THE EFFECTS OF TAXES AND PUBLIC INFRASTRUCTURE ON REGIONAL ECONOMIC DEVELOPMENT

by

ABBAS H. MONOFALI

Bachelor of Science
University of Khartoum
Khartoum, Sudan
1980

Master of Science
Texas A&M University
College Station, Texas
1993

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in Partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
May, 1998

THE EFFECTS OF TAXES AND PUBLIC

INFRASTRUCTURE ON REGIONAL

ECONOMIC DEVELOPMENT

Thesis Approved:

Mary A. Marchant

Thesis Adviser

Donald D. Reed

Dr. James R. Fain

Kenneth Olson

Wayne B. Powell

Dean of the Graduate College

ACKNOWLEDGMENTS

I would like to express my appreciation to my major advisor, Dr. Mary N. Gade for her time, intelligent supervision, constructive guidance, inspiration, friendly and sincere advice and encouragement. My sincere appreciation is also to the other members of my committee, Dr. Kent W. Olson, Dr. James R. Fain and Dr. Derrill Peel, whose guidance, assistance and encouragement are also invaluable.

I wish to express my sincere gratitude to Dr. Joseph M. Jadlow for the financial assistantship granted to me during my study program, and the very warm, friendly, great and sincere encouragement and support. I am very grateful to Dr. Keith Willett for his invaluable advice and support. I owe very much thanks and appreciation to Ruby Diamond for her extremely sincere, kind and helpful advice, assistance and encouragement.

I would like to thank Dr. Khoon Koh, Karen Koh, Dr. Amjad Khan and Dr. Massood Saffarian for their care, sincere encouragement and support.

I am very grateful to my mother, for her care, love, patience and encouragement.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Statement of the Problem:

> "The role of public investment in the economy captivated national attention in the early 1990s. Over time, the calls for increased public spending became lost in an increasingly austere budgetary climate. Nonetheless, the issue of the role of the public sector in the provision of infrastructure has not been resolved." (Grihfield and McGuire, 1997, p.113)

The effectiveness of state and local economic development policies has been a controversial issue for decades. State and local governments implement policies that offer incentives to businesses in an effort to promote economic development. These include grants such as land grants, or the right-to-use certain natural resources at below-market prices, low-interest loans, tax incentives such as property tax abatements and other types of tax exemptions, and what Bartik (1991) termed "new wave" economic development policies which encourage innovation and business expansion into export markets. Tax incentives can be general or selective tax cuts for businesses in a state or for certain areas in a state.

Ralph Baily (1986) and others argue that state and local economic development policies are a "zero-sum" game for the U.S. economy as a whole. Netzer (1991) argues that competition for economic development is a "negative-sum" game for the national

U.S. economy in terms of efficient resource allocation until all governments have adopted same economic development package, then it would be a "zero-sum"game. However, the discussion under this study is restricted to the state and local perspective only.

Even from the state and the local perspective, there has been much disagreement among researchers with regard to the effectiveness of state and local economic development policies. Proponents argue that such policies are effective in increasing local jobs and promoting local economic development. Critics argue that they are not effective and are a waste of resources because their effects are offset by other states counter policies. Even if they are effective in creating new jobs, they do not effectively benefit the local population because labor moves in from other states or localities. Tax incentives, which are a major component of such policies, are not a major determinant of business location decisions.

The most important point raised recently is that state and local economic development policies are very expensive to state and local governments. Thus, the question raised now is not only about the effectiveness of such policies in attracting businesses and thus creating jobs to the state and local economies (ignoring the national benefit or loss), but also, and more important than that, is whether they do that in a cost-effective manner.

Let us narrow down the focus and restrict our discussion to the major component of economic development policies, which is tax incentives. The costs of such tax incentives are, in essence, foregone public services. One way to examine the cost-effectiveness of tax incentives then would be by focusing on the costs in terms of public services reductions.

The recent attention given to pubic infrastructure deterioration has increased the interest of policy makers and researchers in the effects of state and local tax and spending policies on regional economic growth. Public infrastructure includes non-military non-residential structures and equipment including transportation facilities , such as streets, highways, railroads, canals, airports, and harbors; water and sewer treatment facilities and networks; communication systems; and education facilities. D. Dalenberg and R.W. Eberts (1988), among others, have discussed the declining state of the nation's public infrastructure, specially in mature cities and metropolitan areas. They cited the example of the 58-year old Eagle Avenue ramp on the western edge of downtown Cleveland, Ohio, as typical of the problem of public infrastructure deterioration and effects on urban development. They outlined that the ramp was unsafe and without considerable repair would have to be closed. Closing it would limit access to the surrounding industrial region, increase the cost of doing business in the area and possibly lead to the flight out of businesses. They explained that the case of the Eagle Avenue ramp is just an example of thousands of roads, bridges and other public infrastructure that are in similar condition. Moreover, they found that , in Cleveland, every dollar spent on public infrastructure is needed just to maintain the public capital stock at its current level. They found that the situation is similar in Chicago and that the trend is increasing for both the Midwest and the U.S. as a whole.

It has been suggested that the condition of a locality's public infrastructure might affect economic development in the surrounding area. It may increase the cost of businesses, decrease the attractiveness of the area to firms that are looking to migrate into the area, and cause existing firms to move out.

So, the question is whether the impact of public infrastructure capital stock is statistically significant for economic growth. Absolute calculations of expenditures on public infrastructure maintenance and replacement are very meaningful and direct. But the relative significance of these expenditures is more important since it considers the relative magnitude of the need for maintaining or increasing the stock and considers other factors that determine economic growth and in turn the public capital stock itself.

Earlier studies that estimate the effects of public capital on state and local economic growth used government spending flows on public infrastructure, or the number of government employees, as proxies for public infrastructure capital stocks. Therefore, they were not able to estimate such effects directly. The reason is that there were no data available on the stocks of public infrastructure capital for the state or local levels. In a project for the National Science Foundation, R.W. Eberts, C.S. Park and D. Dalenberg (May 1986) have estimated the components of public capital stock for 38 metropolitan areas from 1958 to 1981 using the perpetual inventory method. Randall W. Eberts (Dec 1986) made the first attempt to use such data to estimate the contribution of urban public infrastructure to regional manufacturing production. Public capital stock was entered as an input into a translog production function. The production function estimates show, among other things, that public capital stock makes a positive and significant contribution to the manufacturing output in the sample of 38 SMSA's (Standard Metropolitan Statistical Areas). Aschauer's (1989) empirical results indicate that nonmilitary public capital stock is dramatically more important in determining productivity than either the flow of nonmilitary or military spending. His study was for the national level, not the state and local level. Alicia Munnell (1990a) constructed

estimates of public and private capital stocks for the state level and used that data in examining the relationship between public capital investment and private economic activity. She found that public capital enhances the productivity of private capital and that it has a positive and statistically significant impact on private sector output. Holtz-Eakin (1993) constructed estimates of public capital stocks for the state level. A bulk of research then followed using state and local public capital stock estimates to investigate whether public capital stock has a significant effect on productivity and growth. This has raised the concern about the deterioration of public infrastructure and triggered the rise in the interest of policy makers and researchers in the issue of the effects of state and local tax and spending policies on regional economic growth.

Major limitations:

There are some major limitations of previous studies that motivated this current study:

1. Most of the bulk of research just referred to, i.e. the research that used state and local public capital stock estimates, has been on the effect of public capital stock on manufacturing productivity using the framework of the neoclassical production function. Therefore, these studies, with very few and limited exceptions, confined to investigating the significance of public capital stock in aggregate. But there are different types of public capital stock. Thus, the results regarding the significance of public capital are averages across types that are likely to differ in significance and signs. Therefore, when public capital stock is dis-aggregated to types, its significance might differ. Few studies, as shall be discussed below, have considered this but with some limitations.

Besides, there is a possible specification problem, as explained in more detail in chapter II , when entering total public capital stock estimates in the aggregate production

function the same way private capital is entered, explicitly or implicitly assuming that, in terms of Meade's (1952) classification, all public capital is 'unpaid input' and not 'atmosphere' type. A proper treatment could have been achieved by estimating the 'atmosphere-type' portion of public capital stock and entering it in a way similar to the way technology level is entered in the production function.

2. Such studies investigate the significance of public capital in isolation of state and local tax and spending policies. This is partly because the majority of the studies using new data, i.e. state and local public capital stock estimates, adopted the framework of the neoclassical production function. Regardless of being able to determine whether increases in public capital stock are significant or not, that cannot by itself answer the question of whether the positive effects, on growth, of public capital stock increases would be smaller or larger than the negative effects of tax increases to finance such capital stock increases. Lynch (1996) and Bartik (1996) have explained that the benefits of greater public services must be compared with the costs of higher taxes. In other words, even if increases in state and local public capital stocks have positive and statistically significant effects on economic growth, such positive effects should be compared with the negative effects of the tax increases to finance such public capital stock increases. The estimates of these tax effects also might differ significantly when public capital stock is disaggregated. This has not been addressed by previous research.

3. Studies of the determinants of firm location can include the effects of taxes. However, most of the previous firm location studies have used public capital spending amounts or the number of government employees as proxies for public capital stocks. The evidence by Eberts (1986), Aschauer (1989), and others indicates that public capital stock

variables have more explanatory power than public capital outlays. Hence, it seems appropriate to consider using state and local public infrastructure capital stock estimates in the framework of the firm location models.

4. Holtz-Eakin (1992) and Bartik (1996) argue that most previous studies of productivity levels or growth failed to control for fixed effects of state or regional unobserved characteristics and that such failure constitutes one of the reasons of the lack of consensus among researchers on the effects of public capital stock on state and local economic growth.

5. As far as the author of this current study knows, all of the studies that have controlled for state or regional unobserved characteristics have assumed that such characteristics can be controlled for by introducing dummy variables for differences in intercept parameters assuming that the slope parameters are the same across states and regions. In other words, they assume that state and local economic growth can be estimated by one equation for all the states. Therefore, their results constitute averages of the effects of policies across all the states. It seems misleading to conclude on the basis of the sign or magnitude of such averages that increasing, or decreasing, taxes would benefit the nation, or in other words "what is good ,e.g., for New York is good for Oklahoma". This constitutes a reason to suspect structural stability of the regression model even after controlling for fixed effects by dummy variables for intercept changes across states or regions.

6. Most studies that considered the effects of state and local public infrastructure capital and taxes on state and local economic growth have used total state and local taxes as their tax variable. Some studies considered certain types of taxes, such as property taxes, sales taxes, etc. Olson (1990) has indicated that it is the total tax bill that is relevant, not

individual types of taxes, such as property tax alone. This directly suggests that it is a total business tax bill that might matter. His study also suggests that the tax bill paid by individuals might also be a relevant tax variable since it might be of interest to upper-level managers who make location decisions. So, it might be the case that firms, when considering locational decisions, 'look at' taxes paid by businesses and not just total state and local taxes or single types of taxes. If so, then the appropriate variable to include in a model for estimating the effects of state and local infrastructure capital and taxes on economic growth based on firm location decisions would be a measure of business taxes. It might as well be the case that taxes paid by individuals, i.e. non-business taxes, are an important factor because they might affect the cost of labor and local demand for products, and because firm owners or top management who make location decisions do look at taxes paid by individuals because they affect their own incomes and thus their well being. Therefore, it seems reasonable to consider a measure of business taxes as well as a measure of taxes paid by individuals in the model for estimating the effect of state and local public infrastructure capital and taxes on state and local economic development. This study is an attempt to accomplish that goal.

Objectives of the study:

The general objective of this study is to provide more evidence on the effects of taxes and public infrastructure on regional economic growth in a way to check, shed light on, and correct for the factors that might have contributed to the lack of consensus among researchers in this issue. The specific objective is: to estimate the effects of state and local taxes and public infrastructure capital, using the recently constructed state and local

public capital stock data, in a framework that combines both of these variables since considering them in isolation of each other is not much meaningful as outlined above. This objective would be accomplished by using a cross-sectional multiple regression model with employment growth rate as a dependent variable and public infrastructure capital and taxes as explanatory variables, with other variables, within the context of a firm location model.

The studies that considered breaking down public capital stock figures into types are very few, notably by Eisner (1991), and in the framework of the neoclassical production function, i.e. not including taxes or other factors. Alicia Munnell (1990a) has included both taxes and new data of public capital stock variables in a model (of 13 observations only) but with public capital as a total, not disaggregated to types. Eberts (1989) did the same thing using total public capital stock. So, within the studies that have used the recently generated state and local public capital stock data, the ones that have considered disaggregates/types of public capital stock have not included taxes, and the ones that have included taxes have not considered the types of public capital.

This study would consider total as well as types of public capital. This would be accomplished by using the framework of a firm location model as mentioned above. To avoid the estimation problems of previous researchers, this study would control for regional and unobserved or unmeasured fixed effects. This would be accomplished by introducing intercept dummy variables for regions. So, estimation would be done with a fixed effects model (FEM). In addition to that, this research study will also investigate the structural stability of the regression model used to estimate the effects of public infrastructure and taxes on state and local economic development even after controlling

for regional unobserved characteristics. The purpose of this is to check whether the slope parameters are the same across all states.

It also seems important to consider business vs. non-business taxes since it might be the case that when making location decisions, firms do not just look at the state and local total tax revenues. This would be accomplished by introducing a measure of each of these two categories of taxes, as explained in Chapter III (Empirical Model), and including them as the tax variables in the model.

Importance of the Study:

The significance of this study can be outlined as follows:

- There is lack of consensus between previous research results on the impact of state and local infrastructure capital stocks and taxes on state and local economic development. This study is an endeavor to provide more evidence on the relationship between state and local public capital stocks and taxes and regional economic development.
- Most of the previous research on the effects of state and local public infrastructure capital used public capital outlays , or the numbers of government employees, as proxies for public capital stocks. This study uses state and local public capital stock estimates, a newly constructed data, to directly estimate the relationship between state and local public capital stocks and regional economic growth.
- The research that uses state and local public capital stock estimates and considers the effects of taxes together with those of public infrastructure capital stocks on regional

economic growth is scant. One of the objectives of this study is to combine both public capital and tax variables in estimation of the relationship between regional economic growth and such tax variables.

- This study does not consider state and local public capital stocks as total only, but also considers types of public capital to avoid averaging the effects across types of public capital.
- The econometric model constructed for the purpose of this study includes controls for regional unobserved or unmeasured fixed effects.
- Another contribution of this study is testing the structural stability of the regression model used to estimate the relationship between state and local public capital stocks and taxes and state and local economic development. Testing structural stability of a regression model can be done by either formal tests, like the Chow test, or the statistical significance of slope dummy variables. Previous studies have assumed that all regional and state unobserved or unmeasured characteristics and effects can be thrown in the intercept of the estimation equation, assuming that all slope parameters are equal across all states.
- Another important contribution of this study is that it uses, as tax variables, a measure of business taxes and a measure of non-business taxes, since when considering location decisions, firms might not just 'look at' state total tax revenue or just types of taxes.
- The typical measure of welfare used in previous research is total welfare amount. The variable 'transfer' used in this study is calculated in a manner different from previous

studies to include only the amounts paid by the state, not the federal share which is considered as exogenous from the individual state's perspective, specially when modeling in the context of a firm location model.

- Almost all of the studies that used state and local public capital stock data in estimating the impacts of state and local public capital stocks on economic development at the state level have used Alicia Munnell's (1990) estimates. This point is discussed in more detail in chapters IV and V. This current study uses Holtz-Eakin's (1993) data and not Munnell's data.
- With regard to policy implications, whenever the issue is vital, such as the issue of development, and the costs are substantial, more evidence is demanded especially if existing evidence is mixed and/or scant. This is the case of the situation under discussion. Providing more evidence on the relationship between state and local economic development and state and local infrastructure capital stocks and, also, taxes helps to resolve the problem of the lack of consensus among researchers and thus helps policy makers decide "on which buttons to put their hands."

  It is useful for policy makers to have evidence that suggests to them what types of public capital are more effective for regional economic development and for which jurisdictions. Furthermore, it is important for policy makers to have evidence with regard to which taxes, for generating a certain amount of revenue, create less of a disincentive for employment growth, the ones that are paid by businesses or the ones that are paid by nonbusinesses.

Organization of the Study:

The study is organized into six chapters. Chapter I is an introduction and a statement of the problem. Here the problem is elaborately stated and the objectives of the study are mentioned. Chapter II deals with the conceptual framework and literature review. Chapter III contains the underlying theoretical model and its specification. Chapter IV is devoted to empirical model identification . Chapter V summarizes the results and analysis. Chapter VI presents conclusions from the present study and outlines the potential policy implications, limitations of the study, and further research.

CHAPTER II

LITERATURE REVIEW

Conceptual Framework and Review of Theoretical Literature:

Economic growth and economic development:

Economic growth, a major goal of economic policy and societies, is said to occur when real per capita income increases over a period of time, usually a year. In other words, economic growth occurs when society's output increases more rapidly than its population. Economic growth usually implies a higher standard of living.

The term 'economic development' is conceived of as implying secular increases in per capita real income, just as the term 'economic growth' implies, but in addition to that as involving changes in the structures of production, cultures, laws and institutions, and income distribution. Usually the term economic development is used to describe economies of less developed countries when they undergo long-run increases in per capita income. Such increases of per capita income are associated with considerable structural change as mentioned above. Long run increases in per capita income in a developed country do not involve considerable structural change of society and institutions, and thus is described as economic growth. However, the definition of economic development under our current study is not exactly the same as of the term economic development

when associated with less developed countries. There is, except in economically distressed regions, no substantial structural change of societies or institutions involved. So the term is used to distinguish the economies of less grown states or regions from those of fully grown ones. All, of course, are within the U.S, which is a developed country, in which the less developed states are converging in their levels of growth (per capita income) to the national average.

Neoclassical vs. Regional economists view:

Traditional neoclassical economics is based on the assumptions of perfect markets, perfect flexibility of price adjustments, long-run market-clearing, rationality of agents whose behaviors are governed by decisions of marginal optimization of utility and profits. The traditional neoclassical view of regional economic development is based on the idea of the mechanism of equalization between the value of marginal product of the input unit with the market price of the input unit, which is theoretically sound but, assuming perfect mobility of inputs and a ubiquitous world.

Robock (1966), Dubey (1964) and other regional economists, argue that the economic growth factors of resources, human skills, and access to markets are not evenly distributed among the regions of a nation.

> "Human activity and its concomitants occupy space. Resources, markets, products are not located at mythical points having no lengths and breadths. There is a spatial separation. Resources and their production and consumption are not evenly distributed over space". (Dubey, 1964, p 28)."

Further, regional economists argue that the mobility of inputs is not perfect or without frictions, and the locations of economic activity are not homogeneous. Therefore, they argue that it is vital to give sufficient weight to the effects of public fiscal spending on

private investment decisions, and vice versa. For reasons not to be count here, but anyone can simply think of, at least a minimum level of balanced growth is vital for the growth of a whole nation's economy. However, there are always certain regions to which private investment might not flow unless some public infrastructure investment is made at least above the national or regional average and/or some public services or incentives are provided in a way to decrease the comparative costs of private production in such regions. That is to say, unbalanced provision of public services is necessary for balanced growth to occur, or for at least a minimum level of growth to occur in some regions. This explains the importance of state and local tax and spending policies for balanced regional economic growth.

On the other hand, the development of regions or localities that are less developed might better be 'pushed' by creating agglomeration centers within the region. In other words, an unbalanced growth approach might well benefit development of regions within a state. Perroux (1955) has asserted that:

> "growth does not appear everywhere at the same time; it becomes manifest at points on poles of growth, with variable intensity; it spreads through different channels, with variable terminal effects on the whole of the economy" (p.94).

