Public Capital and Growth in a Decentralised Agents Framework

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Abstract

One of the important features of the Indian economy is the disparate growth of state domestic product (SDP). In India regional disparity in growth of output has increased mainly in the post reform period. Given the fact that inter state disparity in growth rate among the Indian states exists and persists, it has now become very essential to give a close look at the individual state level.

A growth model to study the growth performances of the states in India is developed following Barreto (2003) with little modification to fit data and problem of states in a federal country like India. We have shown theoretically that growth of SDP depends on how much state decided to purchase private capital which in turn determines the size transfers made by the several government ministries.

The empirical part of the paper evaluates the effect of public capital on economic growth of four states in India. This paper highlights the role of public productive spending policy on economic growth of the four states in India. This paper not only assesses the effect of state's own productive policy on economic growth but also evaluates the contribution of center's productive transfer policy on economic growth. This study also helps us to check which sector, public or private, plays crucial role in the high growth state. This will help the poorer states to decide their strategy so that they can also achieve higher growth as in the high growth states. This paper also highlights on how efficiently states uses resources by making a comparative study of efficient resource allocation by the public and private sector in a state.

On the basis of data availability and also to give a close look at the individual state level we have concentrated on four fastest growing states, *Maharashtra, Gujarat, Tamil Nadu and West Bengal.* The period of this study is from 1981 to 2000, that is, we have taken years from pre reform period and post reform period.

Given this, first we attempt to check, as far as possible on the basis of reasonable assumptions, whether variations in state domestic product (SDP) of a particular state in India over time can be attributed to differing levels of public capital? For this we have studied the elasticity of output with respect to public and private capital in different states in India. Having done so, we try to seek answers to a few related questions. How do states' own productive expenditure policy and the centre's transfer of productive resources affect the growth of public capital and thereby the elasticity of output with respect to public capital. Then we measure the efficiency of resource allocation by the states over the period 1981-2000.

Introduction:
One important feature of economic development in India is the wide difference in average rates of growth of output among the states in India. Economic growth of a state depends on the availability of public and private capital stock in that state, among other factors.

The planning process in India was initiated with the view that it will take care of public sector investment and thus will remove the barriers to equitable development among the states in India. Even after more than a half century of state led intensive planning regional inequality exists and persist in India. The heterogeneous growth performance in India is often attributed to disparate spread of public capital over the states. So time has come to take a close look at the regional growth performance in India and the role of public capital plays in it. Given this it is also important to examine the factors on which the stock of public capital or the formation of public capital in a state depends. The availability of public capital stock in that state depends not only on the state's own spending for the creation of productive capacity and revenue raising policy but also on the level of transfers received from the central government for financing productive expenditure and the utilization of such a transfer.

In India regional disparity in growth of output has increased mainly in the post reform period. The central government also transferred lesser amount to the states for productive purposes, and thus reducing the state's capability to spend for productive purpose and thus building productive capacity. There is a large literature that links government productive expenditure and economic growth. The main proponent of this class of literature is Barro. Barro (1990) develops a constant return to scale endogenous growth model with productive public sector. In Barro model productive public spending is financed by taxes proportional to income, that is, the government budget is balanced. Another line of thought proposed by Schliefer and Vishny (1993) is corruption in the government, which was extended later to a decentralised set up by Bardhan and Mokherjee (1990, 2003). Barreto (2003) is an extension in this line of research where he assumes that productive public services are provided through the imposition of taxes on income as well as user charges. These user charges provide an opportunity to decentralised public agents to get a rent out of the system through institutional means. This paper provides a theoretical model that is appropriate for the study of growth performance of a state in a federal country like India. Here we have used the framework provided by Barreto.

Although a considerable literature on public policy and growth at the cross national level exists, analyses of effects of public capital on economic growth at the state level within the country is limited, especially for India. One of the reasons for the lack of such study is that relevant state level data in appropriate form are not available. Those studies have tested whether the convergence hypothesis holds for the Indian states. Dholakia (1994), Cashin and Sahay (1996) find convergence of economic growth rates for the states in India. Ahluwalia (2000), Nagraj et al (1997), Rao et al (1999), Marjit et al (1996) and Dasgupta et al (2000) conclude studying Indian states that there is divergence of SDP. Das et al (1996) and Shand et al (2000) have identified a positive link between a few social variables and infrastructural variables with high growth rates of NSDP. Nagraj et al. (1997) identify Maharashtra, Gujarat, Tamil Nadu and West Bengal as the fastest growing states in India. Ahluwalia (2000) points out that given the fact that inter state disparity in growth rate among the Indian states exists and persists, it has now become very essential to give a close look at the individual state level. This has motivated us to take the issue of public policy and growth as a study of research. Our study is different from those studies available for the Indian economy. In our study we have tried to build up a theoretical model that is most appropriate to describe the growth performance of a state. On the basis of data availability and also to give a close look at the individual state level we have concentrated on four fastest growing states in India for the empirical verification of the model. In our model we have used the actual value of gross fixed capital formation (GFCF) in the public sector instead of taking any proxy estimate for that. The empirical part of the model estimates the elasticity of output with respect to public capital proxied by GFCF by the public sector. This paper not only assesses the effect of state's own productive policy on economic growth but also evaluates the contribution of center's productive transfer policy on economic growth. This study also helps us to check which sector, public or private, plays crucial role in the high growth state. This will help the poorer states to decide their strategy so that they can also achieve higher growth as in the high growth states. The period of this study is from 1981 to 2000, that is, we have taken years from pre reform period and post reform period.

Given this, our objective is two fold: firstly we attempt to check, as far as possible on the basis of reasonable assumptions, whether variations in state domestic product (SDP) of a particular state in India over time can be attributed to differing levels of public capital? For this we have studied the elasticity of output with respect to public and private capital in different states in India. Having done so, we try to seek answers to a few related questions. How do states' own productive expenditure policy and the centre's transfer of productive resources affect the growth of public capital and thereby the elasticity of output with respect to public capital.

This paper is organized as follows: section I describes the theoretical model, section II presents the empirical results and section III states the conclusion of the model.

I. Theoretical Model:

We begin with a framework, similar to the one that is given by Barreto (2003). Raul A Barreto developed a model of state infrastructure with decentralized public agents for the study of cross-country growth performance. We have used the same framework as in Barreto model with appropriate modification to explain the growth performance of the states in India.

Barreto considered an aggregate production function where public infrastructure is a productive input. The public infrastructure again is produced by public capital and public labour. The public sector competes with private sector over the available resources in the economy. Due to non-availability of data on public sector output and also for explaining the question of how productive expenditure policy of a state affects the growth of public capital we have developed a model where decentralized agents produce public capital using private capital as another factor of production. In our model public sector only produces public capital.

(A) <u>Private Sector and Public Sector Production Functions:</u>

<u>(a) Private Sector:</u>

We consider two sectors: (i) the private sector (P) and (ii) the public sector (G).

Following Barreto (2003) we use the following set up with Cobb-Douglas production functions:

The private sector produces society's consumable output, the final output, using private capital (K_P), public capital (K_G) and labour employed in the public sector (L_G) as inputs. The production function is homogeneous of degree one in all inputs.

$$Y = AK_P^{\alpha} K_G^{\beta} L_P^{1-\alpha-\beta} \tag{1.1a}$$

Where Y is output of consumable goods measured by real state domestic product (SDP); A is the technology parameter; $\alpha, \beta, (1-\alpha-\beta)$ elasticity of SDP with respect to private capital, public capital and labour employed in the private sector. Equation (1.1a) also indicates that income from the sale of final output (Y) is equal to total factor payment. Equation (1.1a) can be written in intensive form as follows:

$$y = \frac{Y}{L_p} = Ak_p^{\alpha}\left(\frac{k_g}{B_L}\right)^{\beta} \qquad \text{(1.1b)}^{1}$$

where $B_L = \frac{L_{Pt}}{L_{Gt}}$

Now suppose government imposes tax on sale of final output (Y) at a rate τ_S and income tax is imposed on factor income at a rate τ_Y. Then after tax income can either be consumed or be saved.

<u>(b) Public Sector:</u>

Keeping India as a case in point here, we assume that the state government operates its services through some decentralized agents, that is, government employees. The role of the state government only

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[1] $y = \frac{Y}{L_p} = A\left(\frac{K_P}{L_P}\right)^{\alpha}\left(\frac{K_G}{L_P}\right)^{\beta} = A.k_p^{\alpha}\left(\frac{K_G/L_G}{L_P/L_G}\right)^{\beta} = Ak_p^{\alpha}\left(\frac{k_g}{B_L}\right)^{\beta}$

is to impose and collect taxes and transfer that to the decentralized agents. Public agents (L_G) then produce public capital (K_G) using private capital purchased from the private sector ($\widetilde{G}$). Thus $\overline{K}$ = Total private capital = $K_P + \widetilde{G}$, where '~' over a variable in public sector denotes a real variable.

Following Barreto we assume that state government operates its activity through some self-seeking decentralized agents. Barreto assumed that public services are partly subsidized by tax revenues. But to study the regional growth performance in India we assume that the costs of producing public services are not only subsidized by the state own tax transfer but also by the transfer received from the central government.

The state government in India collects mainly indirect taxes and agricultural income taxes whereas the central government collects direct taxes. We assume that the state government collects taxes at a constant proportion (τ_S) of real SDP at market price and transfer the entire own tax revenue to the decentralised agents. The central government on the other hand imposes direct taxes at a rate τ_Y on factor income.

