and Sachs (1999) examined the situation of state finances in India. Rao (2002) finds that situation of state finances deteriorated after 1990-91. State finances in India are adversely affected by low buoyancy of central transfer. Bajpai and Sachs (1999) find that reform of the state fiscal system is necessary in order to reduce expenditure and increase revenue. They find that inefficient intergovernmental transfer mechanism in India is responsible

for fiscal indiscipline at the state level. Rajaraman and Visstha (2000) find that an increase in non-matching grants to panchayats affects the tax effort negatively in districts of Kerala. GR (2001) argued that the negative relationship between tax effort and grants is arrived by Rajaraman and Visstha (2000) because of their assumption that population size represents tax capacity. Assuming the same tax effort over the districts in Kerala they have shown that the negative relationship between tax revenues and grants obtained by Rajaraman and Visstha (2000) rather represent the negative relationship between grants and taxable capacity.

The paper by Sinelnikov, Kadotchnikov, Trounin and Schkrebela (2001) relates the rules applied in intergovernmental transfer mechanism for the Russian economy and its impact on the regional optimal tax and expenditure. Another paper by Dahlby (2004) has derived the optimal tax and expenditure ratios considering borrowing as one of the sources of financing deficit.

Sinelnikov, Kadotchnikov, Trounin and Schkrebela (2001) in their paper considered that expenditure on public goods and services is financed by taxes and transfers and in Dahlby (2004) intergovernmental transfer mechanism is not considered. Our theoretical model follows from these two papers where we have addressed the impact of rules applied in transferring resources on the optimum fiscal performance of a state considering the fact that deficit is financed by borrowing. Our model is different from these two models in the sense that in our model we have considered the role of transfer along with the case that after devolution of transfers, deficit is financed by market borrowing. The transfer formula used in this model is also relevant for Indian economy. We have tested the theoretical model developed in this chapter using the state level data from the Indian economy. Dahlby (2004) finds that public debt ratio affects the optimal tax ratio but it does not affect the optimal expenditure ratio. But in our model we find that both the revenue and expenditure ratios depend on public debt ratio.

In our study we have assumed a simple formula of transferring resources to the states and derived the optimum revenue and expenditure of a state from the utility maximizing principle. Instead of examining the relationship between total transfer and fiscal performance of a state we have tried to show how weights given by transferring agencies to revenue effort index, deficit financing criterion and distance of per capita income criterion affect the optimum revenue and expenditure of a state.

Formula used and weight assigned to various criteria in transferring resources by several Finance Commissions seems to be somewhat arbitrary and subjective. As written in the

"Memorandum to The Twelfth Finance Commission of the Government of Gujarat"[1] in p21 that "The weights assigned by the various Finance Commissions to the parameters used in the formula of horizontal distribution does not seem to flow from any comprehensive theoretical framework. If there exists a scientific basis for deriving these numbers, none of the Finance Commissions has cared to explain it properly in their reports and hence it gives an impression that they are arbitrary and subjective. In a note appended to the main report of the Fourth Finance Commission, the chairman, Dr. P.V. Rajamannar, had remarked that the selection of a particular set of factors and weights assigned to them for determining the shares has largely remained subjective and continues to be "a gamble on the personal views of the five persons or a majority of them"." In our study we have used a simple formula for transferring resources and statistically estimated the coefficients associated with selected criteria.

Thus objective of this study is to find out the weight assigned by transferring agencies to three important criteria in per capita transfer of funds. Having identified these parameters we have estimated the utility maximizing level of optimum revenue and expenditure of a few selected states in India. The states that we have selected are Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu and West Bengal and period of analysis is 1981 to 2001.

The chapter is organized in the following way. Section 4.2 summarizes the criteria used by several agencies in transferring funds in India, section 4.3 provides the theoretical model of estimating optimum revenue and expenditure of a state, section 4.4 explains the methodology used for empirical analysis, section 4.5 represents the data source and variables, section 4.6 analyses empirical results and section 4.7 provides the conclusions derived.

2. Rules applied in transferring resources in India

In analyzing intergovernmental transfer mechanism in India it is very important to know the criteria used by different finance and planning commissions. In India, Finance Commission (FC), Planning Commission and different central ministries transfers resources to the states on the basis of a few criteria. In this section we have discussed about the criteria used by different Finance and Planning Commissions.

(a) Finance Commission's (FC) transfer criteria used by different finance commissions in giving grants in aid and sharing income tax and excise tax are summarized in the following table.

[1] http://fincomindia.nic.in/pubsugg/memo_guj.pdf

1st FC	Grants	(i)For seven states to cover their deficits during the period 1951-56; (ii) For eight states to improve their primary education facilities
	Share in taxes	Income taxes were shared in the following way: 80 percent on the basis of population and 20 percent on the basis of revenue collection of the state. 40 percent of the net proceeds of excise duties were to be distributed among the states on the basis of population.
2nd FC	Grants	Larger grants in aid for meeting development needs of states
	Share in taxes	Income taxes are to be distributed in this way-90 percent pf tax collection was to be distributed on the basis of population and 10 percent on the basis of revenue collection. 25 percent of the net proceeds from excise duties were to be distributed among states.
3rd FC	Grants	(i) Rs. 550 crores to all states except Maharashtra to cover part of their revenue expenditure; (ii) Rs. 45 crores for improvement of communications
	Share in taxes	For income taxes, 80 percent was distributed on the basis of population and 20 percent on the basis of revenue collection of the state. In case of excise tax there is an increase in the number of commodities in the divisible pool from 8 to 35 by including all commodities on which duties were collected in 1960-61 but reduced the state's share from divisible pool from 25 percent to 20 percent.
4th FC	Grants	Rs. 610 crores to cover deficits during the period 1966-71
	Share in taxes	80 percent on the basis of population and 20 percent on the basis of revenue collection of the state income taxes were shared. In case of excise tax the number commodities had been increased to 45. The share of commodities was retained at 20 percent.
5th FC	Grants	Rs. 638 crores to cover deficits during the period 1969-74
	Share in taxes	Population was the major criterion of devolution of income tax. Did not make any change for excise taxes.

6th FC	Grants	Rs. 2510 crores for fourteen out of twenty one states to cover their non-plan revenue deficit
	Share in taxes	Population became the major criterion of devolution of income tax Did not make any change for excise taxes.
7th FC	Grants	Rs. 1600 crores to cover deficits of a few poor states during the period 1980-85 and also to upgrade the standard of administration
	Share in taxes	Population became the major criterion of devolution of income tax. For excise taxes, 7th FC raised the state's share to 40 percent of the net proceeds. 25 percent weightage was equally given to population, increase in per capita income of the state, the percentage of poor in each state, a formula for income equalization between states.
8th FC	Grants	(i) A small grant of Rs. 1556 crores for the period 1985-90 to cover deficit; (ii) A grant of Rs. 915 crores to certain states to upgrade the standard of administration
	Share in taxes	For income taxes, (i) 10 percent on the basis of income tax collection. (ii)Out of remaining 90 percent, 25 percent on the basis of population,25 percent on the basis of inverse of per capita income of the state multiplied by population, 50 percent on the basis of the distance of per capita income of a state from the highest per capita income state multiplied by population of the state. For excise tax 8th FC raised state share to 45 percent and introduced the same formula as 7th FC for 40 percent of proceeds and retained 5 percent share to distribute that among deficit sates.
9th FC	Grants	(i) Grant of Rs. 15017 crores to cover deficits of plan and non-plan revenue account during 1990-95. (ii) A special annual grant of Rs. 603 crores towards centre's contribution o the calamity relief fund-totaling Rs. 3015 crores for five year period, 1990-95. (iii) A grant of Rs. 122 crores to Madhya Pradesh towards expenditure on rehabilitation and relief of victims of Bhopal gas leak.
	Share in taxes	For income tax, 9th FC basically followed the above formula with minor modification. Ninth FC added one more criterion, that is, backwardness