Hirschman (1958) has stressed concentration of investment strategies on a few sectors instead of wide dispersion of projects. This unbalanced growth notion, together with the argument that the mobility of private capital is not perfect or without frictions explains the significance that state and local tax and spending policies might have on regional economic development.

How infrastructure affects firm location :

Among the public services that might affect regional growth are public infrastructure quantity and quality in a region. How does public infrastructure affect the production decisions of a firm?

A good is said to be excludable if people can be excluded from consuming it when they do not pay for it. A good is rival if one person's consumption of it reduces the amount available to others. Private goods are both rival and excludable. Those who do not pay the price are excluded. A pure public good is one that is not excludable and non-rival. A public good that is rival, e.g. is subject to congestion, although still not excludable, is not a pure public good. Some examples of public goods are national defense, police, highways, and so on. Like private goods and services, public goods and services can be used by consumers as consumer goods, or by producers as inputs used in production.

An externality is said to exist if the production by one firm affects the production of another firm in a manner not accounted for by the market. (Let us restrict the discussion here to production, although the same can be said about utility). Externalities can be positive or negative.

Meade (1952) has distinguished between two types of external economies or diseconomies. He calls the first type "unpaid factors of production" and the second the "creation of atmosphere." Viewed in this premise, public infrastructure can affect a firm's profitability via both channels. As an unpaid factor of production, public infrastructure is used by private firms as an input and since it is a public good they do not pay a market

price for it. As an atmospheric factor, public infrastructure enhances the productivity of the private factors of production.

Dalenberg (1987) and Eberts (1990) have explained Meade's (1952) classification and suggest that "atmosphere public goods' fit into the pure public inputs type. Thus, they are characterized as being non-rival. Entrance of new firms would not affect the other existing firms ability to take advantage of the public inputs. The other type of public inputs classified as 'unpaid factors' of production are rival and thus are not pure public goods. Entrance of more and more new firms in the area would result in crowded streets, and thus affect usage by other existing firms.

Almost all of the studies that included public infrastructure capital stock estimates into the neoclassical production function to estimate the impact of public infrastructure capital stocks on private productivity growth, output growth, or employment growth have explicitly or, mostly, implicitly assumed that public capital is an 'unpaid factor' of production, i.e. the second type of Meade's classification. That is, it is not a pure public good since it is rival, e.g. streets and local services are subject to congestion.

Because it is an 'unpaid factor', it is just entered into the aggregate production function the same way private capital is entered. Although that makes the task of modeling simple and easy, it implies a specification problem. Not all public capital is an 'unpaid factor', some is 'atmosphere' and thus not a pure public good. Even local public infrastructure capital is not all subject to congestion. In fact, a considerable portion of public capital is directly 'atmosphere' type, such as fire protection, defense, police, research and technology, education, etc. Local business development centers, technology centers, ..etc. are not excludable and non-rival. They are thus 'atmosphere' public goods

also. What is important is that much of this type of public capital is used by businesses and it augments the productivity of private inputs. This implies that this 'atmosphere'type has to be entered into the aggregate production function in a way similar to the technology parameter included in the production function, and not the way private capital is entered. This, then, implies partitioning total public capital estimates into two parts. One part is 'atmosphere' type of public capital , i.e. the one that augments the productivity of private inputs, and the other part is the 'unpaid input' type. The first is to be entered in the aggregate production function the same way the technology parameter is entered. The second one is to be entered the usual way private capital is entered. Hulton and Schwab (1991) have built a formulation of an aggregate production function that is based on Meade's classification and embodied both of the two types of public capital entered separately into the production function, the 'environmental' type as a shift parameter and the 'unpaid factor' entered in a way similar to private capital. In fact, the above discussion on the possible specification problem that growth models, that entered total public capital stock in an aggregate production function, might have run into, is based on and triggered by the above referenced Hulton and Schwab specification.

Hansen (1965) developed a comprehensive theory on the potential impact of infrastructure investment on regional development. He divides OC (overhead capital) into two components: SOC (social overhead capital) and EOC (economic overhead capital). EOC is aimed at supporting directly productive activities, and includes roads, bridges, harbors, power plants, and similar facilities. SOC is aimed at investment in human beings.

Hansen then hypothesized that the effectiveness of infrastructure investment depends on the type of infrastructure and the type of region in which it is implemented. He has classified regions into three types: congested, intermediate, and lagging. Congested regions are characterized by very high concentrations of population, industrial and commercial activities and public infrastructure. In these regions, the marginal social benefit from an expansion of economic activity would be less than the marginal social cost because external diseconomies resulting from such expansion would outweigh the external economies resulting from it.

> "Intermediate regions, on the other hand, are those which offer significant advantages - raw materials, qualified labor, cheap power, etc. - to private firms, and where entry of new firms or expansion of existing firms would result in marginal external economies substantially in excess of concomitant social costs. In other words, other things being equal (except the degree of concentration) the marginal social product to cost ratio would be greater in these areas than in congested regions" (Hansen, 1965, p.6)

Lagging regions are characterized by small-scale agriculture or stagnant or declining industries, low standards of living and relatively deficient in SOC and thus they present few, if any, attributes to attract new firms. Thus concentrating EOC in lagging regions would not be the right strategy since such regions do not have comparative advantages as compared with intermediate regions.

Based on these characteristics of the three types of regions, Hansen hypothesizes that the best strategy is to aim EOC at intermediate regions. They are the regions that are relatively deficient in EOC only. It is not economically rational to direct excess EOC to lagging regions. However, his conclusion regarding SOC is that it is anticipated to give

better outcomes if SOC is concentrated in lagging regions, rather than intermediate or congested regions.

The above scenario is applicable for the initial situation where public investment is first introduced. As more concentration of EOC occurs in intermediate regions, the marginal need for SOC rises in intermediate regions. The opposite occurs in lagging regions. As intermediate regions reach optimal concentration mix, public policy then switches to balanced growth.

The above discussion shows how state and local public spending policies can affect the state and/or local economy by providing public infrastructure capital. Investment in public capital affects the supply side of the economy through increasing the productivity of private inputs, as well as through decreasing costs to firms since public capital services can also be considered by firms as 'unpaid inputs'. Such potential impact on the supply side is not only through increases in productivity of private capital, but also through expansion of industries due to the entrance of new firms being attracted by the enhanced amenities in the area, as well as the establishment of firm branches and increases of scale of existing businesses.

On the demand side, public expenditure, one of the tools of fiscal policy, has the potential effect of increasing aggregate demand since it increases household income. Public spending is expected to have a multiplier effect. Increased public spending is thus a means to stimulate the economy of the region or locality. It has the potential of increasing employment and output. In contrast to supply-side effects, the demand-side effects on a state or local economy from public spending are likely to occur more quickly. However, as reported by Bartik (1996), active government policy to manipulate the

demand side of a state or local economy is seen by most economists as having limited benefit because much of the purchasing power resulting from such policy would "leak out" of the state or local economy since firms and households would spend considerable portions of the increments to their purchasing power on purchases from outside the state or local economy. Besides, most of the public services increases are funded by higher taxes, or borrowing, dampening or crowding out purchasing power, which decreases the mentioned demand-side effect.

Thus, the aforementioned theories indicate that private investment location and expansion decisions, and household location decisions, could be affected by the provision of public infrastructure and other public services. These factors increase the attractiveness of a region or a locality to businesses. Even further, when more businesses are attracted, external economies of agglomeration can be enjoyed by the region. This is why, as outlined by Bartik (1996):

> "spending increases and tax cuts are often advanced by state and local governments under the rationale that they would bring significant and collateral benefits for jobs and the economy over and above their specific benefits". (p.3)

How taxes affect firm location :

Taxes are exogenous to firms, i.e. firms have no direct control on the amounts of taxes levied on them. Most public services, such as public infrastructure, are financed to a considerable extent by taxes, some of which are levied on businesses. But both taxes and public services are controlled /provided by government. So, taxes cannot be considered as prices of public services in the usual sense of prices. Firms look at taxes as costs. Thus, state and local taxes can affect business costs and thus affect business location and

production decisions, which in turn affect the state or local economy. Of course taxes have more of an effect at the margin. Firms compare business tax costs across states, the thing which has heightened the interstate tax competition for businesses. Several measures of state and local business taxes have shown considerable interstate differences. Wheaton (1983) has reported considerable interstate variations in business tax levels. There are several factors that need to be considered when we say firms look at interstate business tax differentials. Beyond the nominal magnitudes of such tax differentials there is tax deductibility. There are ample sources of information about tax deductibility that is available to firms. Deductibility reduces the magnitudes of interstate tax differentials. Another factor is the backward or forward shiftability of taxes imposed on businesses. This might be partially estimated by firms, but it is in general not readily known by firms before moving into an area. Also, whether or not taxes are matched by public services would affect the magnitude of interstate business tax differences from a firm perspective, if firms know the magnitudes and quantities of such services.

Thus, firms consider business taxes as costs. Firms also might consider other taxes, i.e. non-business taxes, when they consider locational decisions. Individual income taxes, or in general, taxes that are paid by individuals might affect labor availability, quality, local demand for goods and services, etc. They might as well be considered by owners of small firms or location decision makers of large firms since they affect their incomes.

The effects of interstate or inter-jurisdictional tax differentials on firm location decisions are subject to several other factors, such as whether such differentials rank high or low relative to the other variables that affect firm location decisions. This implies the

need for empirical research.

The effectiveness of a state's "business climate," - a term that mainly refers to factors such as state and local taxes, laws, and labor unionization - has been a controversial issue. Bartik (1991) describes the effect of taxes on state and local business growth as the most controversial issue in economic development policy and that the resolution of such controversy can affect the entire design of state and local tax systems.

"Laissez-faire":

Adam Smith, as well as the other liberals and opponents of mercantilism, came to adopt 'laissez-faire', i.e. free trade or maximal level of non-interference of government in the free-course of economic activity. Smith believed that the human being is a creature of self-interest. He believed in the natural harmony between individual and public interests. Therefore, he considered government intervention as an evil. Government should mainly protect property rights, enforce the law and only handle those services such as postal service, insurance, and banking, over which there was no controversy as to whether they be handled by the government or not.

Bentham, however, did not believe in an unlimited natural harmony between individual and public interest. Therefore, he deemed government intervention as necessary in instances where there is conflict between individual and public interests, in order to enforce protection of public interests.

J.S. Mill believed in self-interest as a drive for human behavior and believed in 'laissez-faire' but, following Bentham, he believed that there are limits to 'laissez-faire'. He cited, in his "Principles of Political Economy", many exceptions to the doctrine that

"individuals are the best judges of their own interests", and following Bentham, he did not believe that there is always natural harmony between individual and public interests:

> " a certain line of conduct is for the general interest does not always make it people's individual interest to adhere to that line of conduct" (J.S. Mill, p.966)

Thus, he deemed government intervention as , in some instances, necessary.

Beside the very basic functions of government, J.S. Mill has indicated various exceptions to the maxim that individuals are the best judges of their own interests, including public infrastructure and public services such as research.

> "There are many scientific researches, of great value to a nation and to mankind, requiring assiduous devotion of time and labor, and not infrequently great expense, by persons who can obtain a high price for their services in other ways. If the government had no power to grant indemnity for expense, and remuneration for time and labor thus employed, such researches could only be undertaken by the very few persons who, with an independent fortune, unite technical knowledge, laborious habits, and either great public spirit, or an ardent desire of scientific celebrity" (J.S. Mill, p.996)

However, it should be noted that, Mill has rigorously stressed that government should first check whether that task can be done by private undertaking and, if so, whether or not that private performance of the task would be better than the government handling of it. He emphasized that practical experience proves that:

> "in all the more advanced communities, the great majority of things are worse done by the intervention of government, than the individuals most interested in the matter would do them, or cause them to be done, if left to themselves. The grounds of this truth are expressed with tolerable exactness in the popular dictum, that people understand their own business and their own interests better, and care for them more, than the government does, or can be expected to do. This maxim holds true throughout the greatest part

> of the business of life and wherever it is true we ought to condemn every kind of government intervention that conflicts with it".(J.S. Mill, p.947)

So, Mill strongly maintained that government intervention should be restricted to only the situations where it is necessary, and even when it is necessary it should be kept to its minimum.

> "Laissez-faire, in short, should be the general practice: every departure from it, unless required by some great goods, is a certain evil" (J.S. Mill, p.960)

So, government intervention should be seen as a restricted exception to the doctrine that individuals are the best judges of their own interests. Beside the primary functions of government, government intervention is justifiable only where it deems necessary to correct for market failure, such as the cases of public goods, externalities, natural monopolies and information asymmetries. This implies that it is justifiable to the extent of the existence of such market failure(s), and beyond that it is detrimental to the economy.

Optimal levels of infrastructure and taxes:

The above discussion places the question as to what is that minimum level of government intervention that is justifiable and would not harm the economy and society's well being. This leads us to the question: what is the optimal level of public goods and services, or, somewhat narrowly, what is the optimum level of public infrastructure capital stock and the optimum level (and mix) of taxes?

Economic efficiency, or Pareto efficiency or optimality, is satisfied in an economy if it is not possible to make someone better off without making someone else worse off. The condition for economic efficiency is that marginal social cost equals marginal social benefit. This condition satisfies Pareto efficiency because under the equality of marginal social cost and marginal social benefit it is not possible to make someone better off without making someone else worse off. It can be shown that if there are no externalities, perfectly competitive markets satisfy Pareto efficiency.

An externality is said to exist when the consumption or production actions of one agent affect the utility or production of another agent(s) via some way rather than the market price. Then marginal social benefit would not be equal to marginal social cost. Therefore, the presence of an externality causes the market outcome to be not efficient. Perfectly competitive markets fail to satisfy Pareto efficiency condition under the presence of externalities. In many situations of externalities, government intervention can work towards optimal outcomes.

So, externalities and public goods are two cases where competitive markets fail to satisfy the condition for economic efficiency, and where government intervention can improve efficiency and can lead to higher levels of welfare. Government can design mechanisms and /or directly interfere to decrease the supply of negative externalities, and increase the supply of positive externalities (where public goods themselves can be considered as creating positive externalities).

How can the government provide the optimum level of public goods ? The condition for efficient provision of public goods is that marginal social cost, including all costs to society, equals the sum of individuals' marginal benefits (Samuelson rule).There

are in general three channels of intervention in this regard: direct provision of public goods; incentives (by taxes and subsidies), and ; regulation. There are several models of the optimal provision of public goods, and the problems associated with revelation of true preferences. Most of the results suggest that, although the government may not be able to provide the theoretically efficient level of public goods, it can improve efficiency toward the optimal level. However, how much of a public good is optimal has not been determined, nor has which type of public good will have a more positive impact on growth. This implies the need for empirical evidence. It is vital for policy makers to know what type of public goods and services would lead to a greater enhancement to growth, is it public capital, some types of it, or other services, and how much of it ?

We have discussed, above, how taxes can affect business location decisions and thus state or local growth. As far as economic efficiency is concerned, a tax or a tax increase generally causes a loss of economic efficiency. This is because it generally causes agents to change their behavior. These changes of behavior cause a departure away from optimality to a less efficient situation.

To sum up, the above discussion indicates that government intervention to provide public goods can correct for market failure, improve efficiency and increase society's welfare. It is concluded that the determination of the optimal level or mix of public goods necessitates empirical evidence. The provision of public goods is in general, and for the most part, financed by taxes. Taxes affect firm location and thus state and local economic growth. To what extent are tax effects significant in this regard ? That also necessitates empirical evidence. Also, as far as economic efficiency is concerned, the effects of taxes by themselves are that they cause loss of efficiency. If the provision of

public capital might have positive effects on growth while such provision implies taxes or tax increases , and taxes have negative effects on growth, what is the net effect in this regard ? Again, empirical evidence is needed to shed light on these questions.

Empirical review:

It has been concluded in the previous section that empirical evidence is needed to check for the significance of the effects of public infrastructure capital stock and taxes on state and local economic development. Now, we focus on what the empirical evidence suggests in this regard. First, we shall look at empirical evidence on the effects - on regional economic growth - of public infrastructure capital, then we turn to the effects of taxes. The section on the empirical review of the effects of taxes shall, of course, also cover those studies that include both tax variables as well as public capital stock and public services variables.

Public capital:

Before we proceed, it worthwhile to note some basic features of the studies of the impact of public infrastructure on state and local economic development. These pertain to the public capital measure used by the studies; the economic growth measure considered; the methodological problems ; and the findings of such studies. These shall be outlined in what follows.

Some of the studies considered the effect of public capital on economic growth using national data, i.e. their estimation were for the national economy. Some considered census regions, or Sunbelt vs. Snowbelt. Some considered state level. Others considered smaller regions such as metropolitical statistical areas, cities or countries. While some of

these studies used total public capital, not just public infrastructure capital, some of them considered types of public capital.

All earlier studies (before 1990), that have investigated the effects of public infrastructure capital stocks on regional economic growth, with few exceptions (basically Eberts 1986, 1989, Dalenberg 1987, Eberts and Fogarty 1987, Eberts and Deno 1989) have used public expenditure or the number of government employees as proxies for public infrastructure capital stock and thus were not able to directly estimate the relationship between public infrastructure capital stocks, and regional economic growth. The recent studies, from 1990 and on, are dominated by the use of public capital stock estimates, and thereby are considered as attempts to estimate the direct relationship between public capital stock and economic growth.

Different measures of economic growth are used by all of the mentioned studies. These measures include: productivity, output growth, employment and firm location indicators. Most of the studies that used productivity and output growth indicators of economic growth have estimated a version of an aggregate production function. Some of the models that used productivity measures as indicators of economic growth have used private sector productivity, while others used manufacturing productivity. Bartik (1996) and others argue that manufacturing productivity could be a better indicator of economic growth than private sector productivity because manufacturing data is more accurate and better measured than private sector productivity. Further, they argue that empirical evidence on the relationship between public capital, or broadly public services, could

yield better results if it focuses on manufacturing output growth instead of productivity growth for several reasons, outlined by Bartik as follows:

> "Output growth is easier to measure than productivity growth. A positive effect of pubic services on state manufacturing output growth is a good sign of a positive effect of public services on productivity; manufacturers serve a national market, so a states cost structure is the key variable affecting its attractiveness to manufacturers. In addition, the effects of public services in attracting labor to a state will be captured by an output measure, but not by a productivity measure. Finally, from the perspective of state and local policy makers, the effects of fiscal policies on business output are at least as important as their effects on business productivity".(Bartik 1996, p.50 .)

Another indicator of economic growth used by the studies of the impact of public capital and services on growth, is the number of firms, whether firms enter the jurisdiction under study, i.e. move from other jurisdictions, or new business startups in the jurisdiction. This is because more firms in the area, or more branches of firms, would in general imply more output, more jobs and more revenue for government. The effects of the number of new firms in the area might extend beyond the direct increase in output or employment brought about by such new businesses. It might also include the benefits of agglomeration, and the increase in household income and thus aggregate demand. Therefore, a considerable portion of the studies of the impact of public capital and spending on regional economic growth have used firm location models. The framework of firm location models has the advantage of combining public fiscal spending variables with public capital infrastructure variables, as shall be elaborated later in this study.

There are several methodological problems associated with previous research, specially earlier research. Such problems are outlined in chapter I in the section of the

statement of the research problems. However, two of them deserve a bit more discussion.