In India state government receives certain proportion of central taxes and grants, loans from the central government. We assume that like state own tax transfers decentralised agents receive a constant proportion θ of SDP as share in central tax, grants and loans. Thus total subsidy (S) received from the different levels of government is

$$S = \tau_S.Y + \theta.Y \quad \text{where } \theta = (1-\tau_S).\tau_Y$$

In this model we assume that public capital are not free goods, the decentralised agents produce public capital and charge a price P_{K_G} for the services they provide. Thus public capital is non-rival but excludable. The demand for public capital is negatively sloped as long as P_{K_G} is positive. If taxes are set in such a way that entire cost is financed by exogenous tax, grants and loans transfer **(Barro case)** decentralised agents are not allowed to charge a price. The public sector production can be defined as follows:

$$K_G = B.\widetilde{G}^{\gamma} L_G^{1-\gamma} + \frac{\tau_S.Y}{P_K} + \frac{\theta.Y}{P_K} \tag{1.2a}$$

$$= B.\widetilde{G}^{\gamma} L_G^{1-\gamma} + \frac{(\tau_S+\theta).Y}{\beta\frac{Y}{K_G}} = B.\widetilde{G}^{\gamma} \cdot L_G^{1-\gamma} + \frac{\tau_S+\theta}{\beta}.K_G = \frac{\beta}{\beta-\tau_S-\theta} B.\widetilde{G}^{\gamma} L_G^{1-\gamma} \tag{1.2b}$$

where B is the technology parameter; τ_S is the average tax rate proportional to the state domestic product (SDP); θ is the average rates of centre's transfer (as a proportion to SDP); γ , $(1-\gamma)$ are the elasticity of public capital with respect to public productive input and public labour respectively. P_{K_G} is the price charged by the public agents and it is equal to the value of marginal product of the public capital, that is, $P_{K_G} = \frac{\partial Y}{\partial K_G}$.

Thus if τ_S is the average tax imposed by the state government per unit of SDP then $\frac{\tau_S}{\beta}$ is the tax received per unit of public capital, K_G , from the state government.

From equation (1.2b) it is clear that total public capital produced in a state depends not only on the how much private capital and labour are employed in the public sector but also on the rates of state own taxes and central transfers. Thus it is seen that the states with high rates of state own taxes, share in central taxes and grants plus loans as a proportion of its SDP will have bigger size of public capital given the level of private capital purchased by the public sector and the labour employed by the public sector. Equation (1.2b) written in intensive form is as follows:

$$k_g = \frac{K_G}{L_G} = \frac{\beta}{\beta - \tau - \theta}.B.\tilde{g}^{\gamma} \quad (1.2c)$$

(B) <u>Private capital used in public sector production:</u>
Public agents using private capital as input produce public capital in our model. In (1.2b) we have defined $\tilde{G}$ as the private capital used in public sector production. From the convention of distinguishing plan and non-plan expenditure in India it follows that real plan expenditure reflects how much government is spending in real term in enhancing productive capacity. We assume that state real plan capital expenditure along with real plan grants and loans received from the central ministries constitute the private capital used in public production. The revenue component of state own plan expenditure corresponds to overhead types of expenditure such as wages and salary expenditure. As labour is taken as a separate variable in our model we only consider the real plan capital expenditure by the state government. This helps us to avoid double counting if any.
(C) <u>Cost Function:</u>
The costs of producing public capital are the wage and the rental cost. Here we assume that the public sector pays the wage and rental rate as paid by the private sector. The wage rate of labour and rental rate of capital are given to the public sector. Thus the total cost can be written as:

$$C = w.L_G + r.\tilde{G} \quad (1.5)$$

In our model a part of the production is subsidised by tax revenue and rest is financed by the revenue earned from user fees (***see equation 1.2b***). Thus the objective of the agents is to minimize cost (equation1.5) subject to the production function (equation1.2b). The corresponding derived cost function is as follows:

$$C' = \left(\frac{\beta - \tau_S - \theta}{\beta}\right)\left[\frac{w^{1-\gamma}.r^{\gamma}}{B.\gamma^{\gamma}.(1-\gamma)^{1-\gamma}}\right].K_G \quad (1.5)'$$

This cost function shows the cost of producing public capital net of subsidy. Here the term $\left[\frac{w^{1-\gamma}.r^{\gamma}}{B.\gamma^{\gamma}.(1-\gamma)^{1-\gamma}}\right].K_G = C$ ***(say)*** represents the cost borne by the decentralised agents when there is no subsidy[2] . In other words this is the actual cost of producing public capital.

So it is very clear that though total cost of producing public capital is C only $\left(\frac{\tau_S + \theta}{\beta}\right)$ proportion is financed by transferred revenue and other part is to be filled up by the revenue from the sell of the public capital. We define marginal cost of producing K_G and the marginal cost to the decentralised agents whose production is subsidised by exogenous transfer as MC_{K_G} and MC'_{K_G} respectively. Then

$$MC_{K_G} = \left[\frac{w^{1-\gamma}.r^{\gamma}}{B.\gamma^{\gamma}.(1-\gamma)^{1-\gamma}}\right] \quad \text{and} \quad MC'_{K_G} = \left(\frac{\beta - \tau_S - \theta}{\beta}\right)\left[\frac{w^{1-\gamma}.r^{\gamma}}{B.\gamma^{\gamma}.(1-\gamma)^{1-\gamma}}\right]$$

(D) <u>Premium Function:</u>

In our model we have assumed that the state government along with the central government are unable to finance the total cost of providing public capital as a result they allow the decentralised agents to charge

[2] This can be shown if we minimize equation (1.5) subject to $K_G = B.\tilde{G}^{\gamma} L_G^{1-\gamma}$

price for the public capital they produce. As the government has monopoly for the services they provide therefore the public agents can earn some extra premium over and above their wages. The premium is like the monopoly rent. We assume that extra premium is equally distributed among the public agents. This premium exists because government regulates the production of the good by law and as a result, the institutional monopoly generates a premium for agents, which simply does not disappear on account of competition. Thus premium is defined as the value of public capital net of total cost and it is defined as follows:

$$\Psi = P_K.K_G - w.L_G - r.\widetilde{G} \qquad (1.3a)$$

where Ψ is the extra premium received by the decentralized agents over and above their wages. Equation (1.3a) is the difference between the total revenue of the decentralised agents less the opportunity cost of employing resources in the public sector. The public capital, K_G as defined in (1.2a) is subsidised by tax, grants and loans subsidy.

The premium is a function of the income tax rate, competitive wage and rental rate of capital, and the marginal product of public capital in terms of final goods. ψ =0 implies that the public agents earn no extra premium and therefore no inefficiency is present.

Modeling the Behavior of Public Agents:

Case –I: Decentralised agents behave like a true monopolist and thus sets price of the services by equating marginal revenue to marginal cost. In this case no amount of resources is transferred from the government. Entire cost is borne by the agents. This is ***Schliefer-Vishny (1993)*** case.

Case –II: Decentralised agents do not charge any user fee to exploit its position rather they behave like a social planner in this case premium is zero and entire expenditure is financed by transfer received as tax or grants or loans. This is the ***Barro case.***

Case –III: Third possibility is that the decentralised agents operate in between the two extremes just stated above. This is **Bardhan-Mokherjee** type model.

Decentralised agents generally operates in between two extreme, that is total cost of producing public capital is financed partly by the revenue earned from the sell of public capital and partly by the subsidy received in terms of exogenous grants or taxes.

In this model we have already assumed that total expenditure is not fully financed by tax revenues and grants transfer. So decentralised agents are allowed to impose user fee in the services they provide. Thus the demand curve for public capital is negatively sloped as long as P_{K_G} is positive. The decentralised agents will then try to exploit this and set price according to its marginal product. Thus $P_{K_G} = \frac{\partial Y}{\partial K_G}$. Thus decentralised agents will produce output by equating marginal revenue to marginal cost (net of subsidy) and corresponding price will be determined from the downward sloping demand curve of public capital.

As in Barreto, the relationship between government and public agent is such that public agent does not directly affect the marginal product of the public capital as well as the marginal product of her work effort. User fee (P_{K_G}) in this model is determined by the endogenous allocation of labour and capital in both the sectors. Both the sectors face the accounting constraint $\overline{L} = L_P + L_G$ and $\overline{K} = K_P + \widetilde{G}$. In our model ultimately all the capital stock is owned by the private sector. Competition between the two sectors for the available resources ensures that public agents receive the same wage rate as paid by the private sector. Thus to the decentralised agents rental value of capital and labour are given. We assume that all capital stock is initially owned by the private sector over which both private and public sector compete. Then private sector produces society's consumable commodities and public sector produces public capital.

Optimum Allocation of Resources:

Given the taxes set by the government, if decentralized agents accept the value of private capital used in the public sector and wage rate as given, competitive resource market ensures that their opportunity costs equal the private sector after tax rental rate of capital and wage respectively. Therefore the decentralized public agent maximizes her welfare function given the resource markets.

$$\Psi = P_K K_G - wL_G - r.\tilde{G} > 0$$

$$= [VMPG.\tilde{G} + VMPL_G.L_G] - VMPL_P.(1-\tau_S).(1-\tau_Y)L_G - VMPK_P.(1-\tau_S).(1-\tau_Y).\tilde{G}$$ [3]

$$= [VMPL_G - VMPL_P.(1-\tau_S).(1-\tau_Y)].L_G + [VMPG - VMPK_P.(1-\tau_S).(1-\tau_Y)].\tilde{G} > 0$$

The decentralized agent would like to choose L_G and $\tilde{G}$ in such a way that $\psi\,(>0)$ is maximum. Marginal labour cost to the public agent is the competitive wage rate, w, which is equal to the private sector wage rate. Public agents receive competitive wage, w plus the premium. This is the marginal benefit of getting employment in the public sector. The resource allocation is determined by marginal benefit equalizing marginal cost. Thus the equilibrium condition is

$$\frac{\partial \Psi}{\partial L_G} = \frac{\partial Y}{\partial L_P}(1-\tau_S).(1-\tau_Y) \qquad \text{(a)} \qquad \text{and} \quad \frac{\partial \Psi}{\partial \tilde{G}} = \frac{\partial Y}{\partial K_P}(1-\tau_S).(1-\tau_Y) \qquad \text{(b)}$$