		of sates based on population of scheduled castes and scheduled tribes, number of agricultural labourers in different states as revealed in 1981 census. According to NFC the composite index would correctly reflect poverty and backwardness of a state in large measure. The states having larger share of these components were required to bear substantial expenditure responsibilities. For excise taxes, 9th FC proposed to distribute the entire amount of 45 percent as a consolidated amount. The formula used was: 25 percent on the basis of 1971 census, 12.5 percent on the basis of index of backwardness, 33.5 percent on the basis of per capita income of the state from highest per capita income state, 12.5 percent on the basis of income adjusted total population, 16.5 percent among states with deficits, after taking into account their shares from all sharable taxes.
10th FC	Grants	(i) Grant of Rs. 15017 crores to cover deficits of plan and non-plan revenue account during 1990-95. (ii) A special annual grant of Rs. 603 crores towards centre's contribution to the calamity relief fund-totaling Rs. 3015 crores for five year period, 1990-95. (iii) A grant of Rs. 122 crores to Madhya Pradesh towards expenditure on rehabilitation and relief of victims of Bhopal gas leak.
	Share in taxes	For income taxes, 10th FC proposed (i) 20 per cent on the basis of population of 1971. (ii) 60 per cent on the basis of distance of per capita income of a state from that of state having highest per capita income.(iii)5 per cent on the basis of area adjusted. (iv) 5 percent on the basis of index of infrastructure. (v) 10 percent on the basis of tax effort. 9th FC distributed 47.5 percent of net proceeds from excise taxes among states. Using the same formula as used in sharing of income taxes, 40 percent of excise taxes were distributed among major states. Remaining 7.5 percent taxes were distributed among deficit states.
11th FC	Grants	(i) Rs. 35,359 crores was provided among states facing revenue deficit after devolution of grants. (ii) For upgradation of administration and special problems associated with certain states Rs. 4793 crores was

		provided. (iii) A total grant of Rs. 10000 crores has been provided to support local bodies at the panchayat level and municipalities at the urban level. To panchayats Rs. 8000 cores and to municipalities Rs. 2000 crores for the five year period (2000-05) were provided.
	Share in taxes	(i) 10 percent on the basis of population, (ii) 62.5 percent on the basis of distance of per capita income from that of state having highest per capita income, (iii) 7.5 percent on the basis of are, (iv) 7.5 percent weight is given to index of infrastructure, (v) 7.5 percent weight is given to fiscal discipline.

(b) Planning commission's transfer:

The Planning Commission on the other hand transfers resources on the basis of population, per capita income, tax effort, fiscal management, literacy, land reform etc.

The transfer of the planning commission is based on a formula where 30 percent of the transfers are in the form of grants and 70 percent as loans. States cannot accept only grants without taking loans. Thus grants and loans are tied together. In the following paragraph we have discussed about the formula used by the planning commission in transferring resources to the states.

60 percent of the planning commission's transfer is based on population of the state. 15 percent of transfers are based on the following formula. 7.5 percent of resources are transferred on the basis of (a) tax effort (b) fiscal management (include the speed of utilization of committed foreign aid and state's performance of revenue collection) and (c) progress in respect of national objectives, and another 7.5 percent of transfers are allocated to meet special problems of the states such as, population control, literacy and land reform.

The remaining 25 percent of transfers were made on the basis of per capita state domestic product (SDP) based on the following formula. 20 percent was given only to states with less than average per capita SDP on the basis of the inverse formula; and the remaining 5 percent according to the distance formula. The inverse formula is given by:

$(P_i / Y_i)/(\Sigma(P_i / Y_i)$ which is inversely related to the per capita income of the state. The distance formula is given by: $(Y_h - Y_i)P_i /(\Sigma(Y_h - Y_i)P_i)$

where $\mathbf{Y_i}$ and $\mathbf{Y_h}$ denote per capita SDP of the ith and the richest state respectively, $\mathbf{P_i}$, the population of the ith state. The indicator increases as the distance of income of the ith state from the richest state increases. Keeping these in mind we have used revenue effort, budgetary deficit and distance of state per capita income from highest per capita income state as the three important criteria in the devolution of transfer by the central government. It is also observed that population is used as the important criterion of formula based transfer.

3. Theoretical model

Literature on intergovernmental transfer mechanism in India also recommended that formula used in transferring funds should be simple and should not create any fiscal disincentive in a state. In the previous section we have examined first the different criteria used by several Finance and Planning commissions over the period. To fulfill the above objective we have selected three important criteria such as, population, own revenue effort of the state and gap filling to define the formula in transferring resources in India.

Instead of transfers by three different bodies separately we have analyzed the central government's transfers as a whole. Evaluating formula used by different Planning and Finance commissions it is observed that population, revenue effort, deficit filling and the distance criteria are the important criteria used by transferring agencies in India. In our model we assume a simple formula for transferring resources to a state.

We assume here that per capita transfer to a state depends on revenue effort index, actual deficit of the state and the distance criterion. Revenue effort index is measured by the actual revenue[2] to revenue capacity of the state, actual deficit is calculated as the difference between actual expenditure and actual own revenue and the distance of per capita income from highest per capita income is calculated using the formula stated below (1a). Thus transfer to a particular state at any time period t is assumed to follow the following formula

$$\frac{Tr_{it}}{P_{it}} = \alpha(T_{it} - \hat{T}_{it}) + \beta(G_{it} - T_{it}) + \delta DI_{it} \qquad , t=1,2,3,\ldots\ldots \qquad (1)$$

where $DI_{it} = (y_{ht} - y_{it}), G_{it} = E_{it} + B_{i(t-1)}$

[2] Actual own revenue is defined as the sum of own tax and non-tax revenue on revenue account and non-debt capital receipt on capital account.

Here i indicates ith state, Tr_{it} is the transfer to the ith state at time t, P_{it} is the population of the ith state at time t, Ti and $\hat{T}_{it}$ are actual own revenue collection and the estimated revenue capacity respectively of the ith state at time t, Git is the total expenditure by the ith state at period t , $(G_{it} - T_{it})$ corresponds to actual budget deficit of the state i at time t, DI_{it} is the distance of per capita net state domestic product (NSDP) from highest per capita NSDP in India at time period t, y_{it} is the per capita net state domestic product of ith state at time period t, y_{ht} is the highest per capita NSDP at time period t, $B_{i(t-1)}$ is the repayment of borrowing of period (t-1) in period t, E_{it} is the government expenditure on goods and services in period t.

It is assumed that $\alpha, \beta, \delta \rangle 0$. This implies that as states give more effort to raise its own revenue over and above their revenue capacity then transfer of funds by the central government will increase. We also assume that as deficit of a state increases a part of the deficit will be financed by the central government in India. For the empirical part we have used the estimated revenue capacity as estimated by the Finance Commission. As the distance of per capita NSDP of the state from that of state having highest per capita NSDP increases the transfer received by the state also increases.

The budget constraint faced by the state government in a federal country like India is as follows:

$$G_{it} = T_{it} + B_{it} + Tr_{it}$$

$$\Rightarrow E_{it} + B_{i(t-1)} = T_{it} + Tr_{it} + B_{it} \qquad (2)$$

$$\Rightarrow E_{it} = T_{it} + \dot{B}_{it} + Tr_{it} \Rightarrow (1-\theta)G_{it} = T_{it} + \dot{B}_{it} + Tr_{it}$$

Here we assume that $B_{t-1}/G_t = \theta$ (constant).