Holtz-Eakin (1992) has argued that there are state or region-specific unobserved, unmeasured or inaccurately measured characteristics which cause private sector productivity to differ between states or regions. Examples of such characteristics are the quality of inputs, climate, location, political and social features. Failure to control for these characteristics might bias the estimated impact of public capital on economic growth. The other point is that, as argued by Bartik (1996) and others, productivity measures might not be a good indicator of the efficiency of a local economy. This is because, among other reasons, of the difficulty and inaccuracy of the productivity measure.

There are general trends that can be seen from the literature of empirical research on the impact of public capital on regional economic development. The more recent empirical studies found more evidence for the significance of the impact of state and local infrastructure capital on regional economic growth than earlier research did. This trend in empirical findings might be attributed mainly to three factors. First, instead of using capital outlays or the public sector employment as proxies for public capital stocks, more recent studies used estimates of public infrastructure capital stocks, and thus were able to directly estimate the relationship between public infrastructure capital and regional economic development. Second, although some of the earlier empirical studies have considered different types of public capital, most of the recent studies that used public capital stock estimates have used total public capital stock estimates. Only the latest

studies considered different types of public capital stocks. Lastly, recent studies have shown that when controlling for region or state-specific fixed effects, public capital becomes insignificant or less significant.

It should be noted that there are a considerable number of studies on the effectiveness of state and local public services. Those studies, it is to be stressed, are about state and local public services, not public physical infrastructure capital. They are about services such as fire protection and schools. So, they are a broader consideration than physical public infrastructure capital. This is also an extremely important question. However, sometimes the results of such studies are combined with, and estimated together with, those of public physical infrastructure capital stocks. Still, there might not be a problem with that unless the stock and spending flow of the same variable is set in the same estimation model. But the specific point to be noted is that the reader should not be confused when looking at some studies, especially empirical review studies, because it might seem that the percentage of recent studies that found a significant relationship between public capital stock and economic growth is substantial. For example, Bartik (1996) reviewed the new studies that investigated the relationship between public services and economic development. Those are mixed in the review with public capital stock and economic development. Although not readily clear from the review, a distinction should be made between public services and physical capital stocks. The percentage of the new studies that found a significant relationship between public infrastructure capital stock and regional economic growth is not as large as that given for public services. Another related point that deserves mention is that Bartik (1996 p .18)

calculated the long-run effects of different types of state and real public spending on a state's manufacturing productivity and manufacturing output, using the results of new empirical studies. He concluded that public services effects are large enough to be considered in policy decisions. However, caution should be taken when considering those calculations, because Bartik has assumed that the sources of finance for such spending increases is welfare reductions. This assumption made by Bartik and others is criticized, notably by Lynch (1996), because public services are in reality not financed by welfare reductions. This is an important point. The above mentioned calculations are for the effects of public services and would not be the net effect of any policy package because the effects of the tax increase necessary to finance these are still to be subtracted from those calculation results. Therefore, the resultant effects would not be as large as those reported.

Now we turn to review the notable empirical studies on the impact of public stock on regional economic growth.

Mera (1975) introduced social overhead capital or simply social capital into the production function as a way to estimate the impact of public capital on economic growth. Thus, there would be three inputs instead of the normal two; the private inputs labor and capital, and social capital. The private inputs are allocated through markets, while social capital is provided by government. He assumed that the production function of each sector in each region has its own technology. He used U.S data (from 1947 to 1963) to estimate an equilibrium model constructed with the use of production functions of the Cobb-Douglas type, assuming perfect mobility of labor and capital between

regions. Data is constructed by use of data readily available for census regions, as well as dis-aggregation of the national data for social overhead capital to regions based on a concept of regional shares. He found that the economic growth rate in a region is determined primarily by the growth of social capital and technical progress in the region. The growth of the private inputs, i.e. labor and private capital, responds to growth differentials in social capital and technical progress. Growth in less-developed regions is primarily due to the growth of technology, whereas in more developed regions growth is due to growth of social capital.

DeRooy (1978) has estimated a cross-sectional econometric model of economic development to determine the impact of potential contributions to economic development of public investment in social overhead capital (SOC), or infrastructure, in the 16 "Sun belt" states and the 14 "Snow-belt" states. The model contained single equations for income, unemployment and poverty. It used 1970 data for the states included in the study. He found no significant differences in the sizes of impact multipliers of SOC and support services between Sunbelt and Snow-belt regions. Highly significant multipliers were found for education, major commercial airports and total investment in SOC. No significant relation was found between economic development and investment in health care facilities and roads.

Looney and Frederikson (1981) used multiple regression analysis to estimate production functions for Mexico to examine Hansen's hypothesis, explained earlier in this study, that economic overhead capital has greater impact on GDP in intermediate regions but not in lagging regions and social overhead capital has greater impact in

lagging regions but not in intermediate regions. Their results supported Hansen's theory. They conducted a test of causality which indicates that public capital investment precedes income growth. Their results provide evidence that infrastructure is an initiating factor in the economic development process, rather than a passive or accommodating factor. That is evidence in supporting Hansen's hypothesis.

Plaut and Pluta (1983) regressed three measures of industrial growth - growth of real value added, employment, and real private capital stock - on variables measuring the relative probability of states for industrial expansion, including business climate variables and other variables. The theoretical construct underlying their empirical model was the disequilibrium adjustment model. The results for the three indicators of growth they used are similar. In the regression that has the aggregate percentage change in manufacturing as the dependent variable they found a significant positive coefficient for public spending on education. Some more details and discussions of Plaut and Pluta's model will be given in Chapter III.

Hulten and Schwab (1984) investigate the causes of differential regional growth and the sources of the slowdown in manufacturing productivity. They examine whether or not the economic performance of the Snow Belt region is due to an aging public infrastructue and deteriorating urban environment. Basically, they test whether total factor productivity (TFP) significantly differs between Snow Belt regions and Sunbelt regions. They used a framework derived from the neoclassical growth theory of production. They assumed a Hicks-neutral production function relating real production to real factor input, where input prices are equal to the value of their marginal products. They disaggregated

the growth rate of real value-added in total manufacturing to the nine census regions and then allocated it to the growth rates of regional capital stocks, labor and total factor productivity(TFP). They used data for the 1951-78 period. They found that regional variation in output growth was not due to differences in productivity growth, but to variations in the rates of growth of capital and labor. They conclude that there is no evidence to support the belief that the aging public infrastructure has slowed TFP in the snow Belt. This conclusion is simply based on their findings that there is no significant difference in TFP between the Snow belt and the Sun Belt. What is important, as far as our study is concerned, is that their findings and conclusion show that differences in public infrastructure have no significant explanatory power for differences in output growth between regions. However, Eberts (1990b) has explained that Hulten and Schwab have not directly estimated the effects of public infrastructure on regional productivity. He tests Hulten and Schwab's assertion by directly estimating the impact of public infrastructure growth on manufacturing TFP growth, and found that public infrastructure has a positive and statistically significant effect on TFP. We shall review Eberts work later below.

Helms (1985) investigated the effects of several factors, including public spending and taxes, on the growth of states' real personal income during the period 1965-1979. He found that public spending on highways, local schools and higher education has a significant impact on the growth of state personal income. Because Helms work is of very specific interest to our current study, we shall return to it below when we review

empirical studies that attempted to find the net effect of public capital increases or public spending and the tax increases used to finance them.

Wasylenko and McGuire (1985) examined employment growth in the 48 contiguous states through the period 1973-1980. The dependent variables they used were the percentage change in employment in each of six major industries. The independent variables included, with other variables, fiscal variables. Different versions of state and local education spending scaled by state personal income were included as independent variables. Education expenditures were found to have significant positive coefficient for growth in total state employment and two major industries: retail trade and finance, but not significant for the other four major industries; manufacturing, transportation, wholesale and services.

Eberts (1986) is the first study, after Mera (1975) to start the line of studies that use public capital stock estimates, instead of proxies for public capital such as capital outlays or government employment, to estimate the impact of public infrastructure capital on regional economic growth. Although, and surprisingly, most of the studies in this regard in the 1990's have referred to Aschauer's (1990) results, the work of Eberts (1986) has paved the way for endeavors to construct and use public capital stock estimates in studies of the impact of public capital on economic growth in different jurisdictional levels. Eberts, Dalenberg and Park (1986) in a project funded by the National Science Foundation (NSF), constructed a public capital stock series for 38 standard statistical metropolitan areas for the period 1958-81. They used the perpetual inventory technique to evaluate this public and private capital stock series.

The perpetual inventory method is an approach used by the Bureau of Economic Analysis (BEA) for constructing public and private capital stock data for the national level. Basically under such method, the estimate of capital stock is the sum of the capital purchases when capital was put in place, the purchase value of replacements adjusted for inflation, depreciation, less the perpetual value of discard. So, Eberts (1986) was the first attempt to use the above mentioned data series, of the 38 SMSA's, to estimate the impact of public capital stock on regional manufacturing production. Public capital stock was entered into a translog production function as an input. He found that public capital stock has a positive and statistically significant impact on manufacturing output. This is consistent with the view that public capital is an unpaid factor of production. He also found that its impact is much less than that of private capital and labor. Its output elasticity is only 0.03. The third main finding was that public capital and labor were complementary, while public capital and private capital are substitutes. Private capital and labor are also substitutes. He concluded that public capital is important to economic growth and explained that public infrastructure capital is an essential element of agglomeration economics.

Place(1986) found that per capita public spending on highways has no significant impact on firm location. He further found that per capita public spending on sewer and education has a negative but insignificant impact on firm location, whereas welfare spending has a negative and significant impact on firm location. Similar results were found by Quan & Beck (1987) who found that public spending on local and higher education have no significant effect on business location.

Costa, Ellson and Martin (1987) tested the relationship between public capital and other productive factors using a translog production function. Their goal was to estimate the association between public capital and regional output. They estimated a production function using cross-sectional data for 1972. Their public capital variable was total state public capital for 1972, which they estimated using the perpetual inventory method of BEA. They found that labor and public capital are complementary inputs, and that public capital has diminishing returns. The relationship between public and private capital was less clear-cut. They also computed the elasticity of public capital and the scale elasticity for each state. Their findings support Hansen's hypothesis that the ratio of public to private capital has a negative relationship with the output elasticity of public capital. They concluded from this point that the impact of public infrastructure investments on the development of poor regions is still questionable.

Eberts and Fogarty (1987) investigated the casual relationship between public and private investment. They used public capital outlay and manufacturing investment data for the period 1904 to 1978 for 40 cities. They performed the Sims test of "Granger Causality" on such data. Granger's causality is based on the predictive ability of one series to explain another. They found a significant causal relationship between public outlays and private investment in 33 of 40 SMSA's. Their results indicate that

> "The direction of causation goes both ways. Private investment is more likely to influence public outlays in cities located in the south and in cities that have experienced tremendous growth after 1950. Public outlays are more likely to influence private investment in cities that experienced much of their growth before 1950." (Eberts, 1990 p25).

Schmenner, Huber and Cooke (1987) have studied the effects of different factors, including fiscal variables among other variables, on the location decisions of Fortune 500 plants opened during the 1970's. They found that state and local spending per dollar of personal income had no significant impact on Fortune 500 plant location decisions during that period.

Similar results of no significant effect of state and local spending on economic growth are found by Papke (1987). She investigated the determinants of new private investment for the 2-digit and 3-digit industries in twenty states in 1978. She found that public expenditure on police and fire protection had no significant impact on new private investment.

One of the studies that found a negative relationship between public spending on public infrastructure capital and public services and economic growth is Wazylenko (1988). He has examined the impact of several factors, including among other variables public spending on public infrastructure and public services, on state employment in the period 1980-85. His study considered total nonagricultural employment as well as employment in seven major industries. He found that the coefficient of state and local expenditure as a percentage of state personal income is significant and has a positive sign for only two industries; transportation and non-durable manufacturing. However, he found that state and local expenditure as a percentage of state personal income is not significant for the four major industries nor for total nonagricultural employment, and that it actually had a negative and significant effect on durable manufacturing.

McGuire & Wasylenko (1989) found no significant impact of public spending on higher education, education, and welfare, on business location, whereas public spending on highways has a significant negative impact. Bartik (1989) found that public spending on fire protection has a positive and significant impact on small businesses startups, but public spending on education and highways has no significant impact on business location, whereas public spending on higher education and police has a negative but insignificant effect, and welfare has a negative and significant effect.

Eberts (1990 b) tested Hulten and Schwab's (1984) assertion discussed earlier in this section. Hulten and Schwab found no significant difference in TFP (total factor productivity) between the Snow Belt and Sun Belt regions, and concluded that there is no evidence to support the belief that aging public infrastructure has slowed TFP in the Snow Belt. Since Hulten and Schwab did not directly estimate the relationship between public infrastructure and regional manufacturing productivity, Eberts work is to estimate such a relationship directly by using public infrastructure capital stock estimate for 36 SMSA's for the period 1965-1977. Capital stock estimates were constructed using the perpetual inventory approach. Public capital stock growth rates and other determinants were used to estimate growth rates of TFP. Manufacturing output is measured by manufacturing value added, deflated by the producers price index. Simple correlation procedures between the growth rate of public capital stock and the growth rate of TFP, controlling for the age of SMSA's, shows that public capital stock has a positive and statistically significant effect on TFP; a 1% increase in public capital stock is associated with a 0.49 % increase in TFP. So, contrary to Hulten and Schwab's result, Eberts result

indicate that public infrastructure capital stock variations across SMSA's have positive and statistically significant effects on TFP across regions. However, his finding is consistent with Hulten and Schwab's that the variation across SMSA's of the slowdown in output growth is not significantly correlated with the change in growth rate of public capital stock.

Alicia Munnell (1990a) examined the relationship between public capital investment and private economic activity. The regional economic growth measures she used are gross state output, employment growth and private investment. She first constructed estimates of public and private capital stocks for the state-by-state level, using the perpetual inventory approach used by the BEA for generating public and private capital stock data for the national level. Then she used pooled state output, capital and labor data for the period 1970 to 1986 to estimate an aggregate production function treating public capital as an input in the production function, entered as an unpaid factor, to test for the statistical significance of the impact of public capital stock on real gross state output. She found that public capital stock has a statistically significant positive impact on the level of output and does belong to the production function. Then she examined the relationship between public capital investment and private investment. However, her results in this regard are not as clear-cut, since the net effect of public capital is that it positively affects the marginal productivity of private capital and it also substitutes for private capital. Finally, she examined the impact of public capital stock on state employment growth. She used state public capital stocks within the context of a

firm location model of dis-equilibrium adjust. She found that public infrastructure capital has a positive and statistically significant impact on employment growth.

Hulten and Schwab (1991) examined the relationship between infrastructure and economic performance. They estimated the determinants of MFP (multifactor productivity) growth with a production function that includes private inputs and public capital stock. They used data of output, private inputs and public capital by census regions for the period 1970-86. Their public capital variables include total public capital, as well as roads, water/sewer and `other', where other includes the rest of public capital investment. A distinguished contribution of their study is that they considered both of the channels through which public capital is hypothesized (by Meade, 1952) to enter the production function, i.e. as an unpaid factor, as well as an atmosphere factor that augments the productivity of private inputs. Their formulations of the production function included both specifications. They found that the coefficients of the public capital variables, whether total or types, were always insignificant. They conclude that the link between public infrastructure and economic performance is weak.

Eisner (1991) examined the relationship between infrastructure and regional economic performance. He estimated a production function with annual real GSP (state private gross output) as a dependent variable, entering total public capital and types of public capital in the production function, for the period 1970-1986. He controlled for state-specific fixed effect characteristics. He found that total public capital does not have a significant impact on regional economic performance; highways and water/sewer variables have positive and statistically significant coefficients; while the variable 'other',

which measures the rest of the public capital stock after subtracting highways and water/sewer infrastructure capital stocks, has a negative and statistically significant coefficient.

Holtz-Eakin (1992) examined the relationship between public sector capital and private productivity. He estimated production functions using data on annual real private gross state product as well as regional private gross product as dependent variables. Total public capital was entered into the production function. He controlled for unobserved region and state-specific characteristics. He found that the coefficient of public capital is not statistically significant. Holtz-Eakin argues that one of the major problems that leads to the lack of consensus among earlier researchers of the impact of state and local public capital stock on regional economic growth is the failure to control for unobserved or unmeasured state or regional characteristics. He argues that the results of previous research were exaggerated and misleading because when controlling for region or state-specific fixed effects the positive effects found by previous research for public capital on private productivity would disappear or become insignificant. (As discussed earlier in this study, Bartik, 1996, has explained other possible sources for the mentioned lack of consensus.)

Moomaw, Mullen and Williams (1995) examined the inter-regional impact of public infrastructure capital on economic performance. They estimated an aggregate translog production function entering public capital as an input, using state-by-state data for the years 1970, 1980 and 1986, to get state-by-state estimates of the output elasticity of aggregate public capital stock as a total as well as for the types of public capital used.

Using the resultant elasticity estimates, they conducted regional comparative analysis of the output elasticities. In addition to that they tested Hansen's hypothesis. They found that aggregate public capital as well as water/sewer capital stock variables have positive and statistically significant impacts on regional output. They concluded that:

> "Generally aggregate public capital and two of its components (highways, water and sewer systems) make a positive contribution to state output. Water and Sewer systems have a much larger effect on state output than highways and "other" public capital stocks, respectively. The regional influence on the impact of water and sewer systems is more pronounced for states in the south. The implication is that additional investment in waste disposal and water systems offers a greater stimulant to regional economy than increased public funding for highways. Also, a willingness, to facilitate the building of water and sewer infrastructure may allow states to maintain or enhance their competitive advantage in attracting new facilities and jobs." (Moomaw et. Al., 1995, p.843.)

Taxes:

"The impact of state and local taxes upon the ability of a state to attract new business investment has been and continues to be a subject of controversy. Economic theory suggests that inter-jurisdictional tax differentials should make a difference in the location of economic activity. Yet empirical evidence is inconclusive." (Olson, 1990, p.34)

Now we turn to empirical evidence on the effects of taxes on state and local economic development, which has been and continues to be a subject of controversy. This section will also cover the review of those empirical studies that have estimated the effects of taxes as well as those of public infrastructure capital, or more generally, public services, together in the same model. A more detailed review of this approach of estimating the effects of both taxes and public capital stock or public services is also presented in chapter III.

The concern of researchers and policy makers on the effects of state and local taxes on economic development has been due to such taxes being a major part of state and local economic development policies. State and local economic development policies include those policies that offer incentives to attract businesses. Such incentives include grants, such as land grants, or the right-to-use certain local natural resources at below-market prices; low-interest loans for new firm openings, tax incentives such as property tax abatements and other types of tax exemptions; and what Bartik (1991) has termed "new wave" economic development policies which encourage innovation and business expansion into export markets. Tax incentives constitute the major component of economic development policies.

The concern of researchers and policy-makers about the effects of state and local taxes is thus due to two considerations: the effect of tax levels on the ability of a state or local economy to attract businesses; and the fact that tax incentives are very expensive, in terms of tax revenue lost. Yet, competition among states and localities for additional economic development has continued. The recent attention to the deterioration of public infrastructure has increased the interest of researchers and concern of policy makers to find out the extent of the effects of state and local taxes on economic development. The quality of public infrastructure is seen as having a potential influence on state and local economic development through its effects on private output and at the same time on the attractiveness of the state or local area for businesses. Lower taxes or higher tax incentives are seen as having potential impacts on firm location decisions.

Most of the studies on the relationship between state and local taxes and economic development use either firm location models or some measure of economic growth within the context of a firm location model. This is because the theoretical framework of a location model uses as explanatory variables, a scope of factors that have potential direct or indirect effects on the revenues and the costs to firms. Taxes are viewed as costs by the profit-maximizing firm.