The right hand side of equation (a) and (b) measures the value of marginal productivity of private inputs net of taxes. This follows from

$$\frac{\partial \Psi}{\partial L_G} = \overline{P}_K \frac{\partial K_G}{\partial L_G} - \overline{VMPL_P}(1-\tau_S).(1-\tau_Y) = \overline{VMPL_P}(1-\tau_S).(1-\tau_Y) = \overline{w}$$ [4]

or, $VMPL_G - \overline{VMPL_P}(1-\tau_S).(1-\tau_Y) = \overline{VMPL_P}(1-\tau_S).(1-\tau_Y)$

Therefore, $VMPL_G = 2\overline{VMPL_P}(1-\tau_S).(1-\tau_Y)$

$$\Rightarrow \frac{(1-\gamma)\beta}{L_G} = \frac{2(1-\alpha-\beta)(1-\tau_S).(1-\tau_Y)}{L_P}$$

$\because \overline{L} = L_G + L_P$

Therefore,

$$\frac{L_G^*}{\overline{L}} = \frac{\beta.(1-\gamma)}{2.(1-\alpha-\beta).(1-\tau_S).(1-\tau_Y) + \beta.(1-\gamma)} = \frac{\beta.(1-\gamma)}{2.(1-\alpha-\beta).(1-\tau_S-\theta) + \beta.(1-\gamma)} \qquad (1.4)$$

Where $\theta = (1-\tau_S)\tau_Y$

and

$$\frac{L_P^*}{\overline{L}} = \frac{2.(1-\alpha-\beta).(1-\tau_S).(1-\tau_Y)}{2.(1-\alpha-\beta).(1-\tau_S).(1-\tau_Y) + \beta.(1-\gamma)} = \frac{2.(1-\alpha-\beta).(1-\tau_S-\theta)}{2.(1-\alpha-\beta).(1-\tau_S-\theta) + \beta.(1-\gamma)} \qquad (1.5)$$

Similarly,

$$\frac{\partial \Psi}{\partial \tilde{G}} = \overline{P}_K \frac{\partial K_G}{\partial \tilde{G}} - \overline{VMPK_P}(1-\tau_S).(1-\tau_Y) = \overline{VMPK_P}(1-\tau_S).(1-\tau_Y) = \overline{r}.$$

or, $VMP\tilde{G} - \overline{VMPK_P}(1-\tau_S).(1-\tau_Y) = \overline{VMPK_P}(1-\tau_S).(1-\tau_Y)$

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[3] The private sector equates post tax marginal product of the factor to the respective price of the input and public sector takes private sector wage and rental rate as given.

[4] The bar over the variable denotes the public agent's inability to directly affect its value.

Therefore, $VMP\widetilde{G} = \overline{VMPK_P}(1-\tau_S).(1-\tau_Y) + \overline{VMPK_p}.(1-\tau_S).(1-\tau_Y)$

$$\Rightarrow \frac{\beta.\gamma}{\widetilde{G}} = \frac{2\alpha.(1-\tau_S).(1-\tau_Y)}{K_P}$$

Since, $\overline{K} = K_P + \widetilde{G}$

Therefore,

$$\frac{\widetilde{G}^*}{\overline{K}} = \left(\frac{\beta.\gamma}{2\alpha.(1-\tau_S).(1-\tau_Y) + \beta.\gamma}\right) = \left(\frac{\beta.\gamma}{2\alpha.(1-\tau_S-\theta) + \beta.\gamma}\right) \quad (1.6)$$

Thus given the value of λ we can find optimum of G_{SP}^* as follows:

$$\frac{\widetilde{G}_{SP}{}^*}{\overline{K}} = (1-\lambda)\left(\frac{\beta.\gamma}{2\alpha.(1-\tau_S).(1-\tau_Y) + \beta.\gamma}\right) = (1-\lambda)\left(\frac{\beta.\gamma}{2\alpha.(1-\tau_S-\theta). + \beta.\gamma}\right) \quad (1.6)^{/}$$

$$\frac{K_P^*}{\overline{K}} = \frac{2\alpha.(1-\tau_S).(1-\tau_Y)}{2\alpha.(1-\tau_S).(1-\tau_Y) + \beta.\gamma} = \frac{2\alpha.(1-\tau_S-\theta)}{2\alpha.(1-\tau_S-\theta) + \beta.\gamma} \quad (1.7)$$

Equations (4) through (7) may be defined as the allocation rule for $L_G, L_P, \widetilde{G}$ and K_P. It is important to note that equations (4) through (7) are not socially optimal allocations rather they are sub optimal, as they are derived from the condition that $\Psi > 0$. This inefficiency in resource allocation can be eliminated by setting taxes at optimal rate. That is by providing public capital at a competitive level. The benchmark rules for optimum allocation derived from the condition $\Psi = 0$ are defined as follows.

The social planner will choose L_G and G in such way so that

$$\Psi = P_K K_G - wL_G - r.\widetilde{G} = 0$$

$$= [VMPG.\widetilde{G} + VMPL_G.L_G] - VMPL_P.(1-\tau_S).(1-\tau_Y)L_G - VMPK_P.(1-\tau_S).(1-\tau_Y).\widetilde{G}$$

$$= [VMPL_G - VMPL_P.(1-\tau_S).(1-\tau_Y)].L_G + [VMPG - VMPK_P.(1-\tau_S).(1-\tau_Y)].\widetilde{G}$$

Thus the social planner will choose labour at a point where:

$$\frac{\partial\psi}{\partial L_G} = VMPL_G - VMPL_P(1-\tau_S)(1-\tau_Y) = 0$$

$$\Rightarrow VMPL_G = VMPL_P(1-\tau_S)(1-\tau_Y)$$

$$\Rightarrow \frac{\beta(1-\gamma)}{L_G} = \frac{\alpha(1-\tau_S)(1-\tau_Y)}{L_P}$$

Therefore, $$\frac{L_G^{PC}}{\overline{L}} = \frac{\beta.(1-\gamma)}{\beta(1-\gamma) + \alpha(1-\tau_S)(1-\tau_Y)} = \frac{\beta.(1-\gamma)}{\beta(1-\gamma) + \alpha(1-\tau_S-\theta)} \quad (1.8)$$

and $$\frac{L_P^{PC}}{\overline{L}} = \frac{\alpha(1-\tau_S-\theta)}{\beta(1-\gamma)+\alpha(1-\tau_S)(1-\tau_Y)} = \frac{\alpha(1-\tau_S-\theta)}{\beta(1-\gamma)+\alpha(1-\tau_S-\theta)} \quad (1.9)$$

Similarly capital will be produced at a point where:

$$\frac{\partial\Psi}{\partial\widetilde{G}} = VMP\widetilde{G} - VMPK_P(1-\tau_S)(1-\tau_Y) = 0$$

$$\Rightarrow \frac{\beta.\gamma}{\widetilde{G}} = \frac{\alpha.(1-\tau_S)(1-\tau_Y)}{K_P}$$

Therefore, $$\frac{\widetilde{G}^{PC}}{\overline{K}} = \frac{\beta.\gamma}{\beta.\gamma+\alpha(1-\tau_S)(1-\tau_Y)} = \frac{\beta.\gamma}{\beta.\gamma+\alpha(1-\tau_S-\theta)} \quad (1.10)$$

Thus,

$$\frac{\widetilde{G}_{SP}{}^{PC}}{\overline{K}} = (1-\lambda).\left(\frac{\beta.\gamma}{\beta.\gamma+\alpha(1-\tau_S)(1-\tau_Y)}\right) = (1-\lambda).\left(\frac{\beta.\gamma}{\beta.\gamma+\alpha(1-\tau_S-\theta)}\right) \quad (1.10)^{/}$$

and

$$\frac{K_P^{PC}}{\overline{K}} = \frac{\alpha(1-\tau_S)(1-\tau_Y)}{\beta.\gamma+\alpha(1-\tau_S)(1-\tau_Y)} = \frac{\alpha(1-\tau_S-\theta)}{\beta.\gamma+\alpha(1-\tau_S-\theta)} \quad (1.11)$$

The only difference between the two sets of allocation principles is the constant, 2, that appears in (4) through (7) but is absent in (8) through (11). Any deviation from the perfectly competitive benchmark implies allocative inefficiency due to decentralization. The relative resource usage rate thus depends on the estimated values of $\alpha, \beta, \gamma, \tau_S, \tau_Y$ and the degree of allocative efficiency due to decentralization.

Comparative Static Impact of Parameters on Optimum Social Planner Allocation

	$\beta\gamma$	α	$\beta(1-\gamma)$	$(1-\alpha-\beta)$
$\widetilde{G}^{SP}$	+	-		
$K_P{}^{SP}$	-	+		
$L_G{}^{SP}$			+	-
L_P^{SP}			-	+

Note: $\beta\gamma = \left(\frac{\partial Y/Y}{\partial K_G/K_G}\right).\left(\frac{\partial K_G/K_G}{\partial\widetilde{G}/\widetilde{G}}\right) = \left(\frac{\partial Y/Y}{\partial\widetilde{G}/\widetilde{G}}\right)$ $\quad \alpha = \left(\frac{\partial Y/Y}{\partial K_P/K_P}\right)$

$\beta(1-\gamma) = \left(\frac{\partial Y/Y}{\partial K_G/K_G}\right).\left(\frac{\partial K_G/K_G}{\partial L_G/L_G}\right) = \left(\frac{\partial Y/Y}{\partial L_G/L_G}\right)$ $\quad (1-\alpha-\beta) = \left(\frac{\partial Y/Y}{\partial L_P/L_P}\right)$

On the basis of estimated coefficients, $\beta\gamma$ and $\beta(1-\gamma)$, how efficiently a state should utilize society's available resources can easily be predicted though actual resource utilization rate may differ from this. To find the comparative static impact of parameters on social planner's optimum allocation rates we have assumed that tax rate τ_S, τ_Y as given.