Substituting (4.3.1) in (4.3.2) we get,

$$G_{it}(1-\theta) = T_{it} + \dot{B}_{it} + \left[\alpha(T_{it} - \hat{T}_{it}) + \beta(G_{it} - T_{it}) + \delta DI_{it}\right]P_{it}$$

where $\frac{Tr_{it}}{P_{it}} = \alpha(T_{it} - \hat{T}_{it}) + \beta(G_{it} - T_{it}) + \delta DI_{it}$

$$\therefore \dot{B}_{it} = (1-\theta)G_{it} - T_{it} - Tr_{it} - B_{i(t-1)}$$

$$= (1-\theta)G_{it} - T_{it} - \alpha P_{it}(T_{it} - \hat{T}_{it}) - \beta P_{it}(G_{it} - T_{it}) - \delta P_{it} DI_{it} - B_{i(t-1)}$$

$$= (1-\theta)(1-\beta')G_{it} - (1+\alpha' - \beta')T_{it} + \alpha'\hat{T}_{it} - \delta' DI_{it} - B_{i(t-1)}$$

$$= (1-\theta)(1-\beta')G_{it} - (1+\alpha' - \beta')T_{it} + A - B_{i(t-1)} \qquad (3)$$

where $\alpha' = \alpha P$, $\beta' = \beta P$ and $\delta' = \delta P$, $A = \alpha' \hat{T}_{it} - \delta' DI_{it}$

Here we assume that the government borrows a constant proportion of its income in each period thus $\frac{B_t}{Y_t} = b_t$. We also assume that Y_t grows at a constant annual rate of γ. Thus we assume $(\dot{Y}_t / Y_t) = \gamma$

Now $B_t = bY_t \Rightarrow \dot{B}_t = \dot{b} Y_t + b \dot{Y}_t = (1-\theta)G_t - T_t - Tr_t$

$$\frac{\dot{B}_t}{Y_t} = \dot{b}_t + b_t \frac{\dot{Y}_t}{Y_t} = (1-\theta)g_t - \tau_t - \tau_{r_t}$$

$$\Rightarrow \dot{b}_t + b\gamma = (1-\theta)g_t - \tau_t - \tau_{rt} \Rightarrow \dot{b}_t = (1-\theta)g_t - \tau_t - \tau_{r_t} - b\gamma$$

where $g_t = \frac{G_t}{Y_t}, \tau_t = \frac{T_t}{Y_t}, \tau_{rt} = \frac{T_{rt}}{Y_t}, b = \frac{B_t}{Yt}, \forall t$

$$\Rightarrow \dot{b}_t = (1-\beta')g_t - (1+\alpha-\beta)\tau_t + \alpha'\hat{\tau} - \delta' d_t - b\gamma \qquad (3)'$$

To determine the optimal own revenue and expenditure in a federal country like India where certain proportion of revenue comes from central transfer we make the following assumptions:

(i) Same formula is used in transferring resources to all the states.

(ii) The decisions concerning both the state budget revenue formation and the procedures of financing the corresponding expenditures are made by the state governments.

(iii) Government expenditure and revenue collection in real terms are certain proportion of its real output. It is assumed that $G = gY$ and $T = \tau Y$, where G: real government expenditure, T: real revenue collection (tax, non-tax and non-debt capital receipts), Y: real output, g is the government real expenditure as a proportion to the real output, τ is the real revenue collection as proportion to the real output. Here T is not a function as used in case of direct tax.

(iv) Public transfers are not included into regional budget expenditures.

(v) Borrowing taken in period (t-1) is repaid in period t.

(vi) Objective of the state governments is to maximize utility of the economic agents which depends on its own expenditure and revenue policy. Increase in real expenditure increases utility directly and increase in real revenue collection affects utility through its impact on reduction of real output available in the hands of the economic agents. Thus utility is function of public goods and private goods consumption. G represents the public goods consumption while private goods consumption is proxied by the real output less the output taken away by the government as tax (Y-T). Utility function is defined as follows:

$$U = \int_{t=0}^{\infty} U(G_t, (Y_t - T_t))e^{-\rho t}dt$$

$$= \int_{t=0}^{\infty} Y_t U(g_t, (1-\tau_t))e^{-\rho t}dt$$

$$= \int_{t=0}^{\infty} (w \ln g_t + (1-w)\ln(1-\tau_t))Y_0 e^{-[\rho-\gamma]t}dt \qquad (4)$$

Thus as g increases that increases regional utility and as τ increases that takes away certain proportion of real output from the hands of the economic agents. Thus $(1-\tau)$ is the proportion of real output available in the hands of the economic agents. Higher the value of τ lower is the value of $(1-\tau)$ and thus lower is the utility derived by economic agents. Here $(w/(1-w))$ measures the provision of public to private goods and services, ρ is the rate of time preference, γ is the rate of growth of real output.

We maximize (4) with respect to G, T subject to the government intertemporal budget constraint (3)'. The Hamiltonian equation for this problem is as follows

$$\tau^* = w + \frac{(1-w)}{(1+\alpha' - \beta')}\left[\alpha'\hat{\tau} - \delta' d - b\gamma\right] \qquad (5)$$

$$g^* = w\frac{(1+\alpha'-\beta')}{(1-\beta')(1-\theta)} - \frac{w}{(1-\beta')(1-\theta)}\left[\alpha'\hat{\tau} - \delta' d - b\gamma\right] \qquad (6)$$

Thus, state authorities' optimum choice depends upon the rules applied to regional transfer allocation, that is α, β, δ.

Thus optimum revenue to output ratio depends positively on revenue capacity ratio and negatively on higher transfer received on the basis of distance criterion, rate of borrowing (b) in each period, rate of growth of real output and constant rate of repayment of borrowing as a proportion to total government expenditure (θ) . This means that the state with higher the revenue capacity can collect more revenue and poorer the state, the more is the transfer received by the state and lower is optimum revenue collection. Again more it can borrow lower is the state's revenue collection.

Higher the revenue capacity ratio lower is the transfer received and thus lower is the optimum expenditure to output ratio. Poorer the state is higher will be transfer received on the basis of distance criterion and this will affect the optimum expenditure to output ratio positively. More the state can borrow the more it will be able to spend. Thus borrowing rate affects the optimum expenditure to output ratio positively.

Now it is important to check how weights assigned to different criteria affects the optimum revenue and expenditure policy of the state. Increase in weight given to α implies a state can receive more funds if it gives more effort in raising own revenue. Again higher the value of β it indicates transferring agencies are giving positive weight to actual expenditure net of own revenue collection of the state. More weight to δ indicates that instead of giving more weight to state's own revenue and expenditure policy, transferring agency is giving more weight to whether the state is poor or not.

Impact of weights assigned to different criteria by the transferring agency on optimum fiscal policy of the state are discussed below.

$$\frac{\partial \tau^*}{\partial \alpha} = (1 - w)\frac{[(1 - \beta P)\hat{\tau} + (\delta P)d + b\gamma]P}{(1 + \alpha P - \beta P)^2} > 0 \ ,$$

$$\frac{\partial g^*}{\partial \alpha} = \frac{wP}{(1-\beta P)(1-\theta)}(1-\hat{\tau}) < 0, \text{ since } \hat{\tau} < 1 \text{ and } \beta P < 1$$

As the transferring agency attaches more weight to revenue effort criterion that increases the optimum revenue to output ratio and decreases the optimum expenditure to output ratio of the state. More weight to revenue effort criterion will induce the state government to raise its

revenue collection to get the same level of transfer. Given the revenue effort of the government more weight to α will increase the revenue side of the government budget and thus given the budget constraint optimum expenditure to output ratio will increase. This means that as α increases optimum policy of the government will be to raise revenue more. Now as state's revenue collection increases this will have negative influence on regional utility. Now to increase utility the state government's optimum policy will be to increase expenditure to output ratio. Impact of increase in weight assigned to deficit criterion is discussed below.

$$\frac{\partial \tau^*}{\partial \beta} = (1-w)\frac{[(\alpha P)\hat{\tau} - (\delta P)d - b\gamma]P}{(1+\alpha P-\beta P)^2} >=< 0 \text{ according as } \alpha P\hat{\tau} >=< \bar{\tau}_r + b\gamma ,$$

$$\frac{\partial g^*}{\partial \beta} = w\frac{[(\alpha P)(1-\hat{\tau}) + (\delta P)d + b\gamma]P}{(1-\beta P)^2(1-\theta)} > 0$$

Higher weight assigned to deficit financing criterion optimum expenditure rate increases. Impact of weight assigned to deficit criterion may increase, decrease or keep optimum revenue policy of the government unchanged. If transfer received on the basis of revenue capacity of the state is larger than that on the basis of deficit financing criterion and borrowing rates of the state government then optimum revenue policy of the government will be to increase its own revenue collection and vice versa. Now we will discuss how weight assigned to distance criterion affects optimum fiscal policy of the state.

$$\frac{\partial \tau^*}{\partial \delta} = -\frac{(1-w)Pd}{(1+\alpha P-\beta P)} < 0 ,$$

$$\frac{\partial g^*}{\partial \delta} = \frac{wP}{(1-\beta P)(1-\theta)}d > 0$$

Increase in weight assigned to the distance criterion indicates that more weight are given to factors other than state own expenditure and revenue policy. Poorer the state is, more funds will be transferred to the state that increases the value of the revenue side of the budget. Given its expenditure policy, optimum policy of the government will be to reduce revenue to output ratio. Given the revenue effort as transfer to the state increases it is optimum to spend more.