Most econometric models of firm location, or growth within the context of a firm location model, are cross-sectional analysis. It is typical to find the percentage change in the number of firms, or percentage change in the growth measure - whether output, employment or private capital - , regressed on factors that are expected to have potential impacts on business profitability.

The general consensus of previous empirical studies on the effects of state and local taxes on economic development is that there are no statistically significant effects of state and local taxes on state or local economic development. The most recent empirical research tends to find a significant relationship between state and local taxes on state or local economic development.

There are three main reasons that are usually stated for explaining why changes in state and local taxes have little or no significant impact on state and local economic development. First, there are so many other factors that affect business location decisions and state and local taxes do not constitute a major one. Second, interstate or inter-jurisdictional tax differentials do not constitute a considerable difference in business cost, and such differentials might be outweighed by differences in amenities or market-climate.

Third, the number of footloose firms that might be attracted by tax incentives is not large enough.

However, a considerable number of recent empirical studies of the effect of state and local taxes on economic development have found statistically negative effects of such taxes on state and local economic development. Bartik (1991) has summarized 57 studies since 1979 that have examined the impacts of state and local taxes on some measure of state and local business activity, such as employment, output, or private capital stock. Seventy percent of them (i.e. 40 out of 57 studies) have found at least one statistically significant negative tax effect. He concluded that evidence indicates that state and local taxes have much stronger effects on state and local economic development than was believed previously.

Survey evidence also presents mixed views on the impact of tax differentials on business locations. Early questionnaire surveys indicate no considerable impact of taxes on firm locations, whereas very recent surveys indicate that there is some impact of taxes on business locations. However, survey evidence is not very reliable. Firms may exaggerate the role of tax differentials on business location, especially their responses with regard to tax incentives. The significance of tax coefficients in firm location models is, by itself, not necessarily sufficient to conclude from empirical evidence that tax decreases or incentives can benefit a state or local economy

It is difficult to draw any conclusions based on the evidence reviewed. However, an even more interesting question can be raised within the context of the effects of tax

incentives. Suppose tax incentives are effective in attracting businesses and/or expanding existing businesses and thus creating jobs, and suppose further that those jobs do benefit people in the state or locality under consideration, then the question is: are such policies cost-effective?

Lynch (1996) used data on the cost per job of several state and local tax incentive packages and Bartik's estimate of the long-run elasticity of business activity with respect to state and local taxes (-0.1 to -0.6) and roughly calculated that the cost per job created by tax reductions for 1991 varies between $9,000 and $53,000 per year. His review of empirical studies concluded that "while benefits of tax cuts and incentives are insignificant or questionable at best, their costs are clear and probably more substantial." (Lynch, 1991, p.952). He gave several reasons why the findings of recent econometric research that tax cuts are effective in creating jobs and enhancing state and local economic growth are not valid. The most important of these reasons was that the positive effects of tax cuts reported by Bartik (1991 - 94) were based on the assumption that taxes can be cut without reducing public services. He argued that the assumption that tax cuts can be financed by welfare programs reductions is not sound and tax cuts are mainly financed by non-welfare cuts, i.e. cuts in public services.

It is important to note that Lynch did not argue that business tax incentives are not effective in creating jobs, but instead he questioned whether they do that in a cost-effective manner. The most important question raised by Lynch was: which effects on growth are stronger, the positive effects of tax cuts (incentives) or the negative effects of public services reductions made to finance such tax cuts?

Four econometric studies (Helms 1985, Bartik 1989, Munnell 1990, and Bartik 1996) found that increases in state and local taxes for financing increases in public services have positive effects on state and local economic growth. Lynch noted that although there are only four studies, they should give pause to the proponents of tax cuts financed by decreases in public services.

A review of the notable individual empirical studies may help to summarize the major results with respect to tax incentives and economic development.

Carlton (1979) examined the factors that influence the location decisions of firms. He tested the statistical significance of tax variables within other variables, on firm location. The units of observation were large SMSA's in the U.S. His model explained new births of manufacturing firms, including new single establishment firms and new branch plants. The industries studied were plastic products, electronic transmitting equipment, and electronic components. He used Dun and Bradstreet data on new single established births for two periods, each approximately for four years: 1967-71 and 1972-75. Data on new branch plants was for one period: 1967-71. Variables used include wages, corporate tax rates, property taxes measured by effective property taxes, state personal income tax, a measure of electricity cost, natural gas cost, a measure of agglomeration (production man-hours in three codes of 4-digit SIC code industry in an SMSA), number of engineers by SMSA, incentives offered by an SMSA, unemployment rate, and other variables.

Results for the tax variables are either of the wrong sign or statistically insignificant. He concluded that it is not evident that taxes provide strong deterrents to business location. The coefficients for wages and agglomeration variables were significant and indicate that such variables are likely to have considerable impacts on new firm location.

Carlton then tried to explain why tax variables perform poorly.

> "It is difficult to understand why taxes do not matter more strongly in influencing new births, especially in view of the frequent public clamoring of business against taxes. One possible explanation is that because of immobility of certain factors of production, taxes are totally born by factors of production in terms of lower remuneration" (Carlton, 1979, p.37)

The other reasons he gave are, in general, not different from the ones discussed earlier in this section.

Plaut and Pluta's (1983) empirical study of the relationship between business climate, taxes and public spending and state and local industrial growth was summarized earlier in our review of the empirical evidence on the effects of public capital on regional economic development. Therefore, all that remains is to mention their results on the tax variables they included in their estimation. The business climate, tax and expenditure variables they used as a group were found to be insignificantly related to overall state industrial growth, but significantly related to the other two measures of growth they used, i.e. state employment and private capital stock growth. Individually, poor business climate and high tax effort seem to have a negative effect particularly on employment growth. The sign of the property tax coefficient is statistically significant but is positive. The explanation offered by Plaut and Pluta is that high property taxes indicate that the tax

system is a locally dominated tax system (i.e. not state-dominated) and firms might be attracted to those states that have locally-dominated tax systems to avoid high state taxes, in addition to the possibility that local taxes might be matched by local public services.

Wazylenko and McGuire's (1985) empirical study of the effects of business climate on state employment growth rates is reviewed earlier in this study. However, their results on their estimates of the effects of tax variables deserve mention here. The coefficient on the personal income tax rate was significant and negative for retail trade, wholesale trade and finance industries. However, it is not significant for total state employment as well as the three other major industries: manufacturing, transportation and services. The sales tax is significant only for wholesale trade, and neither significant for total employment, nor for the remaining five major industries. The effective corporate income tax variable was not significant for any of the industries, nor for total employment.

Helms' (1985) study is also outlined above. His results for his tax variables are that both of the tax measures (property tax and 'other' taxes) have no statistically significant impact on the growth of states' personal income for the period 1965-79. An interesting and very outstanding finding by Helms in that study is that the net effect of an increase in property taxes used to finance an increase in education spending was positive for the growth of state income, for the period of the study. This point is very crucial, since a positive and statistically significant effect of an increase in public capital stock or public services would not by itself be sufficient information to policy makers. Similarly, a negative and significant coefficient of a tax variable would not by itself be a sufficient

reason for policy makers to adopt tax cuts or tax incentives to attract businesses. Helms model is a useful framework to estimate the net effect of a policy package, especially if we bear in mind that increases in state and local public infrastructure capital stocks or public services are usually for the most part financed by increases in state and local taxes.

Bartik (1985) examined the potential determinants of location decisions for Fortune 500 firms for the period 1972 to 1978. He found a negative and statistically significant impact of the effective corporate tax rate. However, he found the property tax rate, unemployed insurance tax rate and workers compensation tax coefficients statistically insignificant or of the wrong sign.

Other studies reviewed above, with regard to the effects of public infrastructure or public spending on economic growth, also estimated the effects of tax variables. Schmenner, Huber and Cooke's (1987) study indicated that corporate tax rates, as well as property tax variables had no statistically significant impact on the location decisions of new Fortune 500 plants opened in 1970s. Papke's (1987) study found no statistically significant impact for the ACIR business tax, and effective state tax rates on new private investment. Wasylenko (1988) found a negative and statistically significant effect of state and local tax revenues, as a percent of state income, on employment growth in two major industries: manufacturing and non-durable manufacturing industries, but in none of the other five major industries. His results also had the wrong (unexpected) signs for the coefficients of two other tax variables in four major industries.

Alicia Munnell (1990a), with a primary interest in examining the impact of public capital stock on state employment growth, examined the effect of taxes on state

employment growth in the period 1980 to 1988. She constructed an employment growth model within the context of a firm location model, based on the disequilibrium adjustment model. The tax variable included in the model was state tax revenue scaled by state personal income. The results show that this tax variable has a negative and statistically significant coefficient.

Munnell's study is one of the few studies that considered estimating the net effect of public infrastructure capital stock increases and tax increases made to finance them, following the approach set by Helms (1985) outlined above. Munnell found that increases in total state and local taxes used to finance improvements in public infrastructure were likely to have a positive impact on the state private employment growth rate.

Bartik's (1996) study is one of the other few studies that followed Helms' approach in estimating the net effect of increases in taxes used to finance increases or improvements in public infrastructure. He found that increases in property taxes used to finance increases in higher education and health care, would increase the long-run manufacturing output in the state.

CHAPTER III

THEORETICAL FRAMEWORK

In this chapter we describe the theoretical framework on the basis of which we examine the effects of state and local public infrastructure capital stocks and taxes on regional economic growth. The first section presents the underlying theoretical model. The second section explains how the independent variables are related to employment growth.

Underlying Theoretical Model:

In their study that examines the effects of changes in the potential for federal offset and price/migration tax exporting on state tax structures, Gade and Adkins (1990) modeled the choice of taxes at the state level as if a state government official maximizes her effective voter support. Although the problem studied is different, in what follows we are going to use some of the steps of their modeling. Suppose that a state government growth, which can be measured by state employment growth (E), public infrastructure (agent maximizes a welfare function (W). His welfare is a function of state economic G), and non-business taxes (T_2):

$$W = W(E, G, T_2) \quad \text{---------- (1)}$$

W is positively related to E, but negatively related to T_2, because T_2 is positively related with household out-migration. McFadden (1974) regards human choice of geographical locations as the result of individual maximization of a specific utility function. Higher non-business taxes motivate households to move out of state, causing a fall in tax revenue collected in the state. Higher T_2 borne by households also erodes voter support for the state government agent. For these reasons, W is also positively related to G.

The state employment growth (E) is a function of the number of firms (N):

$$E = E(N) \quad \text{---------- (2)}$$

According to Fox and Murry (1990), each firm assigns a welfare level, or rank for each geographic location. This welfare index depends on expected profits (π), public infrastructure capital (G), and non-business taxes T_2, where each has an observable value. Therefore, the number of firms is a function of π, G, and T_2:

$$N = N(\pi, G, T_2) \quad \text{----------(3)}$$

This specification shows that firms may not necessarily choose the location that maximizes profits, because either the owner or the decision-making manager may choose the location because of the quality of life, or the burden of taxes that he expects to be paying from his personal income, even if it is not the location that maximizes profit. The quality of life is affected by G and T_2.

A firm's profit function is given by :

$$\pi = P(D, S, Q)\,Q - C_1(w, h, Q, G) - C_2(T_1) \quad \text{---------- (4)}$$

where P is an inverse demand function, and is a function of market demand (D), number of competitors (S) and quantity (Q): w is input price vector, h is labor productivity, and G is a set of public infrastructure capital stocks. Note that we have modified Fox and Murry's (1990) profit function, and instead of a per unit sales tax and a tax on inputs, the cost function is split into two parts, where C_2 is a function of the vector of business taxes, T_1.

After evaluating all sites considered, a firm constructs a vector of indirect profit functions π^*, composed of its valuation of expected profit at each site, and expressed in terms of parameters:

$$\pi^* = \pi^*(D, S, w, h, G, T_1) \quad \text{----------} \quad (5)$$

Substituting Eq(5) into Eq(3) and then the results of that into Eq (2) yields:

$$E = E(D, S, w, h, G, T_1, T_2) \quad \text{----------} \quad (6)$$

Note that our empirical model is going to be built on Eq (6). The state government agent has direct control on G, T_1, and T_2, but not on the other factors.

After completing the discussion on the specification issues below, the hypothesized channel and direction of the effects of each of the variables in Eq(6) will be discussed. Some other factors/variables that determine the effects of some of the variables in Eq(6), such as market demand, will also be introduced.

In the above framework, taxes and the provision/increases in public infrastructure capital stocks are mutually dependent. The state government agent chooses the optimal mix of taxes and the desired increases in the public infrastructure capital stock. This choice includes the decision of how much of increases (or improvement) in public

infrastructure capital is desired, and consequently how much additional tax revenue has to be collected. There is an optimal mix as between tax increases and public capital increases. The government official's choice also includes the type or types of public infrastructure capital to be increased, on one hand, and the optimal mix of taxes, as between business and non-business taxes, on the other hand. The efficient mix in every choice is the one that has the most positive (or least negative)impact on firm location decisions. Firms react to the type of policy mix by moving into the state (or jurisdiction), not moving in, moving out, not moving out, opening a new branch, or branches, or not opening a branch.

Both the product and input markets are perfectly competitive. Private inputs are assumed to be geographically mobile. McLure (1970) explained the determinants of the degree of geographic mobility of private inputs and found that the geographic mobility of any factor can be expected to increase with time, and with the degree of perfection of markets, especially with respect to the availability and accessibility of information on geographic differentials in earnings possibilities. For the purpose of our model, we assume that private inputs are geographically mobile, but not perfectly mobile.

Regarding the existence of interstate differentials in taxes, as discussed in chapter I, evidence by ACIR (1981) and Wheaton (1983) and others indicate that there are interstate tax differentials, specially in business taxes.

How independent variables are related to employment growth:

Now we turn to the factors/variables that affect the dependent variable "employment growth" in Eq(6); explain how each variable affects employment growth

(or firm location decisions) and thus what is the expected sign of that effect as suggested by theory. In the empirical model in Chapter IV we explain how each variable is measured.

The main factors that affect location decisions can be grouped as:

(a) Business climate and public infrastructure.

(b) Costs and availability of factors of production.

(c) Market and environment.

Considering the first group, the term "business climate", mainly refers to factors such as state and local taxes, laws, and labor unionization. So, group (a) includes public infrastructure capital stock and taxes. Public infrastructure includes non-military non-residential structures and equipment including transportation facilities , such as streets, highways, railroads, canals, airports, and harbors; water and sewer treatment facilities and networks; communication systems; and education facilities. Currently, about 90% of infrastructure capital stocks is owned by state and local governments. So, as Gramlich (1994) stated, if infrastructure investment is a problem, it may be much more a state and local problem than a federal problem. Chapter II includes a detailed explanation of the potential channels through which public capital can affect the production and location decisions of a firm. As hypothesized by Meade (1952), public infrastructure can affect a firm's profitability as it enters the production process as an 'unpaid factor' of production and as an 'atmosphere factor' that augments the productivity of private inputs. The theoretical framework adopted for this study has the advantage of allowing for estimation of the total potential effect of public capital on economic growth, whether such effect is

mainly through its being an 'unpaid factor' or an 'augmenting factor' or both. The effect of state and local infrastructure capital stock on economic activity can be estimated as the effect of 'total' state and local infrastructure capital stock. However, increases or improvements in some type(s) of such stock might be more effective than other types, i.e. the marginal benefit differs across types, depending on the age and condition of the existing stock, business and urban expansion. Therefore, the factors that affect firm location decisions and state and local employment growth include total state and local infrastructure capital stock as well as its types. Thus, the effects of types of public capital stock shall also be considered in estimation.

Chapter II of this study also includes a detailed explanation of how taxes can affect production and location decisions of firms. Business taxes are considered from firms' perspectives as costs. Therefore, total business taxes can cause locational differentials in business profitability. Total taxes paid by individuals also may influence location decisions of firms, because firm owners or upper-level managers who make location decisions might take into account the tax bill that falls on their individual incomes. These two types of tax bills are T_2 and T_1, respectively in Eq (6). On the basis of the above discussion, an increase in either of them is expected to have a negative impact on the number of firms and thus on employment growth in the state or local economy.

Group (b) of the potential factors that affect the firm location decisions and thus employment growth, includes cost and availability of factors of production. The most relevant factors include wages, energy costs, current unemployment level, level of education, and welfare transfers. These shall be discussed in turn below.

Following Plaut and Pluta (1983), money capital is assumed to flow somewhat freely between states and localities, and, therefore, there is no considerable variation in the cost of money capital between geographic locations, since interest rates tend to almost equalize across regions. Therefore, the cost of money capital is not included with the variables that are expected to have a differential impact on the cost of businesses. It is worthwhile noting that it is the geographic differential in the factor cost that matters for the purpose of this study. Regarding the cost of money capital, the point is not the extent to which it matters to the cost side of the firm's profit function, but the extent to which it causes geographic profitability differential.

The cost of labor is, of course, not only wage. There are other costs incurred by firms towards labor input. These include several types of fringe benefits provided to employees, cost of training, and insurances, among other things. Wages are used to measure the cost of labor because it is the element that is, in general, expected to cause the major geographic labor cost differential. Since wages are costs to businesses, it is expected that the higher the wage, other things being equal, the lower the level of profits.

Another attribute of the labor market is the availability of labor. The state unemployment rate is used to represent the availability of labor. A high state unemployment rate indicates more availability of labor, and thus is expected to have a positive impact on business location decisions and thus employment growth.

A third variable that is intended to represent the labor market is the level of education as a measure of the quality of labor. This is represented by a measure of

university graduates as is explained in the empirical model, and is expected to be positively related to the state employment growth rate.

Another variable that is partly related to the availability of labor and partly related to the business climate, as well as to the market demand, is a measure of welfare. It is believed that some welfare programs have direct negative impact on the availability of labor, because of their negative impact on the incentive to work. However, there are other potential effects of the welfare programs on the business environment. To the extent that they create a lower rate of crime, a higher sense of altruism, and a positive effect on market demand, they would have a positive effect on business. However, it can be shown, in the empirical model that if the data is processed a certain way, a negative impact of welfare on employment growth would be expected.

Two measures of energy costs are considered. One of them is the price of electricity and the other is a broader measure of energy from the various energy sources. Energy cost enters the cost part of the profit function, and thus, the sign of the coefficient of the energy measure/variable is expected to be negative.

Group (c) of the potential factors that affect firm location decisions and the state employment growth, includes measures of market and climate. A measure of urban population is used to capture the size of the state and local market demand. This seems to be a reasonable indicator of the size of the state and local market. A considerable portion of the local demand is from the urban population, with a higher concentration of households and businesses, where services constitute a major part of small business activities. Such a variable is also a measure of agglomeration. So, for these reasons, it can

be hypothesized that this measure of urban population would be positively related to the state and local employment growth rate.

Another important complementary measure of the market demand could be personal income. However, although some other researchers included personal income, it does not seem appropriate to use this variable on the right-hand-side of a regression equation that has as the dependent variable, in essence, a proxy for per capita income growth. So, personal income is not used as an explanatory variable in this study.

A measure of state temperature is used to represent the state climatic conditions. Such conditions are hypothesized to have implications on most of the aspects of business profitability, such as business costs through energy consumption for heating or cooling, as well as the costs and availability of labor (not only wages), market demand, transportation costs, and other considerations. Businesses located in the 'Snow' regions are hypothesized to incur more of such costs and thus negative impacts on markets and labor availability than businesses located in the 'Sun' regions. Therefore, the above mentioned temperature measure/variable is expected to be positively related to state employment growth rate.