Thus optimum allocation of resources depends on central transfer rate, θ as well as the centre's contribution in total private input used by the public sector, that is, λ .

Optimum Production of Public Capital in Three Different Cases:

***(I)Decentralised Agents' Case*:**

In our model objective of the decentralised agents is to produce K_G at a level where premium received by them is maximum. Thus they will try to

Maximize

$$\Psi = P_{K_G}.K_G - \left(\frac{\beta - \tau_S - \theta}{\beta}\right)\left[\frac{(1-\tau).w^{1-\gamma}.r^{\gamma}}{B.\gamma^{\gamma}.(1-\gamma)^{1-\gamma}}\right].K_G - \left(\frac{\tau_S + \theta}{\beta}\right).\left[\frac{(1-\tau).w^{1-\gamma}.r^{\gamma}}{B.\gamma^{\gamma}.(1-\gamma)^{1-\gamma}}\right].K_G \quad \text{(a1)}$$

Thus the optimum amount of public capital produced by the decentralised agents will be achieved by equating

$$MR_{K_G} = MC'_{K_G} = \left(\frac{\beta - \tau_S - \theta}{\beta}\right)\left[\frac{(1-\tau).w^{1-\gamma}.r^{\gamma}}{B.\gamma^{\gamma}.(1-\gamma)^{1-\gamma}}\right] \quad \text{(a2)}$$

Since subsidy part that is, $\left(\frac{\tau_S + \theta}{\beta}\right).\left[\frac{(1-\tau).w^{1-\gamma}.r^{\gamma}}{B.\gamma^{\gamma}.(1-\gamma)^{1-\gamma}}\right].K_G$ is given to the decentralised agents and they cannot control this part so to decide optimum production they will equate only $MR_{K_G} = MC'_{K_G}$ and last part of equation (a1) will be kept constant.

In fig (i) it is observed that premium will be maximum if decentralised agents produce K_g^*. The user fee charged will be then $P_{K_G}^*$.

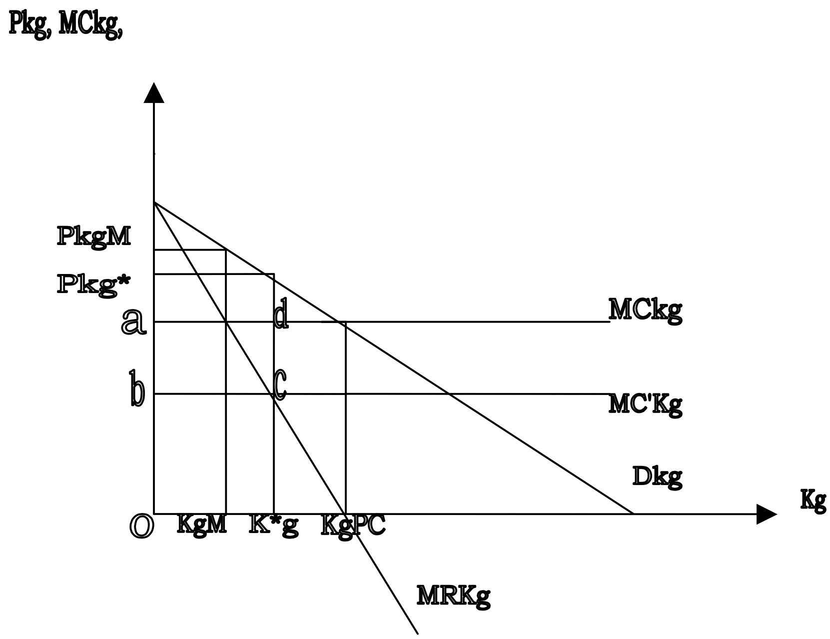
(II) Social Planner's Case

If decentralised agents do not exploit its monopoly power and behave like a social planner that is no user fee is charged over and above taxes then entire cost must be financed by exogenous transfers received from various levels of governments. The decentralised agent's model boils down to the social planner model. The Objective of the social planner is to minimize premium earned by the decentralised agents. So they will try to set tax rates in such a way that premium is zero. If $\tau_S = \beta - \theta$, then $MC'_{K_G} = 0$. In this case entire cost is financed by exogenous tax, grants and loans transfer and then output will produced at a point where D_{K_G} curve intersects the MC_{K_G} curve. In this case $\Psi = 0$ thus no premium is earned over and above taxes.

(III) Monopoly Case

If no exogenous transfers are received by the decentralised agents then the term $\frac{\tau_S + \theta}{\beta}$ disappears from the above equations (a1) and (a2). That is here we assume that governments do not transfer any amount to the decentralised agents and allowed them to behave like a monopolist and then they will produce output by equating $MR_{K_G} = MC_{K_G}$.

In Fig(i) D_{kg} and MR_{Kg} represent the demand for public capital and the corresponding marginal revenue curve respectively. MC_{Kg} is the marginal cost of producing public capital and MC'_{K_G} is the marginal cost net of subsidy. The decentralised agents will produce output by equating marginal revenue to marginal cost of producing public capital thus when there is no subsidy then OKgM amount of public capital will be produced and OPkM price will be charged. If total cost is partly subsidised by the taxes, grants and loans then OK*g units of public capital will be produced and user fee will be OPkg*. Here, area abcd = cost subsidised by tax, grants and loans transfer. If transfers finance entire cost then OKpc will be produced and no price will be charged.



Fig(i)

Growth Rate in a Decentralised Frame Work

We will now describe the analytical solution of the model just described above. In our model there are two separable agents public and private. We assume that they have identical preferences. The agents maximize welfare, which is a function of consumption per worker. Upper case characters represent levels and lower case represents per capita values. n is exogenous growth rate of population.

$$\text{Max}\, W = \int_{t=0}^{\infty}\left[U\left(\frac{C_{Gt}}{L_{Gt}}\right).L_{Gt} + U\left(\frac{C_{Pt}}{L_{Pt}}\right).L_{Pt}\right].e^{-\rho t}dt = \int_{t=0}^{\infty}\left[\frac{\left(\frac{C_{Gt}}{L_{Gt}}\right)^{1-\sigma}}{1-\sigma}.L_{Gt} + \frac{\left(\frac{C_{Pt}}{L_{Pt}}\right)^{1-\sigma}}{1-\sigma}.L_{Pt}\right].e^{-\rho t}.dt\,.$$

$$= \int_{t=0}^{\infty}\left[\frac{\left(\frac{C_{Gt}}{L_{Gt}}\right)^{1-\sigma}}{1-\sigma}.L_{Gt} + \frac{\left(\frac{C_{Pt}}{L_{Pt}}\right)^{1-\sigma}}{1-\sigma}.L_{Pt}\right].e^{-\rho t}.dt \qquad = \int_{t=0}^{\infty}\left[\frac{\left(c_{gt}\right)^{1-\sigma}}{1-\sigma}.L_{G0}.e^{nt} + \frac{\left(c_{pt}\right)^{1-\sigma}}{1-\sigma}L_{P0}.e^{nt}\right].e^{-\rho t}.dt$$

$$= \int_{t=0}^{\infty}\left(\left(\frac{c_{gt}^{1-\sigma}}{1-\sigma}\right).L_{G0} + \left(\frac{c_{pt}^{1-\sigma}}{1-\sigma}\right).L_{P0}\right)e^{[n-\rho]t}dt$$

(1.12)

$$= L_0\int_{0}^{\infty}\left[\frac{c_{gt}^{1-\sigma}}{1-\sigma}z_L + \frac{c_{pt}^{1-\sigma}}{1-\sigma}(1-z_L)\right]e^{-[\rho-n]t}dt$$

where $c_{gt} = \frac{C_{Gt}}{L_{Gt}}$ and $c_{pt} = \frac{C_{Pt}}{L_{Pt}}$, $z_L = \frac{L_{Gt}}{L_t}$, $(1-z_L) = \frac{L_{Pt}}{L_t}$, The subscript 'p' represents representative private firm who produces output and sells that to the whole economy. Income of the private sector comes from wages, rental income and sell of output to the whole economy. We assume that Y_P is the value added by the private sector then

$$Y_P = Y(1-\tau_S) - P_{K_G}.K_G$$

Since Y_P is the sum of factor income that is, wage and rental income of labour and capital employed in the private sector. But this does not include the rental income earned from the sell of private capital to the public sector. The disposable income is the personal income less of taxes. A part of after tax income of the private sector goes to consume goods and remaining part of it is saved. Thus,

$$Y_{pt}(1-\tau_Y) - P_{K_G}.K_{G_t} + r(1-\tau_Y)\widetilde{G}_t = C_{Pt} + S_{Pt}$$

$$Y_t(1-\tau_S)(1-\tau_Y) - (1-\tau_Y)P_{K_G}.K_{G_t} + r(1-\tau_Y)\widetilde{G} = C_{Pt} + S_{Pt} \tag{1.13a}$$

here τ_S, τ_Y rate of taxes on final output and factor income respectively, P_Y is the price of consumption good which is assumed to be equal to one (normality assumption).

or $$\left(y_t(1-\tau_S) + \frac{r_t\widetilde{g}_t}{B_L}\right)(1-\tau_Y) - (1-\tau_Y)P_{kt}.K_G = c_{pt} + s_{pt} \tag{1.13b}$$

where, $$y_t = \frac{Y_t}{L_{pt}} = A_t k_{pt}^{\alpha}\left(\frac{k_{gt}}{B_L}\right)^{\beta} \text{ and } B_L = \frac{(1-z_L)}{z_L} \tag{1.14}$$

Therefore $$s_{pt} = \left(y_t(1-\tau_S) + \frac{r_t\widetilde{g}_t}{B_L}\right)(1-\tau_Y) - (1-\tau_Y)P_{kt}K_{Gt} - c_{pt} \tag{1.13c}$$