4. Methodology

4.1. Empirical Methodology used in this chapter

Ordinary least square method is used on pooled data taken from five selected states in India over the period 1981 to 2001. We have estimated the parameters of the transfer formula using the following regression model.

$$\left(\frac{Tr}{P}\right)_{it} = \alpha\left[(T - \hat{T})\right]_{it} + \beta\left[(G - T)\right]_{it} + \delta DI_{it} + c_0 + c_1 D1 + c_2 D2 + c_4 D4 + c_5 D5 + u_{it}$$

where D1=Andhra Pradesh, D2=Karnataka, D3= Orissa, D4=Tamil Nadu, D5= West Bengal. Di=1 for ith state, =0 otherwise, u_i is the random disturbance term. To estimate the coefficients of the above model and eliminate the problem of dummy variable trap we have excluded D3 that is, Orissa and applied ordinary least square method to the above equation.

$(Tr/P)_t$ is the per capita transfer at time period t, $(T-\hat{T})_t$ is defied as the revenue effort by the state over and above their revenue capacity at time period t, $(G-T)_t$ is the difference between the total public expenditure and own revenue collection of the state. DI_t is the distance of per capita income of the state from highest per capita income of fifteen major states in India.

To find out whether the error in prediction is significantly different from zero or not the pair difference t-test is used. The test statistic that we have used is $t_{0.025,n-1} = \frac{e - 0}{s_{n-1}/\sqrt{n}}$

where n is the number of pairs or number of differences and s_{n-1} is the sample standard deviation of e for n-1 observations.

Using the estimated coefficients from the above model optimum revenue to output ratio and the optimum expenditure to output ratio are calculated using equations (5) and (6). Actual rates are compared with the optimum rates in order to find out the possible direction of fiscal policy at the state level.

Mean of the absolute difference between actual and predicted values relative to actual values is used as a measure of mean relative error in prediction. Thus mean relative error in prediction is calculated using the following formula: $\frac{1}{n}\left(\sum_{i=1}^{n} \left|x_i^* - x_i\right| \Big/ x_i\right)$,

where x_i is the actual value of the variable, x_i^* is the optimum value of x_i, n is number of observations.

4.2. Methodology used by Finance Commission in calculating tax capacity

The way the Finance Commission has estimated the taxable capacity of a state is explained below. Taxable capacities of the states for each of the major taxes are calculated first

then summing them up the ninth finance commission has estimated the aggregate taxable capacity of the state. Taxes are categorized into six major heads namely: (i) Sales tax (including central sales tax and purchase tax on sugarcane), (ii) state excise duties, (iii) stamp duties and registration fees, (iv) motor vehicles tax and passenger and goods tax, (v) entertainment tax, (vi) tax on agriculture and incomes and a residual category, other taxes.

It is difficult to calculate the revenues from agricultural income taxes and other taxes using statistical method. The taxable capacities of this category of taxes are calculated on the basis of projected actual taxes. Taxable capacities of other five categories of taxes have been calculated using pooled time series and cross section data. It is assumed that there is no state specific variation. Thus it is assumed that the intercept and slope parameters are same across states. Time dummies are introduced in the model to capture the inter-temporal shifts. States are divided into three income groups, high income, middle income and low-income group.

For different categories of taxes different variables are considered and taxable capacities are estimated for each of the income groups. The variables that are used to estimate the tax capacities are as follows: State domestic product at factor cost, roads/railway length per 1000 square kilometer, per capita energy sale to ultimate consumer, total registered motor vehicles, proportion of heavy vehicles to total vehicles, consumption of country spirit (PL), seating capacities in cinema hall, proportion of urban population to total population while time dummies are introduced to capture inter-temporal shifts. The ninth Finance Commission has estimated taxable capacities for the period 1989-90 to 1994-95.

4.3. Methodology used in this paper in calculating revenue capacity of state

Using the estimated taxable capacities we have estimated the taxable capacities to other years within the period 1981 to 2001. First, we have found the actual ratio of non-tax and tax revenue at constant prices for various years. Then three years moving average method is used. Average of these averages is used to calculate the total revenue (tax + non-tax) capacities of the state.

5. Data Source and Variables

5.1. Data Source:

This section summarizes the data used in this study. In this chapter we consider the period 1981 to 2001, using data on five states of India. State finance data such as data on grants - in - aid, share in central taxes, loans and advances by the central government, borrowing,

expenditure on revenue and capital account, own revenue collection of the states are collected from various issues of "State Finances: A study of budgets" published by Reserve Bank of India, India. Revenue capacity of the states is obtained by using the estimated tax capacity data by the finance commission for the period 1989-90 to 1994-95.

5.2. Variables:

The variables[3] that have been used in the empirical estimation of the model are defined below: Y: Gross State Domestic Product (GSDP) at constant 1993-94 prices[4] Tr: Transfer of the central Government= Share in central taxes, grants and loans; B_t: Borrowing from all sources other than central government, B_{t-1}: Repayment of loans taken in period (t-1) from sources other than loans from the central government; G: State own expenditure net of transfers =Revenue Expenditure + Capital expenditure –Grants and loans other than central ministries grants[5]; T: Actual Revenue=Own Tax + Own Non-Tax Revenue + non-debt capital receipt; $\hat{T}$ =Own Revenue capacity[6], DI: distance of per capita income of the state from highest per capita income multiplied by population relative to the over all distance of income over the fifteen major states in India.

6. Empirical Analysis

6.1. Estimation of per capita transfer

The regression results are summarized as follows: Table 1 below indicates that over the selected states during the period 1981 to 2001 the estimated weights given to revenue effort index and deficit criteria are $\hat{\alpha} = 0.0459$, $\hat{\beta} = 0.0307$ and $\hat{\delta} = 0.0361$ respectively. All the estimated coefficients are found to be positive and significantly different from zero at 99 percent level of confidence. Our empirical results support our assumptions that α, β and δ are positive and less than one. The value of the condition index is 21.942. This indicates that the multicollinearity problem is not severe. Goodness of fit measured by adjusted R^2 (=0.6277) is also good. (see Appendix 6, Table A6.1)

[3] All variables are expressed in constant 1993-94 prices.
[4] This corresponds to real output as mentioned in the theoretical part.
[5] As central ministry's grants and loans go directly to the block offices they do not appear in state budget whereas other transfers are included in the state expenditure. To find out state's own expenditure net of transfer we have used this formula.
[6] Methodology used by the finance commission in estimating tax capacity of a state is explained above.