CHAPTER IV

EMPIRICAL MODEL

In this chapter, the first section presents the empirical model specification. The second section outlines the data construction and sources. The third section contains estimation procedures.

Specification:

On the basis of the underlying theoretical framework specified in the previous chapter, the goal is to specify an empirical model and to estimate it, using the relevant data, so that the potential effects of state and local public infrastructure capital stocks and taxes on employment growth can be estimated.

Several economic indicators of economic development could be used, such as private productivity growth, gross state output growth, private capital stock growth, and employment growth, to estimate the impact of public capital and taxes on regional economic growth. However, as seen from empirical literature, and as indicated by DeRooy (1978) and Munnell (1990a), employment growth rate is the best measure of economic growth, and is the one that receives much attention by researchers, especially at the state level. So, based on the theoretical model and previous discussion, the empirical

model constructed is an employment growth model within the context of a firm location model. It examines the relationship between the state employment growth rate, as the dependent variable, and the independent variables that might explain the variability of employment growth across states, as indicated in the theoretical model.

On the basis of the theoretical model, the general econometric model is as follows:

$$\begin{aligned} \mathbf{empgrow}_i = {} & \beta_0 + \beta_1 \mathbf{pubcap}_i + \beta_2 \mathbf{bustax}_i + \beta_3 \mathbf{indtax}_i + \beta_4 \mathbf{wage}_i \\ & + \beta_5 \mathbf{u}_i + \beta_6 \mathbf{grad}_i + \beta_7 \mathbf{transfer}_i + \beta_8 \mathbf{energ}_i \ (\text{or } \mathbf{elect}_i) \\ & + \beta_9 \mathbf{urban}_i + \beta_{10} \mathbf{temp}_i + \mathbf{e}_i \end{aligned} \qquad \text{---------- (7)}$$

where empgrow $_i$ = [empgrow $_1$,empgrow $_2$, ..., empgrow $_{48}$] is a 48 x 1 vector of observations on the employment growth rate. [β_0 ,...., β_{10}] is an 11 x 1 vector of unknown parameters, to be estimated; [pubcap,....., temp] is a 48x10 matrix of observations on the explanatory variables; and e_i is a 48x1 vector of unknown, unobservable, random errors, satisfying the classical Linear Regression Model (CLRM) assumptions:--

1. E (e_i) = 0 , i.e. the mean vector of e_i is zero. This implies that E(y_i) = Xβ where X is the matrix of observations on the explanatory variables; β is the vector of parameters as above.
2. Cov(e) = E [e e ′] = $\sigma^2 I_{48}$

Assumptions (1) and (2) sate that the error terms are independently and identically distributed. The specification of identical variances of the random variables (e_{48}) , and $empgrow_{48}$, over all the 48 observations, i.e. $E(e^2) = \sigma^2$, says that the errors are specified as homoscedastic. (Judge et. Al., 1988.)

3. X_{ij} is nonstochastic.

Equation (7) is the general form of the econometric model to be estimated. There are several variations that are made to this general model. First, 'pubcap' is state and local total public capital stock. Another version of the model is formed by replacing 'pubcap' by different types of state and local public capital stock, which are defined below. Second, equation (7) does not include regional fixed-effect dummy-variables. Other versions of equation (7), as well as the one that replaces 'pubcap' with types of public capital stock, include intercept dummy variables ($B_o dj$) to control for region-specific unobservable characteristics. $B_o dj$ is a vector of such intercept dummy variables, where j = MWD, SD, WD are abbreviations for the Mid-west, south, and west dummy variables.

The variables included in the different versions of the econometric model are defined as follows, where more detailed explanations are given in the data section (all are per state, and dollar amounts are in 1988 dollars) :--

Empgrow: average annual percentage change in private nonagricultural employment for the years 1988 to 1993.

Pubcap: state and local total public capital stock, per non-farm employee, in the year 1988.

Strehigh: state and local streets and highway public capital stock, per nonfarm employee, 1988.

Sewage: state and local public capital stock on water and sewer facilities 1988.

Edu: state and local education public capital stock per nonfarm employee, 1988.

Strswage = strehigh + sewage.

Stredu, swgedu, strwgedu, restpubk are variables formed for the purpose of this study as strehigh + edu, sewage + edu, strehigh + sewage + edu, and pubcap – (strehigh + sewage + edu), respectively.

Bustax: sum of state business taxes, divided by corporate profit, 1988.

Indtax: sum of taxes paid by individuals, divided by state personal income, 1988.

Wage: average hourly wage in the manufacturing sector, 1988.

U: state unemployment rate in 1988, defined by the U.S. Bureau of the Census as the "percent unemployed of the civilian labor force" U.S. Bureau of the Census (1990).

Grad: the number of university graduates per 100 persons aged 22 and over. So, it is the percent of population, in the mentioned age range, that have attained a graduate level, by 1988.

Transfer: the sum of AFDC + MIDICAID amounts paid by the state (as its share, i.e. not including the Federal share), per one thousand dollars of state personal income in 1988.

Energ: the price of energy per million Btu's (British thermal units) in 1988. It is an average of the prices of energy from all different sources in the state. The Btu is defined in the Data section.

Elect: the price of electricity per million Btu, 1988. Note that either 'energ' or 'elect' will be used in a regression equ, but not both.

Urban: % of state population residing in metropolitan areas in 1988.

Temp: the normal daily maximum temperature for the month of July, 1988.

The three assumptions stated earlier in this section, that E(e) = 0, Cov(e) = E[ee'] and Xij is nonstochastic, are necessary and sufficient for the Gauss-Markov theory to hold. Note that the fourth assumption for such theory to hold, i.e. Lim $T \to \infty$ X'X/T is finite and non-singular, is not assumed above because it is readily satisfied, on the basis of our calculations. The Gauss-Markov theory states that under the Classical Linear Regression Model (CLRM) assumptions: b(OLS), i.e. Ordinary Least Squares estimator is the best linear unbiased estimator of β.

There are four basic issues that have to be addressed here. The first has to do with the a priori linear specification. A linear statistical model means "that the specification is linear in the unknown parameters but not necessarily linear in the treatment of the explanatory variables." [Judge et. Al. 1978 p. 185] As explained in the estimation section, a formal test, "Mackinnon–White–Davidson", or in abbreviation form "MWD", test (Gujarati, 1995) is performed for one version of the general model to select the correct functional form, either linear or log-linear. The other versions are then checked by inspection of standard errors.

Second, the parameters of the model are estimated by use of cross-sectional data, since "location decisions of economic agents are long term in nature and inferences about long-term behavior are more appropriate from cross-section analysis," (DeRooy 1978, p.

48.) In the disequilibrium-adjustment model, the change in the dependent variable throughout the period is regressed on the levels of the explanatory variables at the beginning of the period. It is assumed that differences in non-farm profitability are large enough to cause differences in the rates of non-farm growth. This is the key assumption behind the disequilibrium adjustment model. It is based on the assumption of initial locational disequilibrium. The disequilibrium adjustment model, as explained by Plaut and Pluta :

> "is commonly used in cross-sectional studies of regional growth. In each regression, the change in the dependent variable over the period is related to the levels of tie independent variables at the beginning of the period. The independent variables in the regressions capture differentials in manufacturing profitability across states: differentials in manufacturing profitability then cause differentials in the rate of industrial expansion across states." (Plant and Pluta, 1983, p.102)

Cross-sectional data, explained below, is thus used to estimate our empirical model.

Third, OLS is selected is selected to estimate the model. According to Gauss-Markov theorem, under the CLRM assumptions, its estimator, the vector b, is BLUE, i.e. best linear unbiased estimator. There are two requirements for the selection of OLS. The first is homoscedasticity, i.e. $E(e^2_i) = \sigma^2$ for all i. This means the error terms have identical variances over all observations. Heteroscedasticity is likely to exist in economic cross-section data, because large errors are likely to be associated with large observation units while small errors tend to be associated with small observation units. (Judge et. Al, 1988, p. 327). The consequence of heteroscedasticity is that, if it exists and is ignored, OLS vector of estimations would still be unbiased, but not the best, i.e. not efficient.

Then, t and F tests would be misleading. Formal tests are thus performed in this study for checking for heteroscedasticity.

The other assumption to be checked regards the possibility that each cross-section unit has a different coefficient vector. When such situation occurs, or when errors of different observation units at the same time period are correlated, (i.e. contemporaneous correlation), the OLS estimation would not be efficient, and seemingly unrelated regression (SUR) estimator is used. In order to test the structural stability of the model, the Chow test is performed. The results of such test indicate whether or not it is necessary to use slope dummy variables for sample partitions, to allow for differences in coefficients. As is explained in Judge (1988, p. 468), this is a simple and appropriate way, especially for cross-sectional data. In this case, since slope dummy variables are already used, there is no need for testing for contemporaneous correlation.

The above explanation completes the discussion on the choice of OLS, and thus it is concluded that OLS is chosen because under the specified procedures, its estimator vector remains BLUE according to Gauss-Markov theory. Other tests, regarding other issues, are outlined in the estimation section.

The fourth basic issue associated with the estimation of our main model involves controlling for region-specific unobservable characteristics. Such controls are either performed by a random effects model (REM) or a Least Squares Dummy Variable (LSDV) model. The REM is appropriate when the individuals on which we have data are considered as a random sample from a larger population and we are interested in inferences about the population. If such individuals cannot be considered as a random

sample from a larger population, or we are interested in those individuals only, then LSDV is appropriate. (Judge et. al.1988, p.489). The REM treats the region-specific effects as random effects. The LSDV model treats the region-specific effects as fixed effects. LSDV model is thus a fixed-effects model (FEM). The LSDV model just introduces an intercept dummy variable for each group (on cross-section), or region as in our model, and then estimation proceeds by OLS. The LSDV estimator is BLUE. (Judge et. Al. 1988 p. 489). Since the states constitute all 48 contiguous states, and we are not interested in inferences about a larger population, and the states are not a random drawing from a larger population, FEM (LSDV) is appropriate for our case.

Data:

The data for estimating the multiple regression model of this study is cross-sectional. On the basis of the disequilibrium-adjustment model, the dependent variable, which is the average annual growth rate of private non-agricultural employment over the period, is regressed on the levels of the explanatory variables at the beginning of the period.

> "Public spending's effects on economic development would be expected to occur only gradually over time. This assumption is implicit when using public capital as the measure of public services. Measured public capital at any point in time is simply some complex distributed lag function of past public capital investment. Public spending on other public services such as education may also have effects on economic development only after a considerable lag. In the case of education, the quality of educational services may not improve until some years after an increase in funding. After educational quality has improved, it will take some time for the quality of the local labor force to improve. Similar arguments can be made for other types of public spending.

> Hence, all estimates of the effects of different types of public spending allow for public spending in a given year to have effects on economic development up to 11 years later. Taxes are also allowed to have up to an 11-year lagged effect." (Bartik, 1996, p.42.)

Public capital stock data used is for the year 1988. This allows the calculations of average annual private nonagricultural employment growth rates for up to 8 years. The 11 year period is the maximum to which tangible effects of public spending are expected to extend. However, a period up to 8 years is satisfactory. Several time periods are considered in the estimation since the period in which public capital spending might have considerable effects is unknown. Specifically, the dependent variable is measured as the average annual percentage change in private nonagricultural employment for the years 1988-1995 (or 1988-1994, 1988-1993, etc.) for each of the 48 contiguous states. The levels of the explanatory variables on which the average nonagricultural employment growth rate is regressed are for the year 1988.

The choice of using private nonagricultural sector as the dependent variable is a matter of both availability and accuracy of data, as well as the notion that the effects of state and local public infrastructure capital stock and spending are usually more manifest in such sectors. Source for data on the state-by-state annual private non-farm employment is the U.S. Bureau of the Census, Statistical Abstract of the United States, 1991-1996. The percentage change in employment growth is calculated for each year, and the average growth rate is calculated for each of the periods considered in the study.

Public infrastructure includes non-military non-residential structures and equipment including transportation facilities , such as streets, highways, railroads, canals,

airports, and harbors; water and sewer treatment facilities and networks; communication systems; and education facilities.

The state-by-state public capital stock estimates are constructed by Holtz-Eakin (1993) for the year 1988. The Bureau of Economic Analysis (BEA) constructs total public and private capital stocks at the national level each year. However, state-by-state estimates of public and private capital stocks were unavailable until recent years. The BEA also publishes nominal annual public capital investment flows for each state. Holtz-Eakin used that investment data, after deflating it by the BEA deflator for purchases of structures by state-local governments, and calculated public capital stock estimates following the BEA perpetual inventory approach used in constructing similar measures at the national level. To provide a benchmark capital stock at the state level, the BEA national aggregate real net capital stock for the state-local sector for the U.S. as a whole is apportioned to each state. Then the level of public capital investment flow is related to the capital stock through the common scale effect. Depreciation rates are computed, capital accumulation is valuated, and the process continues until total public capital stocks are calculated for each state. The state level data is then disaggrgated for the state and local level separately, to provide information for the different levels of government. For detailed explanation of the procedures involved, refer to Holtz-Eakin (1993).

The state and local public capital stock variables used in this study are listed and defined in the previous section, and include total state and local public capital stock as

well as the different categories of state and local capital stock. (The Appendix to this chapter includes a summary of the variables used in this study.)

The variable "bustax" is defined as the sum of state business taxes for 1988 divided by corporate profits for that year. This does not include all of the taxes paid by businesses, but the major taxes paid by businesses. The items left out of the calculations are left out due to unavailability of data or lack of data that can be used for apportioning the tax to the to business and non-business sectors. However, the items left out from calculations of the data for this tax variable are of small magnitude and are left out also from the calculations of "indtax."

State total property tax revenue is available from ACIR publications. However, no data is available for state and local business property taxes or the business share of the total for 1988. The most recent year for which property tax revenue is reported for types of property taxes, i.e. residential, industrial, farm and public utilities, is 1983 (ACIR, 1986, pp. 89-93). Assuming that all residential property tax is non-business tax, all public utilities and farm taxes are business taxes, total property taxes revenue for 1988 is apportioned to business and nonbusiness (i.e. to 'bustax' and 'indtax'), based on the 1983 breakdown. The ratio of state and local tax revenue from residential property to total state and local property tax revenue for 1983 is calculated by dividing such tax revenues, respectively, for that year. The ratio is used for apportioning state and local total property tax revenue for 1988. The data for 1988 is from ACIR (1991, p. 56).

State and local general sales tax revenues per state for 1988 are from ACIR (1991, p. 34). They are apportioned to business and non-business taxes using an index created by Ring (1989) for the consumers' share of state and local general sales taxes for the year 1979.

Data for corporate profit, corporation license, and severance tax revenues for 1988 is directly from ACIR (1991, p. 55, p. 48, and p. 60, respectively.)

Thus, data for the variable "bustax" is calculated for each state by adding the property, general sales, corporate profit, license and revenue taxes paid by the business sector. The sum is scaled by dividing it by the state corporate profit for 1988, which is available from the same source as that for the corporation profit tax.

The data for the variable "indtax" is calculated in a similar manner. It is thus calculated by taking the sum: residential property tax revenue + revenue from sales tax on consumer goods + individual income tax, and scaling such sum by dividing it by state personal income tax revenue.

'Wage' is used to represent the cost of labor. It is measured as the hourly wage for the manufacturing sector (as a proxy for non-manufacturing sector) for 1988. The source of data is U.S. Bureau of the Census, Statistical Abstract of the United States, 1994, p.762.

The state unemployment rate in 1988, U%, is used to represent the availability of labor. It is defined by the U.S. Bureau of the Census as the 'percent unemployed of the

civilian labor force.'(U.S. Bureau of the Census, Statistical Abstract of the United States, 1990).

The variable 'Grad' is used as a measure of labor quality. It defined as the number of university graduates per 100 persons aged 22 and over in a state. So, it is the percentage of state population, in the mentioned age range, that has attained a graduate level. The source for this data is: National Center for Education Statistics, Education in States and Nations, 1993, p. 61.

The variable 'transfer' is used as a measure of welfare transfers in a state. Using the total welfare amount does not seem appropriate for measuring the effect of welfare transfers on firm location. The variable 'transfer' is calculated for the purpose of this study, in a manner different from previous studies, as AFDC + MEDICAID paid by the state (as its share, not including the federal share) as per $1000 of state personal income. Plaut and Pluta (1983), and others, used total welfare (including the federal share and items of other welfare programs) and their results gave a positive sign for the welfare coefficient. This was unexpected classified welfare as a government expenditure that is undesirable by firms and expected a negative sign. However, a positive sign should not be a surprise to them. They used data that should be expected to give a positive sign from the individual state's perspective, because some of the major welfare programs are wholly funded by the federal government and thus exogenous to a state, other things being equal, and the rest of the programs are on the average funded to over 50% by the federal government. I expect the sign and magnitude of the coefficient of the variable 'transfer' to be a good indicator of the effect of welfare transfers in the context of the firm location model. The sources used in calculating such data are : (1) U. S. Bureau of the Census,

Statistical Abstract of the United States, 1990, 1991, and: (2) Social Security Bulletin, Annual Statistical Supplement, 1989, p.82, and 1990, pp. 283, 315.

The variable 'Energ' is used to measure energy cost in a state. It is the price of energy per million Btu's (British thermal units.) A Btu is defined by the U.S. Energy Information and Administration as the amount of energy required to raise the temperature of 1 pound of water 1 degree F (Fahrenheit) at or near 39.2 degrees F. So, the variable 'energ' is an average of the prices of energy from all different sources in the state. The source of data is U. S. Department of Energy, Energy Information Administration, State Energy Price and Expenditure Report. 'Elect' is the price of electricity per million Btu's. The data source is the same as for the energy variable. Either 'Energ' or 'elect' will be used in a regression, but not both.

"Urban" is used a measure of market demand. It is defined as the percentage of state population residing in metropolitan areas in 1988. Data for urban population figures are available only for 1970, 1980 and 1990. However, urban population and metropolitan population figures are very close to each other. Munnell (1990a) used the percentage of state population residing in metropolitan areas and called that variable "URBAN". The same approach will be taken in this study. Data is taken from the U.S. Bureau of the Census, Statistical Abstract of the United States, 1990, p. 28.

'Temp' is the normal daily maximum temperature for the month of July. It is used to approximate the state climatic conditions that might affect business and household location decisions. Data is taken from U. S. Bureau of the Census, Statistical Abstract of the United States, 1994, p. 239.

Estimation Procedures:

On the basis of the underlying theoretical model, the empirical model is specified in the first section of this chapter. The goal is to estimate the empirical model, using the data described in the previous section, to look at the effects of state and local public infrastructure capital stocks and taxes on private non-agricultural employment growth. To achieve this goal, several models are estimated, using appropriate software procedures. The following subsections outline those models, procedures and tests performed.