The representative public agent is denoted by subscript 'g'. The public agents' total income comprise of wage income and the extra premium that they can get. Total income is again either goes to finance consumption expenditure or it is saved. Thus,

$$\Psi_t + w_t(1-\tau_Y)L_{Gt} = C_{Gt} + S_{Gt} \tag{1.15a}$$

or $$\psi_t + w_t(1-\tau_Y) = c_{gt} + s_{gt} \tag{1.15b}$$

where , $\Psi = P_{K_G}.K_{Gt} - w_t.L_{Gt} - r_t.\widetilde{G}_t$

where, $K_{Gt} = B_t\widetilde{G}_t^{\gamma}L_{Gt}^{1-\gamma} + \dfrac{\tau_S + \theta}{\beta}K_{Gt} = \dfrac{\beta}{\beta - \tau_S - \theta}B_t.\widetilde{G}_t^{\gamma}L_{Gt}^{1-\gamma}$

or, $$\psi_t = \frac{\Psi_t}{L_{Gt}} = B_L P_{kt}k_{gt} - w_t - r_t.\widetilde{g}_t \tag{1.16}$$

and, $$k_{gt} = \frac{K_{Gt}}{L_{Gt}} = \frac{\beta}{\beta - \tau_S - \theta}.B_t\widetilde{g}_t^{\gamma} \tag{1.17}$$

Therefore equation (1.15b) may be rewritten as $s_{gt} = \psi_t + w_t.(1-\tau_Y) - c_{gt} = B_L P_{kt}k_{gt} - r_t.\widetilde{g}_t - c_{gt}$ (1.15a)

The two representative agents independently choose consumption and consequent saving to maximize their independent optimal consumption paths. Capital evolves as a result of sum total of savings.

$$\dot{K}_t = S_{Pt} + S_{Gt} \tag{1.18}$$

Since $k = \dfrac{K}{L}$, Therefore, $\dot{k}_t = \dfrac{\dot{K}_t}{L_t} - k_t.\dfrac{\dot{L}_t.}{L_t}$ $\Rightarrow \dot{k}_t = \dfrac{S_{Gt} + S_{Pt}}{L_t} - \dfrac{\dot{L}_t}{L_t}.k_t$

$$\Rightarrow \dot{k}_t = \frac{\left(\frac{S_{Gt}}{L_{Gt}}\right).L_{Gt}}{L_t} + \frac{\left(\frac{S_{Pt}}{L_{Pt}}\right).L_{Pt}}{L_t} - n.k_t \quad \Rightarrow \dot{k}_t = s_{gt}.z_L + s_{Pt}.(1 - z_L) - n.k_t \tag{1.19}$$

Incorporating (1.13a) and (1.15a) in (1.19) we get

$$\dot{k}_t = \{y_t(1-\tau_s)(1-\tau_Y) - (1-\tau_Y).P_{k_G}K_{Gt} + r_t\frac{\tilde{g}_t}{B_L}(1-\tau_Y) - P_{yt}c_{pt}\}(1-z_L) + \{\psi_t + w_t(1-\tau_Y)L_{Gt} - P_{yt}c_{gt}\}z_L - nk_t \tag{1.19'}$$

Total labour in the economy is sum of labour employed in the public sector and in the private sector. We assume that labour grows at an exogenous rate of growth of population, n. This can be summarized as follows:

$$L_t = L_{Pt} + L_{Gt} \tag{1.20}$$

$$L_t = L(0)e^{nt} \tag{1.21}$$

The growth rate of consumption per capita for either agent defined by the modified golden rule is obtained from the maximization of the following Hamiltonian function[5] as

$$H = u(c_g) + u(c_p) + \mu_1.[\dot{k}] + \mu_2.[k - k_p(1 - z_L) - \tilde{g}(z_L)]$$

$$\frac{\partial H}{\partial c_p} = \frac{\partial u(c_p)}{\partial c_p} - \mu_1.P_y.(1 - z_L) = 0 \Rightarrow \frac{\dot{c}_p}{c_p} = \frac{-1}{\sigma}\left(\frac{\dot{\mu}_1}{\mu_1}\right) \tag{1.22}$$

$$\frac{\partial H}{\partial c_g} = \frac{\partial u(c_g)}{\partial c_g} - \mu_1.P_y.(z_L) = 0 \Rightarrow \frac{\dot{c}_g}{c_g} = \frac{-1}{\sigma}\left(\frac{\dot{\mu}_1}{\mu_1}\right) \tag{1.23}$$

$$\frac{\partial H}{\partial k} = -\mu_1 n + \mu_2 = -\mu_1[n - \rho] - \dot{\mu}_1 \Rightarrow \frac{\mu_2}{\mu_1} = \rho - \frac{\dot{\mu}_1}{\mu_1} \tag{1.24}$$

$$\frac{\partial H}{\partial \tilde{g}} = \mu_1.\frac{\partial \psi}{\partial \tilde{g}} z_L - \mu_2.z_L = 0 \Rightarrow \frac{\mu_2}{\mu_1} = \frac{B_L\beta.\gamma.y}{\tilde{g}} - r \tag{1.25}$$ [6]

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[5] μ_1 and μ_2 are associated with a dynamic constraint and a static constraint that should me maintained in each period respectively.

[6] The decentralised agents don't control the interest income of the private sector, so here it is assumed that $r.(1-\tau_Y).\dfrac{\tilde{g}}{B_L}$ that appears in the private saving function is constant for the decntralised agents. Same interpretation is applicable for the term $(1-\tau_Y)P_{k_G}.K_G$

$$\frac{\partial H}{\partial k_p} = \mu_1 \frac{\partial y}{\partial k_p}(1-\tau_S)(1-\tau_Y) - (1-z_L) - \mu_2.(1-z_L) = 0$$

$$\Rightarrow \frac{\mu_2}{\mu_1} = \frac{\partial y}{\partial k_p}(1-\tau_S)(1-\tau_Y) = \frac{\partial y}{\partial k_p}\left((1-\tau_S)-(1-\tau_S)\tau_Y\right) = \frac{\partial y}{\partial k_p}\left((1-\tau_S)-\theta\right) \quad (1.26)$$

$$\frac{\partial H}{\partial \mu_2} = k - (1-z_L).k_P - z_L.\tilde{g} \quad (1.27)$$

Growth:

$$\frac{\mu_2}{\mu_1} = \frac{\partial \psi}{\partial \tilde{g}} = \frac{\partial y}{\partial k_p}(1-\tau_S-\theta) = \rho - \frac{\dot{\mu}_1}{\mu_1}$$

Therefore, the growth rate of consumption per worker for either agent is defined as follows:

$$\xi = \frac{\dot{c}_p}{c_p} = \frac{\dot{c}_g}{c_g} = \frac{1}{\sigma}\left[\frac{\partial y}{\partial k_P}(1-\tau_S-\theta)-\rho\right] = \frac{1}{\sigma}\left[\frac{B_L\beta.\gamma.y}{\tilde{g}} - r - \rho\right] \quad (1.28)$$

$$= \frac{1}{\sigma}\left[\frac{(1-\lambda).B_L.\beta.\gamma.y.}{\tilde{g}_{SP}} - r - \rho\right] \quad (1.28)^{/}$$

The growth rate of consumption per worker and thus the growth rate of output per worker is determined crucially by the public productive spending which in turn is determined by state state's own spending policy and share of grants in total state's private input. The less developed states are supposed to be more dependent on centre's grants than the developed states and thus the value of λ in the poorer state is expected to be high. Since λ appears in $(1.28)^{/}$ with a negative sign therefore we can say that value of λ will decline as we move from slowest to fastest growing states.

The dynamic adjustment process may be summarized as follows:

From equation (1.2b) it follows that

$$\frac{\dot{K}_G}{K_G} = \gamma \frac{\dot{\tilde{G}}}{\tilde{G}} + (1-\gamma)\frac{\dot{L}_G}{L_G} + \frac{\dot{B}}{B} \quad (1.29)$$

$$\Rightarrow \frac{\dot{k}_g}{k_g} = \gamma \frac{\dot{\tilde{g}}}{\tilde{g}} + \chi$$

We assume that technology grows at a constant rate χ .

From equation (1.1a) it follows that

$$\frac{\dot{Y}}{Y} = \alpha \frac{\dot{K}_P}{K_P} + \beta \frac{\dot{K}_G}{K_G} + (1-\alpha-\beta)\frac{\dot{L}_P}{L_P} + \frac{\dot{A}}{A} \quad (1.30)'$$

$$= \alpha \frac{\dot{K}_P}{K_P} + \beta.\gamma.\frac{\dot{\tilde{G}}}{\tilde{G}} + \beta(1-\gamma).\frac{\dot{L}_G}{L_G} + \beta.\frac{\dot{B}}{B} + (1-\alpha-\beta).\frac{\dot{L}_P}{L_P} + \frac{\dot{A}}{A}$$

$$= (\alpha + \beta\gamma)\frac{\dot{K}}{K} + (1-\alpha-\beta\gamma).n + (1+\beta).\chi \tag{1.30'}$$

where, $\frac{\dot{L}_P}{L_P} = \frac{\dot{L}_G}{L_G} = \frac{\dot{L}}{L} = n$, $\frac{\dot{B}}{B} = \frac{\dot{A}}{A} = \chi$ and $\frac{\dot{K}_P}{K_P} = \frac{\dot{\tilde{G}}}{\tilde{G}} = \frac{\dot{K}}{K}$

From equation (1.14) it follows that

$$\frac{\dot{y}}{y} = \alpha\frac{\dot{k}_p}{k_p} + \beta\frac{\dot{k}_g}{k_g} + \frac{\dot{A}}{A} = (\alpha + \beta\gamma)\frac{\dot{k}}{k} + \chi \tag{1.31}$$