Having estimated the parameters of the transfer formula, we have estimated the predicted per capita transfer for each year of the sample period 1981 to 2001 and then estimated the mean transfer over the period using the formula.

$$Tr_{it}/P_{it} = \underset{(***)}{358.04} - \underset{(**)}{(69.68)D1} - \underset{(***)}{(99.58)D2} - \underset{(*)}{(73.61)D4} - \underset{(***)}{(111.42)D5} + \underset{(***)}{(0.0459)(T - \hat{T})_{it}} + \underset{(***)}{(0.0307)(G - T)_{it}} + \underset{(***)}{(0.0361)DI_{it}}$$

where i=1,2,3,4 and 5 indicates Andhra Pradesh, Karnataka, Orissa, Tamil Nadu and West Bengal respectively, t is the time period t. Table 4.1 below shows mean per capita transfer received by a state along with their 95 percent level of confidence. We find that over the period 1981 to 2001 out of five selected states Karnataka received lowest transfer per capita and Orissa received highest transfer per capita. Last two columns of table 2 indicate the 95 percent confidence interval of per capita transfer in the selected five states. From 95 percent confidence interval we find that the maximum and the minimum per capita transfers to Orissa are higher than any other state. It is predicted that the minimum transfer received by Orissa is higher than the maximum transfer received by any other selected states.

Table 1: Estimated mean per capita transfer (1981-2001)

	Mean	Std. Error	95 % Confidence Interval	
Andhra Pradesh	570.56	25.27	517.85	623.27
Karnataka	515.76	11.51	491.75	539.78
Orissa	689.22	17.87	651.95	726.50
Tamil Nadu	533.98	10.30	512.50	555.47
West Bengal	528.31	15.73	495.51	561.11

We have tested whether the mean error in prediction is equal to zero or not. The error in prediction (e) is the difference between the actual and the predicted values. The pair difference t-test is used for this purpose. The test statistic used is $t_{0.025,n-1} = \frac{e-0}{s_{n-1}/\sqrt{n}}$ where n is the number of pairs or number of differences and s_{n-1} is the sample standard deviation of e. The results obtained in table 2 suggest that we fail to reject the null hypothesis at 95 percent level of confidence.

Table2: t- test result of zero mean difference between actual & predicted p.c. transfer

One-sample t test					
Variable	Obs	Mean	Std. Err.	Std. Dev.	Degrees of freedom = 104
e	105	0.00	7.08	72.57	t = -0.0000
Ho: mean (e) = 0					
Ha: mean (e)< 0			Ha: mean ≠0		Ha: mean > 0
Pr(T < t) = 0.5000			Pr(T > t) =1.000		Pr(T > t) = 0.5000

The difference between actual and the predicted value are not significantly different from zero at 95 percent level of confidence. Thus the transfer formula used in this chapter predicts quite well the actual per capita transfer to a state in India. The 95 percent confidence interval of the predicted per capita transfer over the period 1981 to 2001 along with their actual values are also calculated for five selected states in India and shown in appendix tables A2.2-A2.6.

The relative error in prediction[7] using the above model is calculated by taking the absolute difference between actual per capita transfer and the predicted transfer relative to the actual per capita transfer over the period 1981 to 2001in table 3 below. The average relative error in prediction varies from 6.04 percent in Andhra Pradesh to 12.70 percent in West Bengal over the period 1981 to 2001.

Table 3: Relative error in prediction of per capita transfer (1981-2001)

	Mean
Andhra Pradesh	0.0604
Karnataka	0.1046
Orissa	0.0798
Tamil Nadu	0.0892
West Bengal	0.1270

6.2. Comparison of optimum and actual revenue and expenditure ratio

The optimum revenue-output rates and the optimum expenditure-output rates are derived from the following condition[8]:

[7] Absolute difference between actual and predicted values relative to actual values is used as a measure of relative error in prediction.

[8] See Appendix 1, equation (A1.7)

$$g = \left(\frac{w}{1-w}\right)\frac{(1+\alpha'-\beta')}{(1-\beta')(1-\theta)}(1-\tau)\,.$$

The regression of the following equation[9]

$$g_t = \varpi(1-\tau_t) \qquad (7)$$

for Andhra Pradesh, Karnataka, Orissa, Tamil Nadu and West Bengal separately for all t=1981 to 2001.where $\hat{\varpi} = \frac{w}{1-w}\left(\frac{1+(\hat{\alpha}-\hat{\beta})P}{(1-\hat{\beta}P)(1-\theta)}\right)$ (8)

We observe that fit is very good as the value of adjusted $\bar{R}^2$ is above 0.95 in all the five cases. The estimated coefficient is significantly different from zero for all the selected five states. Thus the actual data satisfies the relationship from which the optimum revenue-output and expenditure-output ratios are derived. The optimum values estimated using the equations of optimum revenue-output and expenditure-output (equations (5) and (6)) can be well considered as the optimum values.

Using the above relation (8) we have estimated the $\left(\hat{w}/(1-\hat{w})\right)$ and thus $\hat{w}$. The optimum revenue-output and expenditure-output ratios are estimated using the estimated coefficients of the transfer formula, estimated value of w for different values of P, $\hat{\tau}$ and b. The average optimum T/Y ratio and G/Y ratios for the period 1981 to 2001 along with their 95 percent confidence interval are listed below in table 4.4 for five selected states in India.

It is observed that out of five selected states in India over the period 1981 to 2001on average optimum revenue to GSDP ratio varies from 6.75 percent in West Bengal to 12.90 percent in Karnataka. Again we find that on an average optimum expenditure to GSDP ratio varies from 11.34 percent in West Bengal to 17.00 percent in Orissa. In all the selected states it is found that utility maximizing expenditure to GSDP ratio is lower that of revenue to GSDP ratio.

To check how states have performed over the sample period 1981 to 2001 we have compared the actual rates to their optimum values. The comparison between the actual and the optimum revenue to GSDP ratio indicates that all the selected states are raising revenue less than their optimum level. Again on the expenditure side it is found that actual expenditure to GSDP ratio is much higher than the optimum rates. (See table 4)

[9] Regression results are presented in Appendix 2, tables A2.7-A2.11

Table 4: Optimum revenue to GSDP and public expenditure to GSDP ratios

		Mean (1981-2001)		Std. Error	95 % Confidence Interval of mean of optimum rates	
		actual rates	estimated opt. rates			
Andhra Pradesh	(T/GSDP)	0.1004 (3)	0.1160 (3)	0.0014	0.1132	0.1189
	(G/GSDP)	0.1607 (4)	0.1578 (4)	0.0002	0.1572	0.1583
Karnataka	(T/GSDP)	0.1143 (1)	0.1290 (1)	0.0004	0.1281	0.1299
	(G/GSDP)	0.1714 (2)	0.1685 (2)	0.0001	0.1683	0.1687
Orissa	(T/GSDP)	0.0693 (4)	0.0980 (4)	0.0012	0.0955	0.1006
	(G/GSDP)	0.1755 (1)	0.1700 (1)	0.0002	0.1695	0.1705
Tamil Nadu	(T/GSDP)	0.1082 (2)	0.1244 (2)	0.0004	0.1235	0.1253
	(G/GSDP)	0.1620 (3)	0.1589 (3)	0.0001	0.1587	0.1591
West Bengal	(T/GSDP)	0.0605 (5)	0.0675 (5)	0.0005	0.0663	0.0686
	(G/GSDP)	0.1141 (5)	0.1134 (5)	0.0001	0.1132	0.1135

It is assumed that central government transfer funds on the basis of same formula to all the states. Thus differences in optimum expenditure to GSDP and revenue to GSDP cannot be explained by weights assigned to various criteria in transferring resources. Form (5) and (6) it is clear that such a difference in optimum values lie in difference in $\omega, \hat{\tau}, d$ and $b\gamma$. The difference in optimum expenditure to GSDP ratio can be attributed to the difference in the estimated value of ω which measure the weight assigned to public good consumption as we find a high rank correlation between these two factors. The difference in optimum revenue to GSDP ratio on the other hand cannot be explained by only one term. This is result of all these factors.