Regression equations:

On the basis of the study problem and objectives outlined in chapter I, several empirical models are estimated. (The following equations are called regression equations each time to differentiate them from the numbered equations of the theoretical model.) They are different variations of the general econometric model, equation (7):

$$\begin{aligned} \mathbf{empgrow}_i = {} & \beta_0 + \beta_1\,\mathbf{pubcap}_i + \beta_2\,\mathbf{bustax}_i + \beta_3\,\mathbf{indtax}_i + \beta_4\,\mathbf{wage}_i \\ & + \beta_5\,\mathbf{u}_i + \beta_6\,\mathbf{grad}_i + \beta_7\,\mathbf{transfer}_i + \beta_8\,\mathbf{energ}_i\ (\text{or } \mathbf{elect}_i) \\ & + \beta_9\,\mathbf{urban}_i + \beta_{10}\,\mathbf{temp}_i + \mathbf{e}_i \qquad \text{---------- (7)} \end{aligned}$$

Regression equation (1):

First, one regression is fitted, including the variables in equation (7), and estimated, with state and local public capital stock as total, not disaggregated to types, and without controlling for fixed effects.

$$\text{empgrow}_i = \beta_0 + \beta_1 \text{pubcap}_i + \beta_2 \text{bustax}_i + \beta_3 \text{indtax}_i + \beta_4 \text{wage}_i$$
$$+\beta_5 u_i + \beta_6 \text{grad}_i + \beta_7 \text{transfer}_i + \beta_8 \text{energ}_i \text{ (or elect}_i)$$
$$+ \beta_9 \text{urban}_i + \beta_{10} \text{temp}_i \quad \text{..... Reg. Eq.(1)}$$

Regression equation (2):

Second, a regression equation, which is same as regression equation (1) but with fixed effects (intercept) dummy variables, is fitted and estimated.

$$\text{empgrow}_i = \beta_0 + \beta_1 \text{MWD} + \beta_2 \text{WD} + \beta_3 \text{SD} + \beta_4 \text{pubcap}_i$$
$$+ \beta_5 \text{bustax}_i + \beta_6 \text{indtax}_i + \beta_7 \text{wage}_i + \beta_8 u_i$$
$$+ \beta_9 \text{grad}_i + \beta_{10} \text{transfer}_i + \beta_{11} \text{energ}_i \text{ (or elect}_i)$$
$$+ \beta_{12} \text{urban}_i + \beta_{13} \text{temp}_i \quad \text{..... Reg. Eq.(2)}$$

Regression equation (3) :

This is the same as equation (2), but with "bustax" as the only tax variable. The "indtax" variable is dropped because it proved to be insignificant. in equation (2).

$$\text{empgrow}_i = \beta_0 + \beta_1 \text{MWD} + \beta_2 \text{WD} + \beta_3 \text{SD} + \beta_4 \text{pubcap}_i$$
$$+ \beta_5 \text{bustax}_i + \beta_6 \text{wage}_i + \beta_7 u_i + \beta_8 \text{grad}_i$$
$$+ \beta_9 \text{transfer}_i + \beta_{10} \text{energ}_i \text{ (or elect}_i) + \beta_{11} \text{urban}_i$$
$$+ \beta_{12} \text{temp}_i \quad \text{..... Reg. Eq.(3)}$$

Regression equation (4) is the same as equation (2), but with state and local public capital stocks disaggregated to types. So, the variable "pubcap" is replaced with the types of public capital defined in the empirical model in the first section of this chapter.

Regression equation (5) is the same as regression equation (4), but with 'bustax' as the only tax variable. Again, the "indtax" variable is dropped, because it was insignificant in the results of equation (4).

Regression equation (6) is the same as (5), but with slope dummy variable for "strwgedu". Like other regression equations, this is reached through several runs where slope dummy variables were introduced to all variables and found to be significant for "strwgedu" only. More detailed explanation is given in the procedure section below.

Regression equation (7) is the same as (6), but it includes "strwedlo" which is the variable "strwgedu" for the cross-section of observations that includes the 25 lowest per-capita income states, group "Lo". This is explained in the procedure section below.

Regression equation (8) is the same as (7), but it replaces "strwedhi", which is the variable "strwgedu" for the 23 highest per capita income states, group "Hi", with "strswahi".

Regression equation (9) is the same as (8), but it replaces "strwedhi" with "strhi", ch is the variable of streets and highways for group "Hi".

Summary of Variables Included in the Regression Equations

Equation	Variables included
1	pubcap , bustax , indtax , wage , u , grad , transfer , energ , urban , temp
2	MWD , WD , SD , pubcap , bustax , indtax , wage , u , grad , transfer , energ , urban , temp
3	MWD , WD , SD , pubcap , bustax , wage , u , grad , transfer , energ , urban , temp
4	MWD , WD , SD , bustax , indtax , wage , u , grad , transfer , energ , urban , temp , strwgedu
5	MWD , WD , SD , bustax , wage , u , grad , transfer , energ , urban , temp , strwgedu
6	MWD , WD , SD , bustax , wage , u , grad , transfer , energ , urban , temp , strwedlo
7	MWD , WD , SD , bustax , wage , u , grad , transfer , energ , urban , temp , strwedhi
8	MWD , WD , SD , bustax , wage , u , grad , transfer , energ , urban , temp , strswahi
9	MWD , WD , SD , bustax , wage , u , grad , transfer , energ , urban , temp , strhi

Procedure:

Estimation is conducted and various software procedures are used to compare the statistics and explanatory power of variables and to select the size and composition of the

model that best explains the variability in the dependent variable. The "stepwise" procedure, as explained by SAS Guide (Helwig, 1978 p.69), performs stepwise regression by entering the independent variable one by one into the regression equation in a way to maximize the explained variability and at the same time economize in the number of independent variables entered. This helps to avoid over or under specification. Stepwise by itself does not determine the appropriate specification, but the stepwise results are used along with different test results to avoid over or under specification.

For each of the regression equations (1) to (9) a stepwise procedure is used to perform a stepwise regression, with all of the explanatory variables included in the pool of explanatory variables from which the stepping is done. The pool or group of candidate explanatory variables for each of the regression equations is indicated in the preceding section on regression equations. In each regression equation, a set of variables is included. These comprise the variables of interest, which are state and local public capital stock or tax variables. Then, the stepwise procedure steps into the regression other independent variables one by one in the manner described above. The independent variables forced in the regression equation are as follows:

Regression equation No.	**Independent variables forced in**		
1	pubcap	bustax	indtax
2	pubcap	bustax	indtax
3	pubcap	bustax	
4	bustax,	indtax	

5	bustax
6	bustax
7	bustax
8	bustax
9	bustax

As from regression equation (5) to regression equation (9), the public capital stock is disaggregated and is not in total. So the variables of public capital types are not forced in, but left for the stepwise procedure to select from them.

To avoid over or underspecification, Durbin-Watson 'd' and Ramsey Reset II tests are used as model specification tests. On the basis of the stepwise results, and these model specification tests, as well as the other tests outlined in the following subsection, model selection is made, and the regression equations (1) to (9) are fitted.

Many executions of stepwise are done with state-fixed controls as intercept dummy variables for individual states, taken one at a time, as well as several at a time, in a way to preserve degrees of freedom. However, individual state fixed effects dummy variables are not found statistically significant, but the results of the group intercept dummy variables tended towards significance of regional fixed effects. Thus, the regional fixed effects dummy variables were included in regression equations (2) to (9). It is worth noting that it made no difference whether region intercept dummy variables are forced in

the regression equation a priori or they are stepped in by the stepwise procedure. In other words if not forced, they are stepped in and statistically significant in all cases.

Regression equations (6) to (9) include slope dummy variables. Slope dummy variables are introduced to all independent variables and found statistically significant only for the variables included in these equations. The purpose of including these dummy variables is to test the validity of our claim about the inappropriateness of averaging the effects of taxes and public infrastructure capital stock across states, even after controlling for unobservable state or region-specific characteristics by intercept-shift dummy variables that prove significant.

Then the states are arranged in an order according to the level of growth attained by 1988, measured by state per capita income. A formal structural stability test, the Chow test, (see Gujarati,1995), is performed to the complete model (of 48 states) after including the dummy variables for intercept change across regions. Such test takes alternative groupings of arranged observations and finds if structural stability fails at certain subgroupings. The results of the Chow test indicate that the slope parameters change, with groups 23, and 25, of the ordered observations. Since the states are ordered according to the level of growth from higher to lower, we call the first group of 23, at the end of which the system is dichotomous, group 'Hi', and the remaining states, group 'Lo'. It is more efficient to still estimate the model with the 48 states introducing slope dummy variables for one group. (Judge et. al., 1988.) This is what is done in regression equations (6) to (9). More detailed explanations of such equations are given in the next chapter.

Tests:

A Mackinnon-White-Davidson "M-W-D" test is performed for the selection of the appropriate functional form. The result is a linear specification of the empirical model.

In small samples, the t, F, and Chi Square tests require the normality assumption. (Gujarati, 1995, p.145.) A normality test is performed for each of the estimated regression equations. The software program calculates statistics of Jarque-Bera and Chi Square tests of normality, as well as Skewness-Kurtosis-Omnibus tests. All the regression models estimated have sufficiently passed the first two tests of normality, and there was no need for Skewness-Kurtosis, which is usually used if the other tests failed.

As discussed in the empirical specification section, in order for the Gauss-Markov theory to be valid, and thus the OLS estimator to be BLUE, one of the assumptions that has to be valid is that the error terms should have identical variances over all observations. Then there is no significant presence of heteroscedasticity. Heteroscedasticity is likely to exist in economic data, specifically cross-sectional data. The Breusch-Pagan-Godfrey test is sensitive to the assumption of normality, especially in small sample observations. However, that does not constitute a problem since we have already tested for normality. Both B-P-G and Glejser tests are used, and there is a presence of heteroscedasticity but not of a serious or significant level.

Because the independent variables are measured at the beginning of the period, there is no need for simultaneous-equation estimation. Endogeniety is unlikely to occur in the equilibrium adjustment mechanism used in this study.

Both Durbin-Watson 'd' and Ramsey Reset II tests are used to test for model specification error. These test for over-specification, or the inclusion of extraneous variables, or underspecification, which is the exclusion of significant relevant variables. These tests were already used for model selection during the stepwise process, rather than being used to check for the specification after the model is selected or fitted.

It is already explained above that the Chow test is used for testing the structural stability of the models. A Klein rule-of-thumb test is used for testing for multicollinearity. It indicates no serious presence of multicollinearity in the models without dummy variables. Multicollinearity usually becomes high when slope dummy variables are used, but that is unavoidable.

Overall, no corrective procedures were needed for any estimation problem.

Appendix - Chapter IV
Summary of Variables

	Variable	Definition	Source & Year	Expected Sign
1	**Empgrow:**	Average annual percentage change in private nonagricultural employment for the years 1988 to 1983.	U.S. Bureau of the Census, Statistical Abstract of the United States, 1991-1996.	N/A
2	**Pubcap**	State and local total public capital stock, per non-farm employee, in the year 1988	Holtz-Eakin (1993)	Positive
3	**Strehigh**	State and local streets and highway public capital stock, per nonfarm employee	Holtz-Eakin (1993)	Positive
4	**Sewage**	State and local public capital stock on water and sewer facilities per nonfarm employee, 1988	Holtz-Eakin (1993)	Positive
5	**Edu**	State and local education public capital stock per nonfarm employee, 1988	Holtz-Eakin (1993)	Positive
6	**Strswage**	3+4	Holtz-Eakin (1993)	Positive
7	**Stredu**	3+5	Holtz-Eakin (1993)	Positive
8	**Swgedu**	4+5	Holtz-Eakin (1993)	Positive
9	**strwged**	3+4+5	Holtz-Eakin (1993)	Positive
10	**Restpubk**	2-'9	Holtz-Eakin (1993)	Positive
11	**Bustax**	Sum of states business taxes, divided by corporate profit, 1988.	ACIR (1988-1991)	Negative
12	**Indtax**	Sum of taxesw paid by individuals , divided by state personal income, 1988.	ACIR (1988-1991)	Negative
13	**Wage**	Average hourly wage in the manufacturing sector,1988.	U.S. Bureau of the Census, Statistical Abstract of the United States, 1994, p.762.	Negative
14	**U**	State unemployment rate: percent unemployed of the civilian labor force.	U.S. Bureau of the Census, Statistical Abstract of the United States, 1990.	Positive

15	**Grad**	Number of university graduates per 100 persons aged 22 and over.	National Center for Education Statistics, Education in States and Nations, 1993, p. 61.	Positive
16	**Transfer**	Sum of AFDC + MIDICAID amounts paid by the state (as its share, i.e. not including the Federal share), per one thousand dollars of state personal income in 1988	Social Security Bulletin, Annual Statistical Supplement,1989,1990.	Negative
17	**Energ**	Price of energy per million Btu's (British thermal units) in 1988. It is an average of the prices of energy from all different sources in the state. The Btu is defined in the Data section.	U. S. Department of Energy, State Energy Price and Expenditure Report ,1990.	Negative
18	**Elect**	Price of electricity per million Btu, 1988. Note that either 'energ' or 'elect' will be used in a regression equ, but not both.	U. S. Department of Energy, State Energy Price and Expenditure Report ,1990.	Negative
19	**Urban**	Percentage of state population residing in metropolitan areas in 1988.	U.S. Bureau of the Census, Statistical Abstract of the United States, 1990.	Positive
20	**Temp**	The normal daily maximum temperature for the month of July, 1988.	U.S. Bureau of the Census, Statistical Abstract of the United States, 1994.	Positive

CHAPTER V

RESULTS AND ANALYSIS

The first section in this chapter presents regression results and analysis of the coefficients of public infrastructure capital stocks and taxes. It presents the general results for such variables of primary interest, explains the coefficient magnitudes, discusses what they indicate, and calculates the (balanced-budget) net effects of tax increases used to finance infrastructure increases. The second section presents and discusses the coefficients of the rest of the explanatory variables.

Infrastructure and Taxes:

Results:

In each of the nine regression equations estimated, the F-statistic indicates significance of the regression, with p-value of zero. Estimation results show reasonable precision, where almost all of the standard errors of estimates are of less magnitudes than the corresponding coefficients of estimates, and in each of the final models [(3),(5),(7),(8) and (9)] all of the standard errors are much smaller than the corresponding coefficient estimates. The R^2 is 0. 58 for regression equation (1). This is considered reasonably high since the model is explaining changes, and not levels, of the dependent variable. (Plaut

and Pluta, 1983). The R^2 values for the equations with dummy variables are quite large, and that is due to the dummy variables, and does not reflect how much variability is explained. In general, the results are in line with what is expected on the basis of the theoretical model.

The results of regression equations(3), (5), and (7) are reported in Table 1, Table 2, and Table 3, respectively. The results of regression equations(1), (2), (4),(6),(8), and (9) are included in Appendix A-1.

In regression equation (1) state and local public capital stock is entered as total, not disaggregated to types. No intercept dummy variables are used to control for region- or state-specific fixed effects. As seen in Table A-1-1 in Appendix A-1, the coefficient of the variable 'pubcap' is positive and statistically significant at 8% level. The coefficient of 'bustax' is negative, but not statistically significant. The coefficient of 'indtax' is positive (wrong sign) and not statistically significant. This poor performance is probably due to the failure to control for region or state unobservable characteristics.

Regression Equation (2) is the same as regression equation (1), but with fixed effects (intercept) dummy variables. Intercept dummy variables are introduced for the four regions, but technically only three dummy variables are included to avoid the 'dummy variable trap'. (Judge et al 1988; Gujarati 1995). But that does not mean that we have not controlled for the four regions. We have, since there is an overall intercept used for the fourth region. Estimation with this fixed effects model (FEM), which is the Least Squares Dummy Variable model (LSDV), yields a better performance than the results of regression equation (1). The results of this estimation are reported in Table A-1-2 in

Appendix A-1. All coefficients are statistically significant except those of 'pubcap' and 'indtax'. However, the positive coefficient on 'pubcap' and the negative coefficient on indtax' are as expected. Note that all the intercept dummy variables for regions are statistically significant, with p-values of zero.

Results of regression equation (3) are reported in Table 1 below. This regression equation is the same as equation (2) but with 'indtax' dropped, since its coefficient in regression equation (2) is not statistically significant. All coefficients are statistically significant at 5% level except 'pubcap' coefficient.

In the results of regression equation (1), 'pubcap' was statistically significant at 8% level. In the results of regression equation (3), 'pubcap' is not statistically significant even at 20% level. These results indicate that, when controlling for region-specific unobservable fixed effects, the coefficient of 'pubcap' becomes statistically less significant. This supports the trend in previous research, and especially Holtz-Eakin's (1992) argument that when controlling for fixed effects, the effect of state and local "total" public capital stock on state economic development becomes insignificant or at least less significant.

The results of regression equation (4) are reported in Table A-1-3 of Appendix A-1. This regression equation is the same as equation (2), but instead of state and local "total" public capital stock 'pubcap', a type of state and local public capital 'strwgedu' is used. 'Strwgedu' is state and local public capital stock for streets-highways-sewage and education. Actually, it includes three types together. However, it is the variable that is stepped into the regression equation by the stepwise procedure. In Table A-1-3 of

Appendix A-1, the only two variables that are not statistically significant are 'indtax' and 'strwgedu'. The coefficient of the variable 'indtax' has a much smaller t-ratio than 'strwgedu' and thus 'indtax' is dropped.

Table 1

Results of Regression Equation (3)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.9023	0.3796	5.012	0.000
SD	1.3576	0.3915	3.468	0.001
WD	3.1602	0.3984	7.932	0.000
pubcap	0.000051448	0.00004613	1.115	0.272
bustax	-1.5177	0.6497	2.336	0.025
wage	-0.26232	0.1215	-2.160	0.037
energ	-0.31672	0.1278	-2.478	0.018
urban	-0.014324	0.005722	-2.503	0.017
temp	0.056408	0.02389	2.361	0.023
constant	0.88251	2.919	0.3023	0.764

Dropping 'indtax', as explained above, gives us regression equation (5), the results of which are reported in Table 2 below. The results of equation (5) indicate that

the only insignificant coefficient is that of 'strwgedu'. Although this regression equation (5) is reached by dropping 'indtax' from equation (4), it is also reached by direct stepwise, where this equation is ranked the best, with 'strwgedu' included in it with the same coefficient and t-ratio.

Table 2

Results of Regression Equation (5)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.8645	0.3800	4.907	0.000
SD	1.3987	0.3881	3.604	0.001
WD	3.1767	0.3926	8.092	0.0000
bustax	-1.4559	0.5564	-2.617	0.013
wage	-0.25254	0.1182	-2.136	0.039
energ	-0.31087	0.1269	-2.449	0.019
urban	-0.012487	0.006053	-2.063	0.046
temp	0.054641	0.02366	2.310	0.026
strwgedu	0.000060308	0.00004594	1.313	0.197
constant	0.7942	2.895	0.2743	0.785

Estimating regression equation (5) without the intercept dummy variables shows that the coefficient of strwgedu is 0.000119 and its t-ratio is 1.663. These are higher than the results shown in Table (2). This indicates that when controlling for fixed effects the impact of public capital stock on employment growth becomes less significant.

Regression equation (6) is the same as regression equation (5), but with the introduction of a slope dummy variable for 'strwgedu'. Slope dummy variables are found significant only for the capital variable. The results of regression equation (6), reported in Table A-1-4 in Appendix A-1, show that 'strwgedu' is statistically significant for the 'Hi" group. This includes the first 23 states in the descending order of states arranged according to the level of growth attained by 1988. It is not significant for the 'Lo' group.

Dropping the variable 'strwedlo' (dropping 'strwgedu' for 'Lo') results in regression equation (7). The results of regression equation (7) are reported in Table 3 below. All variables are statistically significant at 5% level. The coefficient of the capital variable is positive and significant at the 5% level.

Regression equation (8) is the same as regression equation (7), but 'strwgedu' is replaced by 'strswage'. This breaks down public capital even further into separate types. The results of regression equation (8) are reported in Table A-1-5 in Appendix A-1. When 'strswage' is broken down to two types, streets/highways and sewage, the coefficient on the streets/highways variable is statistically significant for the 'Hi' group at the 10% level, while that of 'sewage' is not significant. That is reported in Table A-1-6 in Appendix A-1.