At Steady State:

$$\frac{\dot{\Psi}}{\Psi} = \frac{\dot{Y}}{Y} = \frac{\dot{y}}{y} + n + \chi \quad \Rightarrow \quad \frac{\dot{\psi}}{\psi} = \frac{\dot{y}}{y} \tag{1.32}$$

$$\frac{\dot{K}}{K} = \xi + n \tag{1.33}$$

$$\frac{\dot{k}}{k} = \left[\frac{\dot{k}_p}{k_p}.\frac{k_p}{k}(1-z_L) + \frac{\dot{\tilde{g}}}{\tilde{g}}.\frac{\tilde{g}}{k}z_L\right] = \xi\left[\frac{k_p}{k}(1-z_L) + \frac{\tilde{g}}{k}z_L\right] \tag{1.34}$$

$$\frac{\dot{k}}{k} = \frac{\dot{k}_p}{k_p} = \frac{\dot{\tilde{g}}}{\tilde{g}} = \xi \qquad \text{since} \qquad \frac{k_p}{k}(1-z_L) + \frac{\tilde{g}}{k}z_L = 1 \tag{1.34'}$$

Per capita growth:

$$\frac{\dot{c}_{it}}{c_{it}} = \frac{\dot{k}_{pt}}{k_{pt}} = \frac{\dot{\tilde{g}}}{\tilde{g}} = \frac{\dot{k}_t}{k_t} = \xi\ ,$$

$$\frac{\dot{y}_t}{y_t} = \frac{\dot{\psi}_t}{\psi_t} = \xi(\alpha + \beta\gamma) + \chi \tag{1.35}$$

$$\frac{\dot{k}_g}{k_g} = \xi\gamma + \chi$$

<u>Comparative Static Impact of Parameters on Growth</u>

	α	$(1-\alpha-\beta)$	β	γ	$(1-\gamma)$
$\hat{Y}$	+	+	+		
$\hat{K}_G$				+	+

The rate growth of output is the sum of the rate of growth of inputs multiplied by their respective output elasticity of inputs and exogenous rate of growth of technology (equation (1.30)) and the rate growth of public capital is the sum of rate of growth of private capital in public capital production, rate of growth of public labour, rate of growth of technology (equation (1.29)). Thus growth rate of final output as well as rate of growth of public capital not only depends on the elasticity values but also on the rate of growth of inputs. Thus states with same elasticity value may have different growth due to difference in growth of inputs.

The comparative static impact of parameters on growth of output shows that

(i) States with same rate of growth public and private capital but different elasticity coefficients may or may not have different rates of growth of y.
(ii) States with same elasticity values but different rates of growth of inputs may or may not have different rates of growth of y.
(iii) States with same rates of growth of inputs in the public sector but different elasticity values will have different rates of growth of public capital.
(iv) States with more equal elasticity values may have higher actual growth of output than states with unequal elasticity values depending on actual rates of growth of inputs.
(v) The rate growth of public capital is the sum of rate of growth of private capital in public capital production, rate of growth of public labour, rate of growth of technology.

The theoretical model predicts that public productive spending and thus public capital is a crucial determinant of economic growth in a state. The combined policy of the centre and the state government to spend on building productive capacity in a state affects the output growth via its impact on the level of public capital stock in the state. It also predicts that proportion of grants to total private input used by the state public sector affects the growth rate of output. It also helps to predict whether any allocative inefficiency exists or not. In the context of India, which is the case in point here, matching grants component affects the optimum allocation of private capital in the public sector as well as growth of SDP directly. The transfer by the central government can affect growth via the constant θ .

(II) ***The Empirical Analysis of the Growth Rates***

This section provides the empirical estimates of the coefficient within the model. To study the growth performance at the individual state levels our empirical analyses concentrates on four states in India. We have taken the sample of four states, Gujarat, Maharashtra, Tamil Nadu and West Bengal, on the basis of available data and also because we wanted to compare the growth performance of West Bengal with the states that have performed better than West Bengal. Our analysis covers the time period from 1981 to 2000, and thereby contains a very limited amount of time series variation.

Data

This section summarizes the data used in this study. In this paper we consider the period 1981 to 2000, using data on four states of India. The output data used are state gross domestic product (GDP) in constant (1993-94 rupees) prices, derived from current price data on state GDP, deflated by the state gross state domestic product (GSDP) deflator, base year 1993-94.The state-based measures of GDP are analogous of national gross domestic product- they measure income originating from factors of production physically located within the boundaries of each state, and represent the value of goods and services produced within the state. The state GDP data are taken from ***"Domestic product of States of India 1960-61 to 2000-01" compiled and published by Economic and Political Weekly Research Foundation (2003).*** One point should be made regarding the output data. In our theoretical model we have assumed that there are two sectors public and private, the public sector produces public capital and private sector uses that public capital as an input and produces society's consumable commodity i.e., final good. The division of public and private sector output is not available for the states in India. So we have estimated equation (2.1) in order to estimate the elasticity of output with respect to public capital and private capital used by the private sector.

"Statistical Abstract" published by MoSPI, Government of India provides sector wise state wise public organized sector employment. These figures are taken as state level public sector employment data. The method of simple interpolation is used to fill up the gaps in data series. The missing years are 1982, 1983, 1985, 1986, 1988, 1989, 1990, 1991, 1992, 1993, 1994 and 2000. To find the private sector employment two steps are followed.

First, the state wise work force population ratios are calculated from different ***NSSO rounds***. 1990-91, 1994-95, 1997, 1999-00 figures were available. These figures were used to find the employment figures of the missing years in the period 1981-00. Second, the public sector employment data are subtracted from total work force figures to find year wise private sector employment in a state.

Estimates of gross fixed capital formation (GFCF) in the public sector at the state level in constant

(1993-94 rupees) prices are derived ***from "Domestic Product of States of India 1960-61 to 2000-01***", ***First Edition, and June 2003, published by EPW Research Foundation.*** Again we have used the method of interpolation to find the missing data. The years for which we could not find data on GFCF in the public sector differs from state to state. For Maharashtra data for all the years are available. For Gujarat missing years are 1988, 1989, 1999 and 2000. In Tamil Nadu data for four consecutive years from 1989 to 1992 are not available. For West Bengal three years (1981, 1986 and 1987) data are not available. Gujarat and West Bengal's data represents GFCF by the state public sector whereas Maharashtra and Tamil Nadu's data corresponds to GFCF by the state as well as the central public sector of these two states. *It should also be mentioned here that GFCF in the public sector of Gujarat and West Bengal represents GFCF in state sector (government administration and departmental enterprises) where as Mharashtra and Tamil Nadu's figures measures GFCF by both state and central government administration and departmental enterprises in that state.*

Sum of Loans given by All Financial Institutions (AFIs) and the first difference of outstanding ***credit disbursed by the scheduled commercial banks (SCBs)*** are taken as a proxy for private investment. External finance is more than 80 percent of investment by the private sector for India. Out of this, the share capital is a smaller share –at least for the period of consideration this is the reason why we have taken combined loans given by AFIs and SCBs as the proxy for private investment. Missing data are calculated using the method of interpolation.

As public and private capital stock figures at the state level in India are not available we have used public investment and private investment as a measure of public capital and private capital respectively.

Plan capital expenditure by the government is taken as proxy for public productive spending. We assume that public capital expenditure on plan account goes to purchase capital from the private sector. Now it is shown theoretically that only matching grants goes to form $\widetilde{G}$. Thus $\widetilde{G}$ is estimated by subtracting real state plan grants and loans from real total plan capital expenditure and adding real plan grants by different central ministries. So $\widetilde{G}$ is the combined real spending on purchasing private capital. The real plan spending is thus taken as a proxy for private capital used in the production of public capital.

<u>Central and State Transfer Mechanism in India:</u>

The central government transfers resources on state plan, central plan and centrally sponsored schemes. The planning commission transfers funds on state plan account directly to the state and via different central ministries other two types of transfers are given to the states (this is indirect transfer by the planning commission).

Total productive spending by the state, that is, private capital used in public capital production ($\widetilde{G}$ in our model) is defined as follows:

$$\widetilde{G} = \widetilde{G}_{SP} + \lambda \widetilde{G}$$

=State own plan spending ($\widetilde{G}_{SP}$)+ Central ministries' Transfer($\widetilde{\widetilde{G}}_{CP} = \lambda \widetilde{G}$)

In case of India since centre ministries grants and loans transfer expect a matching contribution from state whereas state plan grants and loans do not have any matching component therefore in our empirical analysis we have used the grants and loans given by central ministries to compute λ and state plan grants and loans along with share in central taxes to compute θ .

<u>Variables</u>

Y=SDP at Constant (1993-94) Prices,

I_P=Loans given by AFIS at Constant and Credit disbursed by Schedule commercial banks (1993-94) Prices (proxy for K_P),

I_G = Gross Fixed Capital Formation at Constant (1993-94) Prices (proxy for K_G),

L_P = Private Sector Employment,

L_G = Public Sector Employment,

$\widetilde{G}$ = Total Plan Capital Expenditure + Grants in aid received from the central Ministries at Constant (1993-94) Prices]

Thus to estimate the coefficients within the model we apply simple liner regression technique to the following two equations:

(2.1) $$\ln\left(\frac{GSDP}{L_P}\right) = A_1 + \beta \ln\left(\frac{I_G}{L_P}\right) + \alpha \ln\left(\frac{I_P}{L_P}\right) + u$$

(2.2) $$\ln\left(\frac{I_G}{\tilde{G}}\right) = A_2 + \delta . \ln\left(\frac{L_G}{\tilde{G}}\right) + u \qquad \text{where } \delta = 1-\gamma$$

Here β, α and δ measure the elasticity of output with respect to public capital (K_G), private capital (K_P), private labour (L_P) and elasticity of public capital with respect to labour emoloyed in the public sector (L_G).