Table 5: Mean relative variation of revenue-GSDP and expenditure-GSDP rates

		Mean relative variation	Std. Dev.	Min	Max
Andhra Pradesh	(T/GSDP)	0.1628	0.1026	0.0299	0.3803
	(G/GSDP)	0.0710	0.0466	0.0060	0.2010
Karnataka	(T/GSDP)	0.1368	0.0942	0.0164	0.3377
	(G/GSDP)	0.0497	0.0427	0.0055	0.1482
Orissa	(T/GSDP)	0.4251	0.1727	0.1718	0.7821
	(G/GSDP)	0.1251	0.1235	0.0058	0.5672
Tamil Nadu	(T/GSDP)	0.1764	0.0721	0.0571	0.3367
	(G/GSDP)	0.0649	0.0574	0.0036	0.2183
West Bengal	(T/GSDP)	0.1553	0.1850	0.0020	0.5519
	(G/GSDP)	0.1062	0.0975	0.0031	0.2997

Mean absolute deviation of actual rates from their optimum rates relative to the actual rates are calculated to find out how far the state's actual fiscal policy is from their optimum policy. We observe that such a variation in expenditure to GSDP ratio ranges from 4.97 percent in Karnataka to 12.51 percent in Orissa. Mean absolute deviation of actual revenue to GSDP ratio from optimum revenue-GSDP ratio relative to actual revenue-GSDP ratio varies from 13.68 percent in Karnataka to 42.51 percent in Orissa.

Here we find out whether the deviation of actual rates from their optimum rates is significantly different from zero or not. We define the difference between actual and the optimum revenue-GSDP ratio by e (T/Y) and the difference between actual and the optimum public expenditure to GSDP ratio is denoted by e (G/Y). We have tested whether the mean e (T/Y) and the mean e (G/Y) are significantly different from zero or not. We reject the null hypothesis at 95 percent level of confidence in both the cases. But we fail to reject e (G/Y) =0 at 90 percent level of confidence. Thus we observe that in all the selected states in India they are neither raising revenue nor spending at the optimum utility maximizing level.

Table 6: Error in prediction test of revenue to GSDP ratio

One-sample t test					
Variable	Obs	Mean	Std. Err.	Std. Dev.	Degrees of freedom = 104
e (T/Y)	105	-0.0164	0.0012	0.0121	t = -13.86
Ho: mean (e) = 0					
Ha: mean (e)< 0			Ha: mean ≠ 0		Ha: mean > 0
Pr(T < t) = 0.0000			Pr(T > t) = 0.0000		Pr(T > t) = 1.0000

Table 7: Error in prediction test of expenditure to GSDP ratio

One-sample t test					
Variable	Obs	Mean	Std. Err.	Std. Dev.	Degrees of freedom = 104
e(G/Y)	105	0.0030	0.0018	0.0181	t = 1.7241
Ho: mean (e) = 0					
Ha: mean (e)< 0			Ha: mean ≠ 0		Ha: mean > 0
Pr(T < t) = 0.9562			Pr(T > t) = 0.0877		Pr(T > t) =0 .0438

Above analysis suggests that the state governments can take the optimum values calculated here as the benchmark and change their actual policy accordingly. From this study we find that there should be reduction in expenditure to GSDP ratio and increase in revenue to GSDP ratio in all the five selected states in India.

7. Conclusion

A model of determination of optimum revenue and expenditure in a federal economy like India has been developed. The model shows how the intergovernmental transfer allocation rule affects the utility maximizing level of revenue to output and expenditure to output ratios of the sub-national governments. The model is developed considering the transfer principle used by different transferring agencies in India.

The optimum revenue and expenditure policy of a state government are found to be dependent on the weight assigned to different criteria by the federal government in transferring funds to the state governments. Changing the weights assigned to different criteria federal government can change the utility maximizing revenue to output and expenditure to output rates.

Using pooled regression analysis on data taken from five selected states and for the period 1981 to 2001 we have estimated the weights assigned to various criteria by the

transferring agencies. These coefficients are thus statistically estimated not arbitrarily chosen. All the coefficients are found to be significantly different from zero at 5 percent level of significance. All the dummy variables are also found to be significant at 5 percent level of significance. As we have assumed in the theoretical part all the coefficients are found to be positive in sign.

We find that on an average Orissa received the largest per capita transfer. On the other hand Karnataka received the lowest funds per capita from the centre over the period 1981 to 2001 out of the five selected states. Average per capita transfer during this period was also very high in Andhra Pradesh. Population in West Bengal is highest out of five selected states but estimated mean per capita transfer is higher than that in Karnataka. This implies that West Bengal received higher total transfer than Karnataka during this period. Formula considered in this chapter predicts quite well the actual per capita transfer to a state in India as we fail to reject the null hypothesis of zero mean error in prediction at 95 percent level of confidence.

Optimum revenue and expenditure rates are obtained substituting the estimated coefficients of the transfer formula. The actual revenue to GSDP ratio is found to be lower than the optimum revenue to GSDP ratio in all the selected states. On the other hand, actual expenditure to GSDP ratios in five selected states is higher than their optimum values. Given the transfer formula and the estimated parameters of the model, the optimum revenue and expenditure to GSDP ratios calculated here can be considered as the benchmark by the state governments. The deviation of actual values from the optimum values also give us some idea regarding to which direction the state governments should change its existing revenue and expenditure policies.

Bibliography

Bhal, R.W. (1971). A regression Approach to Tax Effort and Tax Ratio Analysis, *IMF Staff Papers*, International Monetary Fund, 18 (3):570-612

Bajpai, N. and Sachs., J.D. (1999). The State of State Government Finances in India. Development Discussion Paper No. 719, http://www.ksg.harvard.edu/CID/india/pdfs/719.pdf

Coondoo, D., Majumder, A., Mukherjee, R., Neogi, C., (2001). Relative Tax Performances Analysis for Selected States in India, *Economic and political weekly*, 36(40): 3869-3871

Coondoo, D., Majumder, A., Neogi., C. (2000), "Taxable Capacity Function: A Note on Specification, Estimation and Application", in in D. K. Srivastava (ed.), *Fiscal Federalism in*

India: Contemporary Issues, Har-Anand Publications, New Delhi, 166-179.

Dahlby, B.(2004), "The Marginal Cost of Funds from Public Sector Borrowing", Department of Economics, University of Alberta, revised September 2004, http://www.uofaweb.ualberta.ca/ipe/pdfs/DahlbyTheMCFfromPublicSectorBorrowingDec04.pdf

GR (2001). Impact of Grants on Tax Effort of Local Government, *Economic and Political Weekly*, 36(41):4231

Government of Gujarat (2003), "Memorandum to the Twelfth Finance Commission", Finance Commission, India, http://fincomindia.nic.in/pubsugg/memo_guj.pdf

Ma, J. (1997), "Intergovernmental Fiscal Transfer: A Comparison of Nine Countries (Cases of the United States, Canada, the Unoted Kingdom, Australia, Germany, Japan, Korea, India, and Indonesia)", prepared for Macroeconomic Management and Policy Division, Economic Development Institute, The World Bank

Oommen, M.A. (1987). Relative Tax Effort of States, *Economic and Political Weekly*, 22(11):

Rajaraman, I and Vasishtha., G. (2000). Impact of Grants on Tax Effort of Local Government, *Economic and Political Weekly*, 35(33):2943-2948

Rao, M.G. (2002). State Finances in India: Issues and Challenges, *Economic and Political Weekly*, 37(31): 3261-3271

Rao, M.G. and Singh., N. (1998a) "Intergovernmental Transfers: Rationale, Design and Indian Experience", http://econ.ucsc.edu/~boxjenk/cre3.pdf

Rao,M.G. (1998b),"An analysis of explicit and implicit intergovernmental transfers in India" http://econ.ucsc.edu/~boxjenk/cre4.pdf

Rao,M.G.(1998c),"The assignment of taxes and expenditures in India" http://econ.ucsc.edu/~boxjenk/cre1.pdf

Rao,M.G.(2000),"The Political Economy of Center-State Fiscal Transfers in India" http://credpr.stanford.edu/pdf/credpr107.pdf

Sen, T.K. and Trebesch., C. (2004) "The Use of Socio-Economic Criteria for Intergovernmnetal Transfers: The Case in India", NIPFP Working Paper No. 10. Sen, T.K. (1997). Relative Tax Effort by Indian States, NIPFP Working Papers No. 5.