Table 3

Results of Regression Equation (7)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.8309	0.3682	4.973	0.000
SD	1.3722	0.3763	3.646	0.001
WD	3.2812	0.3783	8.673	0.000
bustax	-0.94994	0.3893	-2.440	0.019
wage	-0.28632	0.1167	-2.454	0.019
energ	-0.43042	0.1246	-3.455	0.001
urban	-0.019483	0.005730	-3.400	0.002
temp	0.064213	0.02346	2.737	0.009
strwedhi	0.000044408	0.00002152	2.064	0.064
constant	1.9248	2.734	0.7018	0.487

The results of either or all of regression equations (7),(8), and (9) indicate that the assumption that state or region unobserved characteristics can all be included in the intercept by introducing intercept dummy variables, and that the slope parameters are the same for all observations, does not seem appropriate. When the slope dummy variables are introduced, the public capital stock variable has positive and statistically significant coefficient for the 'Hi' group, but not for the 'Lo' group of states. This suggests that,

when estimating the mean effect of public capital stock on employment growth, researchers are averaging effects across states, which might differ in their hierarchies of needs.

The results of regression equations (7) to (9) also indicate that the type or types of state and local public capital stock that have statistically significant coefficients are infrastructure types, mainly streets/highways and sewage. This supports some of the previous evidence cited in the literature review. It is possible that the 'Hi' group of states might be experiencing "bridge collapses, water main explosions, crumbling condition and catastrophic infrastructure failures", (Munnell 1990a), at a higher rate than the 'Lo' group of states. Greater deterioration of the public infrastructure in the 'Hi' group of states suggests that the gains from investment in public infrastructure are higher in thses states. The estimation results thus indicate that the marginal benefit, in terms of private non-agricultural employment growth, from public investment in streets/highways and sewage infrastructure is higher, and significantly different, in 'Hi' group than in the 'Lo' group. This supports the assertion by Eberts and Dalenberg (1988), and others, that public infrastructure deterioration in older cities, cities with an aging industrial base, has an important impact on urban economic development.

Explanation of coefficient magnitudes:

The magnitudes of the coefficients of the public infrastructure capital stock variables in the regression equations (7), (8) and (9) are reported in Table 3 above, Table A-1-5 and Table A-1-6 in Appendix A-1, respectively. The magnitudes are considerable, yet reasonable. They compare to, and tend to be a little larger than, those of other studies.

On the basis of Table A-1-6, increasing state and local public infrastructure capital stock on streets/highways by an amount of $100 per non-agricultural employee in 1988 would increase the average (for 5 years) annual growth rate of private non-agricultural employment by 0.008% in the 'Hi' group of states. This is a considerable effect, given that it is for a change in the average growth rate for five years. This compares to Munnell's (1990a) results. The estimated coefficient on public capital stock is 0.00008 and is for state and local infrastructure capital on streets/highways in the 'Hi' group of states, for 5 years, starting from 1988. Munnell's estimated coefficient is 0.0002, for state and local public capital stock as a total, for 8 years starting from 1980. The difference between the two estimates is smaller than it seems. Her capital variable is measured as total public capital stock per capita. The public capital stock variable in the current study is measured as public capital stock per non-farm employee. An increase of $100 per capita is more than an increase of $100 per non-farm employee. Population number is on the average twice non-farm employment. This makes Munnell's estimate about 50% smaller if her capital stock variable is measured as per non-farm employee instead of per capita. Munnell's estimates are for total public capital. Therefore, the effects are averaged across types. Her failure to control for fixed effects means that her estimates are for the mean of the 48 states. Evidence by previous studies and this study shows that when controlling for fixed effects the impact of public capital on growth becomes less significant or insignificant.

Table A-1-5 in Appendix A –1 shows that the coefficient of streets/highways and sewage for the 'Hi' group of states is 0.000578, which is higher than

the coefficient of 'strwgedu' of Table 3. This indicates that earmarking more public capital spending on streets/highways-sewage in a state from group 'Hi' would have a greater positive impact on growth than earmarking that increase in spending on streets/highways-sewage-education. The variable 'strwgedu' is picked by the 'stepwise' procedure when considering public capital for the mean state of the 48 states. However, as is apparent from above, when considering the 'Hi' states only, concentrating spending on streets/highways and sewage is more effective for non-farm employment growth (in the period of study) than spreading it over a wider range that includes education. However, this might be due to the fact the time period of the study is too short for increases in education capital to have effect on employment growth. Further, Table A-1-6 indicates that the coefficient of the public capital stock variable is even larger if the type of public capital considered for the 'Hi' states is streets/highways. This estimated coefficient is 0.000766. However, it is significant at 10% level only, not 5%, and thus is not strong evidence.

What do the results indicate about the relevant tax variable ?

Table A-1-5 shows that the coefficient of 'bustax' is negative and statistically significant at the 5% level. The results indicate that, when making location decisions, firms consider taxes paid by businesses, not just total state and local tax revenue. As indicated in the literature review, previous evidence that examined the impact of the level of total state tax revenue on employment growth is mixed. The finding of this study is unique, because all of the previous studies that examined the effects of taxes on public capital stocks or public spending on regional economic development have used total state

and local tax revenue, or types of taxes such as property taxes, sales taxes, or rates as their tax variables. The result that 'bustax' is statistically significant and 'indtax' is not suggests that, when considering firm location decisions, firms give more weight to taxes paid by businesses and not to taxes that fall on individual income. This might be because the business tax bill is more relevant, as it relates to the potential business profitability at different locations. Taxes on businesses might have a more negative impact on employment growth because they repel new businesses, drive existing businesses out, or deter new branch openings. One of the possible reasons why taxes paid by individuals do not have a significant effect on employment growth might be that labor is usually less mobile than capital, and thus taxes on individuals might not have much effect on labor supply. The evidence found by this study, if confirmed by other evidence, is important for policy makers. This is because tax revenue generated from business taxes can hurt employment growth much more than if it is generated from non-business taxes.

Calculation of the net effects of tax increases used to finance infrastructure increases:

Estimation of the regression equations has so far indicated that the coefficient of the public capital stock variable is positive and statistically significant, and the coefficient of the tax variable is negative and statistically significant. Now we want to see what the results suggest about the net effect of a policy package of a tax increase to finance an increase in public infrastructure.

Suppose that the state or local government increased business taxes 'bustax' and used the tax revenue generated from such a tax increase to finance an increase in

streets/highways and sewage. Suppose also that this is done in each of the 23 states of the 'Hi' group in 1988. It is worth noting that calculation of net effects are not done for the rest of the states because the coefficient of the public capital stock variable is not significant for them, and thus it is not meaningful to build any calculations or conclusions on a coefficient that is not statistically different from zero.

If 'bustax' was increased by 0.01, and the resulting tax revenue from such a tax increase is spent on state and local public infrastructure capital stock on streets/highways and sewage, then the net effects of this balanced-budget policy package on state and local private non-farm employment growth rate, by the end of a five-year period, are shown in Table 4. (See Appendix A-2 for calculations).

As shown in Table 4, the results suggest that, the net effect of a 0.01 increase in 'bustax' used to finance an increase in streets/highways infrastructure capital stock 'strhi' in each of the high growth states, in 1988, would have resulted in an increase in private annual average non-farm employment growth rate, for the years 1988 to 1993, for eight of those states, but a decrease in it in the remaining fifteen states. The negative effects of the above mentioned tax increase outweigh the positive effects of the increase in infrastructure capital stock financed by the tax revenue generated by the tax increase in fifteen of the twenty three high growth states. Thus, the state private non-farm average annual employment growth rate falls in those fifteen states. Potential entrance into the state might be repelled, new firm openings might be deterred, and existing firms could be driven out, because of the policy package. The positive effects of increases in streets and highways infrastructure capital stock outweigh the negative effects of tax increases, to

finance them, in eight of the twenty three high growth states. Thus, the private non-farm average annual employment growth rate rises.

Table (4)
Net effects of tax and public infrastructure capital increases

State	Net change in empl. growth rate
NH	-0.0003638306
VT	-0.0013690360
MA	-0.0004545556
RI	-0.0012210850
CT	0.0011153100
NY	0.0000351252
NJ	0.002239652
PA	0.0004731054
OH	0.0003443061
IL	0.0007249460
MI	0.0008453476
WI	-0.0000699889
MN	-0.00007806238
MO	-0.0002647526
KS	-0.0008759114
DE	0.004670051
MD	-0.001474373
VA	-0.001112042
GA	-0.0003312447
FL	-0.001748785
CO	-0.001022140
NV	-0.002941493
WA	-0.0006584812

However, this does not mean that a conclusion can be drawn, on the above mentioned net effects, that a policy package of tax increases to finance streets and highways in the high growth states in the mentioned period would have, on the average, resulted in a negative net effect. Two important points are to be noted. First, the above

calculations are made on the basis of 'bustax' as the tax variable. But the coefficient of this variable is statistically significant and of considerable, but not unreasonable, magnitude. This suggests that this variable is not the right one to be included in a policy package. To raise the same amount of revenue, non-business taxes are the right choice for policy makers. The above calculations are made on the basis of 'bustax' because it is the only tax variable that is statistically significant in the model. Of course, if it turned out that the net effect, on employment growth rate, of the tax increase and public capital increase is positive for all the high growth states, that would have been stronger evidence that the use of 'indtax' in the policy package would most likely yield positive net effects. However, indtax is not used in the experiment, and nothing can be concluded with confidence about the net effect if the non-business tax variable is used to generate the required revenue. No calculation for the net effect of a package that uses non-business taxes is possible within the results of this study, because it is not meaningful to build any calculations or draw any conclusions on a coefficient that is statistically not different from zero.

Second, although, due to the dis-equilibrium-adjustment model framework used, the average change in the dependent variable is for a period of 5 years, this is still very short when compared to the length of life most infrastructure has. The long-run net effect of the same policy package discussed is likely to be considerably different. In the long run, indirect effects of public infrastructure are likely to be substantial. Such indirect effects might not be captured by a coefficient that measures short-run or initial effects. It is worth noting that the increase in the tax rate is for one year, 1988 only. There is no

increase assumed for succeeding years. Thus, it seems that there is every reason for capital to have a positive effect in the long run, because the attractiveness of the area is improved, while the tax rate is set back to its previous level. The negative effect of the tax increase would last for a maximum of 11 years. (Bartik 1996.) That is the maximum. The positive effect of infrastructure increases would last for decades.

However, on the basis of our results, the most important point is that, the calculations are based on 'bustax' as the tax variable. But that is not the tax choice for policy makers in this situation. Non-business taxes are the choice for policy makers as suggested by the study, for the period of data and the high growth states.

Cost per job:

One other simulation can be done to look at the effect of taxes alone, without regard to public capital. Suppose that a general 0.01 cut is made in business taxes, 'bustax', in 1988, in each of the high growth states. What do the results of the estimated regression equations suggest about the effect of that tax competition action? On the basis of the explanations in the above section and Appendix A-2, the results of Table A-1-5, indicate that this tax cut would result in an increase of 0.0094942 in the annual average private non-farm employment growth rate for 5 years. For New Hampshire, e.g., this would cause an increase in private non-farm employment by 0.0094942 x 5 x 529,000 = 25,112 . The tax revenue lost, in New Hampshire, is $ 12,340,000. Therefore, the cost per job is $ 12,340,000/ 25,112 = $ 491. Table 5 shows the similar cost per job, as well as the number of jobs created, for each of the 23 states.

Table 5

Cost per Job and Jobs Created for a 0.01 Business Tax Cut

State	Jobs created	Cost per job
NH	25,112	491
VT	12,153	436
MA	148,394	486
RI	21,789	444
CT	79,514	573
NY	388,598	513
NJ	173,743	634
PA	239,348	537
OH	223,161	530
IL	242,007	551
MI	181,291	557
WI	102,965	507
MN	96,271	507
MO	107,236	496
KS	49,132	463
DE	15,855	768
MD	99,784	430
VA	131,637	450
GA	136,621	493
FL	240,536	415
CO	68,168	455
NV	25,539	349
WA	92,236	475

Other Variables:

With regard to the rest of the explanatory variables, the results are in general consistent with what theory suggests and what the theoretical model has hypothesized. The results of each of regression equations (7), (8) and (9) reported in Tables 3, A-1-5 and A-1-6 show that the coefficient of the variable 'wage', which is a measure of the cost of labor, has a negative sign and is statistically significant. This indicates that the cost of

labor is one of the factors that have significant effects on firm location and employment growth.

Including the variables u, grad and transfer, one at a time, in regression equation (7), which is one of the best-fit equations, gave the results of tables A-1-7, A-1-8, and A-1-9 in Appendix A-1. These results show that the coefficients of u and grad are positive (although the latter is positive for the low-growth states only), and thus consistent with the expected signs, suggesting that the availability and quality of labor are likely to have positive impacts on state economic growth, in the period covered by the study. This is in spite of the fact that, on the basis of the reasonably fitted models, such coefficients are not statistically significant. One possible explanation for insignificance of the coefficient of 'grad' might be that it measures higher education while businesses, especially small firms, are interested in medium-level vocational skills and trades. The backwash effect is another possible explanation. A considerable number of the people who attain high education levels in the low growth states move to high growth states. Another very plausible reason might be that such a measure is not a good measure of the quality of labor.

Similarly, the coefficient of the variable 'transfer', although not statistically significant in the best fitted models, has a negative sign as expected. Apparently, this is because the data for this variable is constructed in such a manner that it includes AFDC + MEDICAID paid by the state (as its share, not including the federal share). This makes this variable endogenous to the state, since it is financed from the state's own resources. Therefore, on the basis of how it is viewed from a firm's perspective, its coefficient is

expected to have a negative sign. This is because being financed from the state's own resources means that an increase in 'transfer' implies higher taxes or less state revenue available to other public resources, and/or because it decreases labor supply through its negative impact on the incentive to work.

The coefficient of the variable 'energ' is negative and statistically significant. This suggests that it is strongly related to firm location and private economic activity since it comprises a considerable portion of the cost of production for many types of businesses and thus affects firm profitability at a location.

The coefficient of the variable 'urban' has a negative sign and is statistically significant. As a measure of the size of the market and thus market demand it was expected to have a positive sign. One explanation of this negative sign is that urban can also be a measure of other factors that are negatively related to the dependent variable. For example, it might be an indicator of congestion, which might have a negative impact on employment growth due to the various negative effects of congestion, extending from crime, to competition in the use of public services. Increases in urbanization and the size of urban population might also be associated with pollution. The variable 'urban' might also be a measure of land cost, whereby a high urban population means high costs of land, and thus high costs of production, especially that the cost of land is not directly measured in our regression equations. Therefore, it is not of much surprise that the sign of the estimated coefficient for 'urban' is negative. This is similar to the results of other studies which have found that their variable 'population density', which is used for measuring market demand has the unexpected negative sign.

The coefficient of the variable 'temp' is, as expected, positive and statistically significant. A warm climate suggests lower energy costs. However, other possible explanations might be that warmer weather indicates greater availability and lower costs of labor, greater population and thus local market demand, especially for services, and might as well indicate certain geographic locations where land costs are low and natural resources are cheaper. In other words, it may capture some of the factors that are already represented by other variables in the regression equations, as well as other factors not measured in the regression.

CHAPTER VI

CONCLUSION

Conclusions:

This study examines the effects of state and local public infrastructure capital stocks and taxes on regional economic development. It does so in a framework that uses, among other explanatory variables, state and local public capital stock estimates, a new type of data, as well as measures of taxes that are consistent with a proper specification of the theoretical model. Estimation procedures are chosen to avoid and correct for the estimation problems that have plagued much of the previous empirical research.

The results indicate that, when controlling for region-specific unobservable characteristics, the estimated positive effects of state and local total public stocks on employment growth became statistically less significant. This supports Holtz-Eakin's (1992) argument that, when controlling for region- or state-specific fixed effects, the estimated effect of state and local public capital stocks on economic activity become insignificant or at least less significant. This suggests that the results of previous studies that failed to include such controls might have exaggerated the effect of public capital, especially total public capital, on economic growth.

Introducing slope dummy variables has indicated that the slope parameter for streets/highways & sewage , or streets/highways, public infrastructure capital stock is significantly different between the two groups of the 48 contiguous states: group `Hi' which includes the first 23 states that have higher levels of growth, measured by per capita income in 1988, and group `Lo', 25 states, which are the rest of the states. This indicates that the notion that the region or state-specific unobserved characteristics can all be controlled by intercept dummy variables assuming that slope parameters are the same for all cross-sections or observations does not seem appropriate.

Introducing slope dummy variables has indicated that the estimated effects of streets/highways & sewerage, or streets/highways public infrastructure capital stocks are positive and statistically significant for group `Hi', the high growth states, and not significant for group `Lo', the low growth states. The results of this study support Eberts and Dalenberg's (1988) assertion that public infrastructure in older cities, cities with an aging industrial base, has an important impact on urban economic development. This suggests that, when assuming that slope parameters are the same, results were averages of the effects of policies across all the states, which might differ in their hierarchies of needs.

Calculations of the net effects, on average annual private non-farm employment growth rate, of business tax increases to finance increases in state and local public infrastructure capital stock on streets/highways and sewage in the grown states indicate that such net effects are negative for fifteen of the high growth states, and positive for eight of them. However, this does not constitute a basis against the policy of tax increases

to finance infrastructure increases or improvements, because the mentioned calculations are made on the basis of business taxes as the tax variable, since it is the only statistically significant tax variable in the model. The tax variable of choice for policy makers should be non-business tax, because the results indicate that such a variable does not have a significant negative impact on employment growth. Besides, the net effects of tax increases to finance increases in public infrastructure capital are likely to be positive for most of the high growth states in the long run.

The results also indicate that when disaggregated to types, the estimated effects of state and local public capital stock become more significant and considerable. This suggests that the estimated effects of total state and local public capital stock are averages across the effects of types that are likely to differ in signs and significance and magnitudes. Further, the results indicate that the public capital types that have significant estimated effects are infrastructure types.

The results of the study suggest that, when taking location decisions, firms give more weight to interstate or inter-jurisdictional differentials in taxes paid by businesses than to taxes that are paid by individuals.

Policy Implications:

- It is useful to policy makers to have evidence that suggests to them what types of state and local public capital stock are more effective for regional economic development, and for what region, state or jurisdiction. The evidence provided by this study suggests that streets/highways and sewerage public infrastructure capital stocks are

more effective for employment growth in the high growth states, at least for the period covered by the study.

- It is important for policy makers to have evidence with regard to which taxes are least harmful to employment growth, given a certain amount of required revenue. Evidence provided by this study indicates that raising an additional amount of revenue would cause less harm to employment growth if it is raised by taxes that are paid by individuals (households) than if it is made by taxes that are paid by businesses. However, since such apportionment of taxes to business and non-business taxes is unique and only done for this study, more evidence is needed for other time periods.
- The results suggest that tax cuts are not effective for employment growth in some of the high growth states. Non-business tax increases to finance increases in public infrastructure on streets and highways are likely to have positive impact on employment growth in those states. However, specific tax incentives need to be considered individually.

Limitations:

Having specified a model as the correct model, there are four broad types of errors (Gujarati, 1955); omission of a relevant variable, inclusion of an extraneous variable, choice of wrong functional form and measurement errors. In this study, all possible caution has been taken to avoid such errors. A consistent theoretical framework is constructed on the basis of relevant economic theory. Data is processed using proper definitions, formulae and software.

- Capital stock data used is Holtz-Eakin (1993) estimates for the year 1988. So, it might be an advantage of this study that it has used Holtz-Eakin data, because his estimates were made later than Munnell's estimates and he has commented on some errors in Munnell's estimates. However, since such estimates are still constructed by an individual effort and not a government statistics entity, measurement errors are not an impossibility.