To avoid the problem of multicollinearity we have assumed that CRS exists and thus taken the form specified above. Equation (2.1) measures the change in average productivity of labour in the private sector for change in private capital to labour ratio and public capital to labour ratio. Equation (2.2) measures how the average productivity of productive input in the public sector changes with the change in labour capital ratio in the public sector. As we have already assumed CRS exists to avoid multicollinearity problem the remaining coefficients are calculated by subtracting the other estimated coefficients from one in each model.

Regression Results:

The regression results of equation (2.1) and (2.2) are presented in appendix Table A1 and Table A2. The results indicate that multicollinearity problem does not exist in any of the model. The problem autocorrelation exist in regression model (2.2) in Gujarat. In other states for both the regression models (2.1) and (2.2) either Durbin –Watson test statistic fall in the inconclusive region or no auto correlation region. The constant term and α are significant in all the four states considered. β is significant only in Maharashtra and Tamil Nadu but insignificant in Gujarat and West Bengal. Though β is not significant in Gujarat and West Bengal, the joint influence of per private labour public capital and private capital is significant in all the four states considered.

Comparative Study of Elasticity:

1. ***Elasticity of GSDP With Respect to Public Capital:***

The column 2 of table 4 shows that the estimated coefficient is statistically significant for Maharashtra and Tamil Nadu but insignificant for Gujarat and West Bengal. Thus our regression fails to detect significant effects of public capital on growth in case of Gujarat and West Bengal. The elasticity of GSDP with respect to public capital is highest in Tamil Nadu followed by Maharashtra, Gujarat and West Bengal. One of the possibilities of the low value of β in these two states is that the quality of public capital is not so good in these two states.

Table 1: Estimated Elasticity Values of Public & the Private Sector[7]

State	α	β	$(1-\alpha-\beta)$	γ[8]	δ
Gujarat	0.356	0.110#	0.534	0.137	0.863
Maharashtra	0.212	0.415	0.373	0.397	0.603
Tamil Nadu	0.371	0.430	0.199	0.291	0.709
West Bengal	0.350	0.093#	0.557	0.343	0.657

Note: α=Elasticity of SDP with respect to Private capital, β =Elasticity of SDP with respect to Public Capital, $(1-\alpha-\beta)$ =Elasticity of SDP with respect to Private Labour, γ =Elasticity of Public Capital with Respect to Private Capital Used in Public Capital Production ($\tilde{G}$), δ =Elasticity of Public Capital with respect to Public Labour,
 # insignificant at least at 10% level of significance

[7] Assuming that CRS exists the rest of the coefficients are estimated by subtracting estimated values from one, thus it can only be said that (1-α-β) and γ not equal to one but it cannot be said whether they are equal to zero or not.

[8] γ=1-δ

Insignificant at least at 90 percent level of confidence.

2. ***Elasticity of GSDP With Respect to Private Capital:***

Column (1) of Table 1 shows that elasticity of GSDP with respect to private capital is again highest in Tamil Nadu followed by Gujarat, West Bengal and Maharashtra and these elasticity values are statistically significant in all the four states considered.

3. ***Comparison of elasticity of GSDP with respect to Public and Private capital:***

Table 4 reflects that in Tamil Nadu both public and private capital is very elastic whereas in Maharashtra though elasticity of output with respect to public capital is very high, 0.415 the elasticity with respect to private capital is 0.212, which is fourth in ranking among the four states considered. Thus we see that in the fastest growing state, Maharashtra, public capital is playing crucial role compared to the private capital in growth performance of that state. But in Gujarat[9] and West Bengal the effect of private capital on growth is much higher than public capital. Again elasticity of public capital is insignificant and that of private capital is significant in these two states. The elasticity of output with respect to private capital in Gujarat and West Bengal are more or less same, 0.356 and 0.350 respectively. Thus given the other factors the differences in growth rates of GSDP in Gujarat and West Bengal can be partially explained by difference in growth of private capital.

4. ***Elasticity of GSDP with respect to Private labour:***

Output elasticity of private labour is highest in West Bengal followed by Gujarat, Maharashtra and Tamil Nadu.

<u>Impact of Private capital used by the Public Sector and Public Labour on Public Capital</u>

Equation (2.2) indicates that δ measures for one percent change in labour –capital ratio in the public sector how much average productivity of capital used to produce public capital changes. We observe that δ varies from .863 in Gujarat to .603 in Maharashtra. The labour-capital ratio has shown a negative growth over the period in all the four states considered. This negative growth is highest in Gujarat and lowest in West Bengal. Thus diminishing return to real plan spending operates in al the four states. The fall in average productivity is greatest in Gujarat followed by Tamil Nadu, Maharashtra and West Bengal. Though the average rate of growth of G is almost same in Maharashtra, Gujarat and Tamil Nadu (10.9%, 10.9% and 12.1% respectively), the value of γ is higher in Maharashtra than Tamil Nadu followed by Gujarat (see TableA3). The possible explanation is that the compositional difference in public spending causing such a differential value of γ. As a result the same kind of growth of G is leading towards higher growth of public capital in Maharashtra than in Gujarat. One of the possibilities is that though high growth of real plan spending signifies state's initiative to build up new capacity but it may have occurred at the expense of maintenance expenditure. As a result even with highest growth of real productive spending, the growth of pubic capital is not so high and thus growth of public capital to private labour is negative in Gujarat. The growth of real productive spending in West Bengal is lower than other states thus instead of second highest elasticity of public capital with respect to real plan spending, the rate of growth of public capital to private labour is lowest. The rate of growth of public capital to private labour ratio is negative and insignificant in West Bengal. One of the reasons behind this is that the growth of new capital is lower and another possibility may be the quality of public capital has deteriorated over time due to lower maintenance expenditure.

State	$\beta\gamma$	α	$\beta(1-\gamma)$	$(1-\alpha-\beta)$
Gujarat	0.015 (4)	0.356 (2)	0.095 (3)	0.534 (2)
Maharashtra	0.165 (1)	0.212 (4)	0.250 (2)	0.373 (3)
Tamil Nadu	0.125 (2)	0.371 (1)	0.305 (1)	0.199 (4)
West Bengal	0.032 (3)	0.350 (3)	0.061 (4)	0.557 (1)

<u>Grants, Loans and Tax Transfer</u>

Our theoretical model shows that growth of output per worker depends negatively on the share of transfer received from different ministries in total budget of the state to purchase productive inputs. Thus the

[9] The second highest growth state over the period 1981-2000

hypothesis is that given the other factors the fastest growing states will have lower value of λ compared to the slow growing states. For empirical purpose we first apply the 3 years moving average method to the actual share of grants, loans and central tax transfer in SDP (θ) and total real expenditure to purchase private inputs (λ). Average of these average values is taken as the value of θ and λ.

Table 2: Average exogenous & endogenous central transfer by & state tax rates: 81-00

State	θ	λ	τ_S
Gujarat	0.0288 (3)	0.0943 (4)	0.0749(2)
Maharashtra	0.0257(4)	0.1157 (3)	0.0745(3)
Tamil Nadu	0.0431(3)	0.2950 (2)	0.0859(1)
West Bengal[10]	0.0433(4)	0.4468 (1)	0.0519(4)

Note: θ=(Average State Plan Transfer (Grants + Loans) + Share in Central Taxes) to GSDP ratio (central transfers)

λ= Average Central Ministries Transfers (Grants + Loans) to Private capital used in Public sector production ($\tilde{G}$) ratio (endogenous transfers)

τ_S=Total State Own Tax to GSDP ratio

Table 2 shows that in all the four states considered average shares of central transfer in SDP varies from 0.0257 in Maharashtra to 0.0433 in West Bengal. It is also observed that states with high growth rate received less average grants as a proportion to SDP compared to the slower growing states. Thus central government tried to reduce regional inequality in growth rate by transferring larger volume of grants to the less developed states. Average rates of state tax also differ from state to state ranging from 8.59 percent in Tamil Nadu to 5.19 percent in West Bengal.

The centrally sponsored schemes and central plan schemes are meant to supplement the resources of the state government who are expected to pay a matching contribution**.** The high value of λ indicates that the state is poor and it can not finance its whole expenditure on own and thus depends more on centre to supplement their resources. We know that states are responsible to implement the centrally sponsored schemes but if the scheme is successful then the credit of successful implementation of that scheme goes mainly to the central government. So the richer states prefer to introduce and implement their own schemes. Thus we observe the low value of λ in Gujarat and Maharashtra.

Optimum Resource Allocation:

Table 3: Comparison of Elasticity Values with Social Planner Optimum Allocation Rates of Capital

State	α	β	γ	$\beta\gamma$	K_P/K	$\tilde{G}/K$
Gujarat	0.356(2)	0.110(3)	0.137(4)	0.0151 (4)	0.9549(1)	0.0451(4)
Maharashtra	0.212(4)	0.415(2)	0.397(1)	0.1648(1)	0.5366(4)	0.4634(1)
Tamil Nadu	0.371(1)	0.430(1)	0.291(3)	0.1251(2)	0.7209(3)	0.2791(2)
West Bengal	0.350(3)	0.093(4)	0.343(2)	0.0319(3)	0.9085(2)	0.0915(3)

Note: α =Elasticity of SDP with respect to Private capital, β =Elasticity of SDP with respect to Public Capital, γ =Elasticity of Public Capital with Respect to Private Capital Used in Public Sector, $\beta\gamma$ = Elasticity of output with respect to private capital used in public sector.

Comparison of estimate values of α and $\beta\gamma$ reveals that in all the four states considered private sector is expected to use private capital more efficiently than public sector. Same capital if employed by

[10] calculations exclude data for the year 1984, 1986 and 1994

the private sector then that increases output by greater percentage than public sector in all the four states considered. Thus it is socially optimum to allocate more capital to the private sector (col. 7 of table 3). Thus social planner's optimum allocation $\tilde{G}/K$ varies in the same way as the change in $\beta\gamma$ over the states. Maharashtra is supposed to utilise private capital more efficiently compared to other states considered (col. 5 of table3).