Sinelnikov, S., Kadotchnikov., P.,Trounin., I. and Schkrebela., E. (2001) "Impact of intergovernmental grants on the fiscal behavior of regional authorities in Russia" http://www.iet.ru/publication.php?folder-id=44&publication-id=1955

Appendix 1: Derivation of optimum revenue and expenditure ratio

The problem is to

$$\text{Max } U = \int_{t=0}^{\infty} U(G_t, (Y_t - T_t)).e^{-\rho t}dt$$

$$= \int_{t=0}^{\infty} Y_t U(g_t, (1-\tau_t)).e^{-\rho t}dt$$

$$= \int_{t=0}^{\infty} (w\ln g_t + (1-w)\ln(1-\tau_t))Y_0 e^{-[\rho-\gamma]t}dt$$

Subject to $\dot{b}_t = (1-\beta')g_t - (1+\alpha-\beta)\tau_t + \alpha'\hat{\tau} - \delta' d_t - b\gamma$

where $\alpha' = \alpha P$, $\beta' = \beta P$ and $\delta' = \delta P$, $(B_t / Y_t) = b_t$, $(\dot{Y}_t / Y_t) = \gamma$, $\hat{\tau}_t = \hat{T}_t / Y_t$, $d_t = DI_t / Y_t$, $(G_t / Y_t) = g_t$, $(T_t / Y_t) = \tau_t$, $(w/(1-w))$ measures the provision of public to private goods and services, ρ is the rate of time preference,

The Hamiltonian equation for this problem is as follows

$$H = w\ln g + (1-w)\ln\tau + \mu\left((1-\beta')(1-\theta)g - (1+\alpha'-\beta')\tau + \alpha'\hat{\tau} - \delta' d - b\gamma\right)$$

$$\frac{\partial H}{\partial g} = \frac{w}{g} + \mu(1-\beta')(1-\theta) = 0$$

$$\Rightarrow \mu = -\frac{w}{g(1-\beta')(1-\theta)} \qquad \text{(A1.1)}$$

$$\Rightarrow -\frac{\dot{\mu}}{\mu} = \frac{\dot{g}}{g} \qquad \text{(A1.2)}$$

$$\frac{\partial H}{\partial \tau} = -\frac{(1-w)}{(1-\tau)} - \mu(1+\alpha'-\beta') = 0$$

$$\Rightarrow \mu = -\frac{(1-w)}{(1-\tau)(1+\alpha'-\beta')} \qquad \text{(A1.3)}$$

$$\Rightarrow \quad -\frac{\dot{\mu}}{\mu} = \frac{\dot{\tau}}{\tau} \tag{A1.4}$$

$$\frac{\partial H}{\partial \mu} = (1-\beta')(1-\theta)g - (1+\alpha'-\beta')\tau + \alpha'\hat{\tau} - \delta' d - b\gamma = 0 \tag{A1.5}$$

$$\frac{\partial H}{\partial b} = \mu\left((1-\beta')(1-\theta)\frac{\partial g}{\partial b} - (1+\alpha'-\beta')\frac{\partial \tau}{\partial b} - \gamma \right) = (\rho-\gamma)\mu - \dot{\mu}$$

$$\Rightarrow -\frac{\dot{\mu}}{\mu} = \frac{\dot{g}}{g} = \frac{(\dot{1-\tau})}{(1-\tau)} = \left[(1-\beta')(1-\theta)\frac{\delta g}{\delta b} - (1+\alpha'-\beta')\frac{\delta \tau}{\delta b} - \rho \right] \tag{A1.6}$$

From (A4.1.1) and (A4.1.3) we get

$$\Rightarrow \; g = \left(\frac{w}{1-w} \right) \frac{(1+\alpha'-\beta')}{(1-\beta')(1-\theta)} (1-\tau) \tag{A1.7}$$

Substituting (A5.7) in (A5.5) we get

$$(1-\theta)(1-\beta')\left(\frac{w}{1-w}\right)\frac{(1+\alpha'-\beta')}{(1-\beta')(1-\theta)}(1-\tau) - (1+\alpha'-\beta')\tau + +\alpha'\hat{\tau} - \delta' d - b\gamma = 0$$

$$\Rightarrow \frac{w}{(1-w)}(1+\alpha'-\beta')(1-\tau) - (1+\alpha'-\beta')\tau + \alpha'\hat{\tau} - \delta' d - b\gamma = 0$$

$$\tau^* = w + \frac{(1-w)}{(1+\alpha'-\beta')}\left[\alpha'\hat{\tau} - \delta' d - b\gamma\right] \tag{A1.8}$$

$$\therefore g^* = \frac{w}{1-w}\frac{(1+\alpha'-\beta')}{(1-\beta')(1-\theta)}\left[1 - w - \frac{(1-w)}{(1+\alpha'-\beta')}\left[\alpha'\hat{\tau} - \delta' d - b\gamma\right]\right]$$

$$= w\frac{(1+\alpha'-\beta')}{(1-\beta')(1-\theta)} - \frac{w}{(1-\beta')(1-\theta)}\left[\alpha'\hat{\tau} - \delta' d - b\gamma\right] \tag{A1.9}$$

Appendix 2

Table A2.1: Regression Result

Source	SS	MS	df	No. of Observations=105	
Model	1029777.41	147111.06	7	F(6, 98)= 26.05 (.000)	
Residual	547744.09	5646.85	97	Adj R-squared = 0.6277	
Total	1577521.50	15168.48	104	Root MSE = 80.94	
Variable	Coef.	Std.Err	t	(P>|t|)	VIF	Conditional Index
$(r - \hat{r})$	0.0459	0.0092	4.98	0.000	1.22	1.000
$(G-T)$	0.0307	0.0049	6.25	0.000	1.18	1.695
DI	0.0361	0.0088	4.08	0.000	3.27	1.919
d1	-69.68	32.09	-2.17	0.032	3.06	1.927
d2	-99.58	34.63	-2.88	0.005	3.57	2.550
d4	-73.61	41.46	-1.78	0.079	5.11	3.924
d5	-111.42	30.26	-3.68	0.000	2.72	4.732
δ_0	358.04	65.71	5.45	0.000	Mean VIF =2.88	21.942

Table A2.2 Per capita transfer over the period 1981 to 2001 in Andhra Pradesh

year	Actual P.C. transfers	Predicted P.C. transfers	se (e)	95 % C.I	
1981	388.05	390.65	26.12	338.93	442.37
1982	415.9	383.38	26.31	331.29	435.48
1983	423.54	417.84	24.63	369.08	466.61
1984	428.85	462.33	20.99	420.77	503.88
1985	513.12	480.69	19.90	441.28	520.10
1986	503	513.16	20.92	471.74	554.58
1987	490.91	506.85	19.36	468.52	545.17
1988	505.87	526.18	17.00	492.53	559.84
1989	504.64	532.03	17.38	497.61	566.45
1990	591.42	525.24	17.28	491.03	559.45
1991	582.65	547.83	16.62	514.92	580.75
1992	593.66	584.63	17.54	549.89	619.37
1993	668.02	582.80	16.85	549.43	616.18
1994	581.42	617.39	18.90	579.96	654.81
1995	666.32	618.05	18.26	581.89	654.21
1996	677.43	649.75	18.36	613.40	686.09
1997	685.97	677.69	23.03	632.10	723.29
1998	675.77	699.94	21.27	657.82	742.07
1999	633.68	713.66	22.74	668.64	758.69
2000	661.86	786.06	29.53	727.58	844.54
2001	789.73	765.66	32.52	701.28	830.05

Table A2.3: Per capita transfer over the period 1981 to 2001 in Karnataka

year	Actual P.C. transfers	Predicted P.C. transfers	se (e)	95 % C.I	
1981	343.47	422.79	18.79	385.57	460.00
1982	355.02	430.29	18.55	393.55	467.02
1983	383.76	425.46	18.89	388.06	462.87
1984	478.88	458.56	18.02	422.89	494.23
1985	538.97	480.78	18.37	444.42	517.15
1986	474.27	477.53	17.77	442.35	512.71
1987	434.84	490.90	17.37	456.51	525.28
1988	457.22	486.33	17.36	451.96	520.70
1989	513.63	506.68	18.10	470.85	542.51
1990	453.14	521.21	18.25	485.07	557.35
1991	458.72	531.20	17.22	497.10	565.30
1992	516.42	538.69	17.27	504.49	572.89
1993	530.19	549.25	17.27	515.06	583.45
1994	583.85	527.06	17.07	493.26	560.85
1995	484.58	562.92	18.50	526.29	599.56
1996	563.55	573.28	18.15	537.34	609.21
1997	612.42	552.32	17.34	517.98	586.65
1998	595.04	541.13	18.25	505.00	577.26
1999	581.79	594.28	20.49	553.72	634.84
2000	664.34	582.48	24.00	534.97	629.99
2001	806.96	577.93	23.79	530.82	625.04

Table A2.4: Per capita transfer over the period 1981 to 2001 in Orissa

year	Actual P.C. transfers	Predicted P.C. transfers	se (e)	95 % C.I	
1981	484.87	571.18	25.38	520.94	621.43
1982	616.55	593.57	22.69	548.65	638.49
1983	553.01	555.02	27.34	500.88	609.16
1984	493.44	607.70	21.79	564.55	650.85
1985	530.37	607.87	20.97	566.34	649.40
1986	610.19	627.25	19.89	587.86	666.63
1987	665.60	646.59	17.61	611.72	681.47
1988	709.01	634.70	19.28	596.52	672.88
1989	762.39	648.93	17.68	613.92	683.94
1990	832.36	688.70	16.62	655.79	721.62
1991	725.08	697.96	16.46	665.37	730.56
1992	740.87	715.64	17.19	681.59	749.68
1993	756.61	717.63	17.16	683.66	751.60
1994	694.57	714.63	17.00	680.97	748.29
1995	628.57	715.51	17.18	681.49	749.53
1996	681.64	764.94	22.12	721.13	808.74
1997	753.43	733.30	19.49	694.72	771.88
1998	717.37	778.06	21.81	734.89	821.24
1999	795.09	790.89	23.33	744.70	837.08
2000	875.36	828.10	26.52	775.58	880.61
2001	847.31	835.53	26.75	782.56	888.51

Table A2.5: Per capita transfer over the period 1981 to 2001 in Tamil Nadu

year	Actual P.C. transfers	Predicted P.C. transfers	se (e)	95 % C.I	
1981	368.73	463.70	17.89	428.27	499.12
1982	391.04	483.00	18.34	446.68	519.32
1983	467.38	481.74	17.71	446.67	516.81
1984	454.30	480.88	17.63	445.96	515.79
1985	507.67	487.88	18.50	451.25	524.52
1986	446.83	497.93	19.51	459.31	536.55
1987	465.91	502.95	19.93	463.50	542.40
1988	484.17	497.46	19.56	458.73	536.19
1989	528.62	530.31	19.37	491.95	568.66
1990	594.77	520.65	17.53	485.93	555.36
1991	610.78	639.56	25.22	589.63	689.49
1992	631.83	583.71	17.62	548.82	618.59
1993	638.82	538.35	16.68	505.33	571.38
1994	672.18	515.26	18.53	478.57	551.95
1995	524.98	534.57	19.72	495.52	573.62
1996	587.14	575.56	18.67	538.59	612.52
1997	639.51	562.20	21.38	519.86	604.54
1998	571.29	569.19	19.41	530.76	607.62
1999	551.90	602.40	22.26	558.33	646.48
2000	561.98	578.34	23.98	530.87	625.82
2001	513.81	568.00	20.92	526.58	609.43

Table A2.6: Per capita transfer over the period 1981 to 2001 in West Bengal

year	Actual P.C. transfers	Predicted P.C. transfers	se (e)	95 % C.I	
1981	367.81	449.98	20.18	410.02	489.95
1982	436.97	439.42	20.56	398.72	480.13
1983	394.73	428.94	22.21	384.96	472.92
1984	344.64	477.16	21.28	435.02	519.30
1985	485.46	469.83	19.75	430.72	508.93
1986	481.99	484.93	17.97	449.36	520.51
1987	451.24	490.65	18.07	454.86	526.43
1988	467.65	500.04	18.71	462.99	537.10
1989	438.02	532.57	18.86	495.22	569.91
1990	518.08	529.40	17.74	494.27	564.52
1991	474.67	528.37	17.78	493.17	563.57
1992	508.82	525.46	18.33	489.16	561.75
1993	552.49	534.39	17.75	499.23	569.54
1994	593.43	532.66	18.01	497.01	568.32
1995	560.36	533.43	16.86	500.04	566.82
1996	648.74	577.64	17.90	542.19	613.08
1997	733.91	512.20	16.90	478.75	545.66
1998	816.77	515.67	18.34	479.36	551.99
1999	486.09	673.38	36.23	601.64	745.12
2000	686.49	691.08	36.54	618.73	763.43
2001	646.13	667.28	40.30	587.48	747.08

Table A2.7Result of regression of (G/Y) on (1-(T/Y)) in Andhra Pradesh (1981-2001)

Source	SS	df	MS	Number of obs	21
Model	0.541	1	0.541	F(1, 20)	2183.110
Residual	0.005	20	0.000	Prob > F	0.000
Total	0.546	21	0.026	R-squared	0.991
Adj R-squared		0.991		Root MSE	0.016
(G/Y)	Coef.	Std. Err.	t	P>t	95% Conf. Interval
(1-(T/Y))	0.178	0.0038	46.720	0.000	0.170 0.186

Table A2.8Result of regression of (G/Y) on (1-(T/Y)) in Karnataka (1981-2001)

Source	SS	df	MS	Number of obs	21
Model	0.617	1	0.617	F(1, 20)	4326.130
Residual	0.003	20	0.000	Prob > F	0.000
Total	0.620	21	0.030	R-squared	0.995
Adj R-squared		0.995		Root MSE	0.012
(G/Y)	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
(1-(R/Y))	0.193	0.0029	65.770	0.000	0.187 0.200

Table A2.9Result of regression of (G/Y) on (1-(T/Y)) in Orissa (1981-2001)

Source	SS	df	MS	Number of obs	21
Model	0.646	1	0.646	F(1, 20)	780.850
Residual	0.017	20	0.001	Prob > F	0.000
Total	0.663	21	0.032	R-squared	0.975
Adj R-squared		0.974		Root MSE	0.029
(G/Y)	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
(1-(R/Y))	0.188	0.0067	27.940	0.000	0.174 0.203

Table A2.10Result of regression of (G/Y) on (1-(T/Y)) in Tamil Nadu (1981-2001)

Source	SS	df	MS	Number of obs	21
Model	0.550	1	0.550	F(1, 20)	1945.940
Residual	0.006	20	0.000	Prob > F	0.000
Total	0.556	21	0.026	R-squared	0.990
Adj R-squared		0.989		Root MSE	0.017
(G/Y)	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
(1-(R/Y))	0.181	0.0041	44.110	0.000	0.173 0.190

Table A2.11Result of regression of (G/Y) on (1-(T/Y)) in West Bengal (1981-2001)

Source	SS	df	MS	Number of obs	21
Model	0.274	1	0.274	F(1, 20)	736.410
Residual	0.007	20	0.000	Prob > F	0.000
Total	0.281	21	0.013	R-squared	0.974
Adj R-squared		0.972		Root MSE	0.019
(G/Y)	Coef.	Std. Err.	t	P>t	95% Conf. Interval
(1-(R/Y))	0.122	0.0045	27.140	0.000	0.112 0.131