Table 4: Comparison of Elasticity Values with Social Planner Optimum Allocation Rates of Labour

State	$1-\alpha-\beta$	$1-\gamma$	β	$\beta(1-\gamma)$	L_G/L	L_P/L
	0.534(2)	0.863(1)	0.110(3)	0.0949(3)		0.8345(2)
	0.373(3)	0.603(4)	0.415(2)	0.2502(2)	0.4271(2)	0.5729(3)
Tamil Nadu	0.199(4)	0.709(2)	0.430(1)	0.3049(1)	0.6375(1)	0.3625(4)
West Bengal			0.093(4)	0.0611(4)	0.1081(4)	0.8919(1)

Note: $1-\alpha-\beta$ *=Elasticity of SDP with respect to Private labour,* β *=Elasticity of SDP with respect to Public Capital,* $1-\gamma$ *=Elasticity of Public Capital with Respect to public labour,* $\beta(1-\gamma)$ *= Elasticity of SDP with respect to Public Labour*

Social planner's optimum allocation of public labour, that is, L_G/L moves in the same direction as the movement in β as well as $\beta(1-\gamma)$ over the states. The output elasticity of public labour is lower than private labour in all the three states considered other than Tamil Nadu. Thus it is socially optimum to allocate labour more to the private sector than public sector in Gujarat, Maharashtra and West Bengal and reverse in case of Tamil Nadu. On the basis of estimated coefficients it can be predicted that in case of labour use by the public sector Tamil Nadu performs much better than any other states considered. What happened to actual allocation during the period 1981-00 can be understood by comparing the actual values with the social optimum values.

<u>Comparative Study of Actual Versus Optimum Allocation of Resource</u>

Table 5: Actual $\tilde{G}$ & L_G Compared to Social Planner & Decentralised Agents' Optimum Allocation

	$D_{\tilde{G}} < \tilde{G}^A < SP_{\tilde{G}}$	$D_{\tilde{G}} < SP_{\tilde{G}} < \tilde{G}^A$
$L_G{}^A < D_{L_G} < SP_{L_G}$	MH	GJ, TN
$D_{L_G} < SP_{L_G} < L_G{}^A$		WB

Note: $D_{\tilde{G}}, D_{L_G}$ *= Decentralized agent's optimum allocation of* $\tilde{G}$ *and* L_G

$SP_{\tilde{G}}, SP_{L_G}$ *= Social Planner's optimum allocation of* $\tilde{G}$ *and* L_G

$\tilde{G}^A, L_G{}^A$ *=Actual allocation of* $\tilde{G}$ *and* L_G

1) Actual and Optimum Allocation of L_G

Actual public labour to total labour are 5.48 percent, 6.99 percent, 6.04 percent and 6.63 percent as compared to socially optimum rates of 16.6 percent, 42.7 percent, 63.8 percent and 10.8 percent in Gujarat, Maharashtra, Tamil Nadu and West Bengal respectively. Thus actual public labour allocation rate is lower than the social optimum allocation rate in all the four states considered.

2) Actual and Optimum Allocation of $\tilde{G}$

From the above table 5 it is clear that in Gujarat, Tamil Nadu and West Bengal there are more than optimum allocation of private capital in public capital production ($\tilde{G}$). The public sector in Maharashtra employs private capital more than what a decentralised agents would choose but less than what is socially optimum. It is socially optimum to allocate 4.5 percent, 46.3 percent, 27.9 percent and 9.2 percent of society's available capital stock to the public sector in Gujarat, Maharashtra, Tamil Nadu and West Bengal respectively. But actual allocation rates are 46.3 percent, 35.8 percent, 31.1 percent and 19.3 percent in Gujarat, Maharashtra, Tamil Nadu and West Bengal respectively**.** Thus except Maharashtra, in all the four states considered too much capital is employed in the public sector. Capital allocation rates in the public sector are much higher than what is socially optimal (Appendix Table A4). The appendix Table 6 indicates that to reach socially optimum allocation of $\widetilde{G}$, adjustment required is highest in Gujarat followed by West Bengal, Maharashtra and Tamil Nadu.

This implies that states should reduce its spending to build up new capacity and allocate that amount of resources for the maintenance of existing capacity or hiring labour in the public sector and this will improve the average productivity of real plan spending and thus quality of public capital which in turn will improve the rate of growth of SDP by improving the elasticity value of public capital. *Again given the elasticity values (see equation 1.28) the growth rate of consumption and thus the growth rate of SDP will increase as* $\widetilde{g}$ *falls over time.*

Here it should be mentioned that maintenance expenditure and expenditure on wages and salaries technically come under non-plan head of state expenditure budget in India. In India states often do not shift the maintenance expenditure to the non-plan account after the completion of the plan period because they consider larger plan size as a positive indication of their economic performance. So our high actual values may be the result of that fact and thus overvaluing the real expenditure on purchase of inputs from the private sector. Due to the misinterpretation of non-plan scheme as plan scheme, maintenance expenditure not only faces tight budget but also finds themselves in direct conflict with new schemes in matter of resource allocation. Thus maintenance of existing capacity gets affected lower transfer by the finance commission and limited availability of plan resource.

We cannot exactly say how much inefficiency exists in these states but we can only say that the observed deviation from perfect competitive benchmark is lowest in case of West Bengal compared to other states considered.

Table 6: Resource Usage Rate (1981-00)

	Gujarat	Maharashtra	Tamil Nadu	West Bengal	
$\widetilde{G}$	0.4629	0.3576	0.3114	0.1928	**Actual Allocation**
K_P	0.5371	0.6424	0.6886	0.8072	
L_G	0.0548	0.0699	0.0604	0.0663	
L_P	0.9452	0.9301	0.9396	0.9337	
$\widetilde{G}$	0.0451	0.4634	0.2791	0.0915	**Social Planner's Allocation (premium=0)**
K_P	0.9549	0.5366	0.7209	0.9085	
L_G	0.1655	0.4271	0.6375	0.1081	
L_P	0.8345	0.5729	0.3625	0.8919	
$\widetilde{G}$	0.0230	0.3023	0.1600	0.0480	**Decentralised Agent's Allocation (premium=maximum)**
K_P	0.9769	0.6984	0.8378	0.9520	
L_G	0.0902	0.2716	0.4679	0.0572	
L_P	0.9098	0.7284	0.5321	0.9428	

Estimated Parameters and Rate of Growth of Inputs and Output

Table 7: Estimated Parameters and Rate of Growth of Inputs on Output

	Gujarat	Maharashtra	Tamil Nadu	West Bengal
Gr. Of (Y/LP)	2.79 (3)	3.35 (2)	4.13 (1)	2.75 (4)
Gr. Of (I_G/LP)	-2.14#	1.58	2.65	-.152#
Gr. Of (I_P/LP)	7.30 (2)	8.15 (1)	6.17 (3)	3.84 (4)
Elasticity (Y,Kp)	0.356 (2)	0.212 (4)	0.371 (1)	0.350 (3)
Elasticity (Y,Kg)	0.110# (3)	0.415 (2)	0.430 (1)	0.093# (4)

Growth rates are obtained by fitting exponential trend
 # not significant even at 10% level of significance, For West Bengal calculations excludes data for the year 1984, 1986 and 1994

Growth of output per labour is more dependent on elasticity of output with respect to public capital than output elasticity of private capital. Though output elasticity of private capital is very low in Maharashtra due to high elasticity value of output with respect to public capital and high growth of private capital per labour, the rate of growth of output per worker is high in Maharashtra. One to one correspondence between the ranking of elasticity of public capital and rate of growth of output per private worker is observed for four Indian states. *Thus performance of the public sector in a state is a crucial determinant of growth of average productivity of private labour.*

III. *Conclusions*

A growth model to study the growth performances of the states in India is developed following Barreto (2003) with little modification to fit data and problem of states in a federal country like India. The empirical part of the paper evaluates the effect of public capital on economic growth of four states in India. This paper highlights the role of public productive spending policy on economic growth of the four states in India. We have shown theoretically that growth of SDP depends on how much state decided to purchase private capital which in turn determines the size transfers made by the several government ministries.

The empirical results indicate the importance of public capital on economic growth of a state. We find that the elasticity of SDP with respect to public capital is positive and significant at 95 percent level of confidence in Maharashtra and Tamil Nadu. Thus the benefit of rate of growth of public capital on economic growth is positive and significant in these two states. On the other hand we observe that during the period 1981-2000 public capitals did not play any significant role on economic growth performance of Gujarat and West Bengal.

It is observed that allocative inefficiency in resource allocation is present all the four states considered. It is observed that inefficiency in the allocation of real plan expenditure thus private capital is largest in Gujarat followed by West Bengal, Maharashtra and Tamil Nadu. Inefficiency in allocation of labour is largest in Tamil Nadu followed by Maharashtra, Gujarat and West Bengal. Less than optimum allocation rate of public labour over the period 1981 to 2000 indicates that employment in the public sector is to be increased in all the four states considered**.**

It is suggested that Gujarat, Tamil Nadu and West Bengal should reduce its real plan expenditure in order to achieve higher growth (equation 1.28'). This would increase the average productivity of capital employed by the public sector.

The analysis of impact of resources employed in the public sector on growth of public capital over the period 1981 to 2000 indicates that elasticity with respect to public labour and thus with respect to real plan expenditure differs from state to state. On the basis of the estimates of elasticity of labour and capital in the public and the private sector we have only made comparative study of elasticities in different states but we have not said anything about the reason behind this. For this we need to study the compositional difference in expenditure in different states. The compositional difference in such a spending, that is, how much state spends on maintenance of existing capacity might need to be focused as categories of expenditure are expected to affect growth of public capital differently. But data on how expenditure is disposed among different sub heads such as maintenance, materials etc. are not readily available. So we could not check how the compositional differences in real plan spending are affecting the growth of public capital in the states in India.

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