- State sales tax revenues for 1988 are apportioned, for the purpose of this study, to business and non-business taxes using Ring (1989) index for the year 1979. There is a very wide range of differences between the Ring index and other indices, including the ACIR index, (which seems primitive and based on Fryman(1969) index.)

State property tax revenue for 1988 is apportioned to businesses and non-businesses using the ratios of 1983, the most recent year for which data for state property tax revenue is available in types, as explained in the Data section.

- The results indicate that the variable 'urban' is not successful as a measure of the market demand, as explained in Chapter IV. A considerable number of empirical studies indicate that economists have used population density as a measure of market demand, and have consistently run into the same problem of encountering the wrong sign.

- The study is cross-sectional. The number of observations is 48. A greater number of observations means more degrees of freedom. That allows more precision, as well as the inclusion of more independent variables, since dummy variables use up degrees of freedom. Expanding the study across time and/or jurisdictional levels could be done upon availability of state and local public capital stock data.

Research Implications and Further Research:

- The results of this study generally indicate that the significance of state and local public capital stock becomes more clear, whether significant or not, the more state and local public capital stock data is broken to types and the more cross-sections on individual states or jurisdictions are considered. That might be the direction of research, specifically more evidence is needed to support, qualify or refute the attempt of this study with regard to the use of slope dummy variables which gave the results that a certain type or types of public infrastructure capital seem to be significant for the grown states and not the other states.
- The other unique contribution of the study that needs to be tested by further empirical work is the classification of taxes to business and non-business taxes. Probably more accurate methods can be adopted to perform such apportionment, and more types of taxes can be apportioned. There are indexes available for business and they might be used and tested with regard to their significance in business and location decisions.
- Further research can endeavor to find a better measure of market demand. Neither urban population, nor population density is a good measure of market demand.
- Further research can also be carried with a greater number of observations to provide more accuracy, and allow more explanatory variables and dummy variables to be included in the estimation.

References

Aschauer, David A., "Is Public Expenditure Productive ?" Journal of Monetary Economics, Vol. 23, No.2, 1989 pp.177-200.

Bartik, Timothy J.,"Business Location Decisions in the United States: Estimates of the Effects of Unionization, Taxes, and Other Characteristics of States," Journal of Business and Economic Statistics, Vol. 3, No.1, 1985, pp.1422.

---------, "Small Business Start-ups in the United States: Estimates of the Effects of Characteristics of States," Southern Economic Journal, Vol.55,No.4, April 1989,pp.1004-1018.

---------, "Who benefits from State and Local Economic Development Policies ?", Kalamazoo, Michigan: W. E. Upjohn Institute for Employment Research, 1991.

---------, "The Effects of States and Local Taxes on Economic Development: A Review of Recent Research," Economic Development Quarterly, Vol.6, No.1, 1992, pp.102-110.

_____,"Jobs, Productivity, and Local Economic Development: What Implications Does Economic Research Have for the Role of Government? ", National Tax Journal, Vol.47, No.4,1994, pp.847-61.

---------, "Growing State Economies: How Taxes and Public Services Affect Private-Sector Performance," Washington, D.C., Economic Policy Institute, 1996.

Baily, Ralph E.,"Memorandum of Dissent," Leadership for Dynamic State Economics, 1986, pp. 88-89.

Baum, Donald N.,"The Economic Effects of State and Local Business Incentives," Land Economics, Vol.63, No.4, 1987, pp.348-360.

Bennett, James T. ,"The Impact of the Composition of Government Spending on Private Consumption and Investment: Some Empirical Evidence," Journal of Economics and Business, Vol.35, No.2, 1983, pp.213-220.

Carlton, Dennis W., "Why New Firms Locate Where They Do: An Econometric Model," in 'Interregional Movements and Regional Growth', William Wheaton, ed., 1979, pp.13-50, Washington, D.C., The Urban Institute, Coupe Papers on Public Economics.

Costa, da Silva, Richard W. Ellson, and Randolph C. Martin, "Public Capital, Regional Output, and Development: Some Empirical Evidence," Journal of Regional Science, Vol. 27, No. 3, 1987, pp.419-437.

Courant, Paul N., "How Would You Know a Good Economic Development Policy If You Tripped Over One? Hint: Don't Just Count Jobs," National Tax Journal, Vol.47, No.4, 1994, pp.863-81.

Dalenberg, Douglas, "Estimates of Elasticities of Substitution Between Public and Private Inputs in the Manufacturing Sector of Metropolitan Areas," Eugene, Oregon: University of Oregon, unpublished Ph.D. dissertation, 1987.

Dalenberg, D., And R. W. Eberts, "Public Infrastructure and Economic Development," Economic Commentary, Federal Reserve Bank of Cleveland, Jan. 15, 1998, pp.1-4.

Deno, Kevin T., "The Effect of Public Capital on U.S. Manufacturing Activity: 1970 to 1978," Southern Economic Journal, Vol.55, No.2, 1988 pp.400-411.

DeRooy, Jacob, "Productivity of Social Overhead Capital: North-South Comparison," Review of Business and Economic Research, Vol.14, No.1, 1978, pp.44-60.

Dubey, Vinod, "The Definition of Regional Economics," Journal of Regional Science, 5, 1964, 25-29.

Eberts, Randall W. "Estimating the Contribution of Urban Public Infrastructure to Regional Economic Growth," Cleveland: Federal Reserve Bank of Cleveland, 1986, Working Paper No.8610.

----------, "Some Empirical Evidence on the Linkage Between Public Infrastructure and Local Economic Development," 1989, in 'Industry Location and Public Policy', Henry W. Herzog, Jr. and Alan M. Schottmann (eds.), 1991.

----------, "Public Infrastructure and Regional Economic Development," Economic Review, Federal reserve Bank of Cleveland, Vol.26, No.1, 1990, pp.15-27.

----------, "Cross-sectional Analysis of Public Infrastructure and Regional Economic Growth," Working Paper No. 9004, Cleveland, Ohio: Federal Reserve Bank of Cleveland, 1990b.

Eberts, R.W., D. Dalenberg, and C. S. Park, "Public Infrastructure Data Development for the NSF Project," Mimeo, University of Oregon, 1986.

Eberts, Randall W. And Kevin T. Deno, "Public Infrastructure and Regional Economic development: A Simultaneous Equation Approach," Cleveland: Federal Reserve Bank of Cleveland, 1989, Working Paper No.8909.

Eberts, Randall W. And Michael S. Fogarty, "Estimating the Relationship Between Local Public and Private Investment," Cleveland: Federal Reserve Bank of Cleveland, 1987, Working Paper No. 8703.

Eisner, Robert, "Infrastructure and Regional Economic Performance: Comment," New England Economic Review, Sept.-Oct. 1991, pp.47-58.

Fisher, Ronald C., "State and Local Public Finance", Irwin, Chicago, 1996.

Fox, William F. And Mathew N. Murray, "Local Public Policies and Interregional Business Development," Southern Economic Journal, vol.57,no.2, 1990, pp.413-427.

Fryman, Richard F., "Sales Taxation of Producers' Goods in Illinois," National Tax Journal, Vol.22, No.2, 1969, pp.273-81.

Gade, Mary N. And Lee C. Adkins, "Tax Exporting and State Revenue Structures," National Tax Journal, Vol. 43, March 1990, pp.39-52.

Garcia-Mila, Teresa and McGuire, Therese J., "The Contribution of Publicly Provided Inputs to States' Economies," Regional Science and Urban Economics, Vol.22, No.2, 1992, pp.229-241.

Gramlich, Edward M., "Infrastructure Investment: A Review Essay," Journal of Economic Literature, Nol.32, 1994, pp.1176-1196.

Grihfield, John B. And Therese J. McGuire, "Infrastructure, Economic Development, and Public Policy," Regional Science and Urban Economics, Vol. 27, 1997, pp.113-116.

Gujarati, Domar N., "Basic Econometrics," McGraw-Hill, New York, 1995.

Hansen, Niles M., "Unbalanced Growth and Regional Development," Western Economic Journal, Vol.4, No.1, 1965, pp. 3-14.

Harberger, Arnold C., "The Incidence of the Cooperation Income Tax," Journal of Political Economy, 1962, pp.215-240.

Helms, L. Jay, "The Effect of State and Local Taxes on Economic Growth: A Time-Series-Cross-Section Approach," The Review of Economics and Statistics, Vol. 67, No.4, 1985, pp.574-582.

Helwig, Jane T., "SAS Introductory Guide," SAS Institute, Cary, North Carolina, 1978.

Hirschman, A. O., "Interregional and International Transmission of Economic Growth," in The Strategy of Economic Development, (New Haven, Connecticut: Yale University Press), 1958, 183-201.

Holtz-Eakin, Douglas, "Public-Sector Capital and the Productivity Puzzle," Cambridge, Mass., National Bureau of Economic Research, Working Paper No. 4122, 1992.

----------, "State-specific estimates of state and local government capital," Regional Science and Urban Economics, Vol.23, 1993, pp.185-209.

Hulten, Charles R. And Robert M. Schwab, "Regional Productivity Growth in U.S. Manufacturing: 1951-78," The American Economic Review, Vol.74, No.1, 1984, pp.152-162.

Hulton, C. R. And R.M. Schwab, "Public Capital Formation and the Growth of Regional Manufacturing Industries," National Tax Journal, Vol.44, No.4, 1991, pp.121-134.

Judge, G. G., R. C. Hill, W. E. Griffiths, H. Lutkepohl, and T. C. Lee, "Introduction to the Theory and Practice of Econometrics," 2nd ed., Wiley, New York, 1988.

Looney, Robert and Peter Frederickson, "The Regional Impact of Infrastructure Investment in Mexico," Regional Studies, Vol.15, No.4, 1981, pp.285-296.

Lynch, Robert G, "The Effectiveness of State and Local Tax Cuts and Incentives: A Review of the Literature," State Tax Notes, Sept.1996, pp.949-53.

McKee, R. Dean, and W. Leahy (eds) : Regional Economics Theory and Practice (New York: The Free Press, 1970), 93-104.

McLure, Charles E., Jr. , "Taxation, Substitution, and Industrial Location," Journal of Political Economy, Vol.78, Jan.1970, pp.112-132.

McLure, Charles E., Jr. And W. R. Thirsk, "A Simplified Exposition of the Harberger Model I : Tax Incidence," National Tax Journal, 1975, pp. 1-27.

Meade, J.E., "External Economies and Diseconomies in a Competitive Situation," Economic Journal, Vol.62, pp.54-67.

Mera, Koichi, "Regional Production Functions and Social Overhead Capital: An Analysis of the Japanese Case," Regional and Urban Economics, Vol.3, No.2, 1973, pp.157-185.

----------, "Income Distribution and Regional Development," Tokyo, University of Tokyo Press, 1975.

Mill, John S., "Principles of Political Economy," W. J. Ashley (ed.), New York, Longmans, Green & Co., 1929.

Moomaw, Ronald L., "Productive Efficiency and Region," Southern Economic Journal, Vol.48, No.2, 1981, pp.344-357.

Moomaw, Ronald L., Mullen, J.K., Williams, M., "The Interregional Impact of Infrastructure Capital," Southern Economic Journal, vol. 61, no.3, 1995, pp.830-845.

Munnell, Alicia H., "How Does Public Infrastructure Affect Regional Economic Growth," New England Economic Review, Sept.-Oct.1990a, pp.11-33.

----------, "Why Has Productivity Growth Declined? Productivity and Public Investment," New England Economic Review, Federal Reserve Bank of Boston, 1990b, pp.3-22.

Olson, Kent W., "The Local Property Tax: Rejection or Reform ?" Oklahoma 2000, Inc., Oklahoma City, OK, Jan. 1990, p.34.

Papke, Leslie, "Subnational Taxation and Capital Mobility : Estimates of Tax-Price Elasticities," National Tax Journal, Vol.40, 1987, pp.191-203.

Perroux, F., "Note Sur la Notion de Pole de Croissance," Economie Appliqee, No.1, 1955, 307-320; translated as "Note on the Concept of Growth Poles" and reprinted in D.

Place, Frank, "The Relationship of State and Local Government Spending and Tax to Economic Performance: An Econometric Analysis of the States from 1972 to

1984," Wisconson Dept. of Development, Division of Policy Development, Bureau of Research Report No. RP-86-7, Sept. 1986

Plaut, Thomas R. And Joseph E. Pluta, "Business Climate, Taxes and Expenditures, and State Industrial Growth in the United States," Southern Economic Journal, Vol.50, No.1, 1983, pp.99-119.

Quan, Nguyen T. And John H. Beck, "Public Education Expenditures and State Economic Growth: Northeast and Sunbelt Regions," Southern Economic Journal, Vol.54, No.2, Oct.1987, pp.361-376.

Ring, Raymond J., Jr., "The Proportion of Consumers' and Producers' Goods in the General Sales Tax," National Tax Journal, Vol. XLII, No.2,1989, pp.167-179.

Robock, S. H., "Strategies for Regional Economic Development," Papers and Proceedings of the Regional Science Association, 31, 1966, 129-141.

Schmenner, Roger W., Joel C. Huber, and Randall L. Cooke, "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol.21, (1987), pp.83-104.

Wasylenko, Michael and Therese McGuire, "Jobs and Taxes: The Effects of Business Climate on States Employment Growth Rates," National Tax Journal, Vol.38, No.4, 1985, pp.497-511.

Wheaton, William C.,"Interstate Differences in the Level of Business Taxation," National Tax Journal, Vol.36, No. 1, 1983, pp.83-94.

Advisory Commission on Interregional Relations: Regional Growth, Interstate Tax Competition, Washington, D.C., 1981.

.Tax Capacity of the Fifty States, ACIR, Washington, D. C., April 1986.

Tax Capacity of the Fifty States, ACIR, Washington, D. C., April 1991.

U.S. Bureau of the Census, Statistical Abstract of the United States, 1990, p. 381.

Bibliography

Atkinson, A.B., and E. Stiglitz, "Lectures on Public Economics," McGraw-hill, 1980.

Ballard, C. L., J. B. Shoven, and J. Whalley, "General Equilibrium Computations of the Marginal Welfare Costs of Taxes in the United States," American Economic Review, 1985, pp.128-138.

Browning, E. K., "On the Marginal We3lfare Cost of Taxation," American Economic Review, 1987, pp.11-23.

Edgmand, Michael R., "Macroeconomics : Theory and Policy," Prentice-Hall, Englewood Cliffs, N. J., 1979.

Ekelund, R. B., and R. F. Hebert, "A History of Economic Theory and Method," McGraw-Hill, New York, 1990.

Fox, W. F., "Tax Structure and the Location of Economic Activity along State Borders," National Tax Journal, 1986, pp.387-401.

Musgrave, R. A., and P. B. Musgrave, "Public Finance in Theory and Practice," 5th edition, McGraw-Hill, New York, 1989.

Stuart, C., "Welfare Costs per Dollar of Additional Tax Revenue in the United States," American Economic Review, 1984, pp.352-362.

Wassmer, R. W., "Property Taxation, Property Base, and Property Value: An Empirical Test of the 'New View'," National Tax Journal, 1993, pp.135-159.

Appendix A-1

Results of Regression Equations (1), (2), (4), (6), (8), (9) and Versions of (7) including 'u','grad' and 'transfer'.

Appendix A-1

Results of Regression Equations (1), (2), (4), (6), (8), (9), and Versions of (7) including 'u', 'grad' and 'transfer'.

Table A-1-1

Results of Regression Equation (1)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
pubcap	0.00011779	0.00006696	1.759	0.086
bustax	-0.52933000	1.06900000	-0.495	0.623
indtax	12.83600000	17.29000000	0.742	0.462
energ	-0.41116000	0.16990000	-2.419	0.020
transfer	-0.3525800	0.082160	-4.291	0.000
constant	4.3166	1.712000	2.522	0.016

R^2 0.58

Table A-1-2

Results of Regression Equation (2)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.8946	0.3800	4.985	0.000
SD	1.2598	0.4049	3.111	0.004
WD	3.1106	0.4021	7.735	0.000
pubcap	0.000062819	0.00004767	1.318	0.196
bustax	-1.848600	0.7359	-2.512	0.016
indtax	-9.695200	10.09	-0.9608	0.343
wage	-0.268290	0.1217	-2.204	0.034
energ	-0.292350	0.1304	-2.242	0.031
urban	-0.013303	0.005826	-2.283	0.028
temp	1.664600	3.033	0.5488	0.586

Table A-1-3

Results of Regression Equation (4)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.8536	0.3807	4.869	0.000
SD	1.3121	0.3993	3.286	0.002
WD	3.1362	0.3954	7.931	0.000
bustax	-1.7309	0.6285	-2.754	0.009
indtax	-9.3850	9.928	-0.9453	0.351
wage	-0.25465	0.1184	-2.150	0.038
energ	-0.28878	0.1293	-2.234	0.032
urban	-0.011302	0.006189	-1.826	0.076
temp	0.049391	0.02433	2.030	0.050
strwgedu	0.000069372	0.00004699	1.476	0.148
constant	1.5853	3.017	0.5254	0.602

Table A-1-4

Results of Regression Equation (6)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.7724	0.3693	4.800	0.000
SD	1.3805	0.3742	3.689	0.001
WD	3.2237	0.3792	8.502	0.000
bustax	-1.3971	0.5372	-2.601	0.013
wage	-0.30560	0.1171	-2.610	0.013
energ	-0.38889	0.1286	-3.024	0.005
urban	-0.016574	0.006191	-2.677	0.011
temp	0.06431	0.02332	2.757	0.009
strwedlo	0.000053328	0.00004442	1.200	0.238
strwedhi	0.000095684	0.00004777	2.003	0.053
constant	1.1755	2.797	0.4202	0.677

Table A-1-5

Results of Regression Equation (8)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.8450	0.3678	5.016	0.000
SD	1.3880	0.3768	3.684	0.001
WD	3.2811	0.3788	8.661	0.000
bustax	-0.94942	0.3898	-2.436	0.020
wage	-0.27902	0.1161	-2.404	0.021
energ	-0.42497	0.1241	-3.425	0.001
urban	-0.01931	0.005718	-3.377	0.002
temp	0.063742	0.02346	2.718	0.010
strswahi	0.000057885	0.00002843	2.036	0.049
constant	1.8420	2.744	0.6712	0.506

Table A-1-6

Results of Regression Equation (9)

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.8570	0.3735	4.971	0.000
SD	1.4128	0.3827	3.692	0.001
WD	3.3286	0.3876	8.588	0.000
bustax	-0.93003	0.3959	-2.349	0.024
wage	-0.27934	0.1190	-2.348	0.024
energ	-0.42644	0.1282	-3.327	0.002
urban	-0.017716	0.00564	-3.141	0.003
temp	0.059415	0.02353	2.525	0.016
strhi	0.000076619	0.00004504	1.701	0.097
constant	2.1283	2.800	0.7602	0.452

Table A-1-7

Results of Regression Equation (7) Including the Variable 'u'

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	2.1065	0.3867	5.448	0.000
SD	1.7557	0.4050	4.335	0.000
WD	3.6138	0.3974	9.094	0.000
bustax	-0.89580	0.4276	-2.095	0.043
wage	-0.39708	0.1270	-3.127	0.003
energ	-0.37171	0.1466	-2.536	0.015
urban	-0.015650	0.0061	-2.576	0.014
strwedhi	0.000033225	0.00002326	1.428	0.161
U	0.030161	0.08782	0.3434	0.733
constant	7.5120	1.982	3.790	0.001

Table A-1-8

Results of Regression Equation (7) Including the Variable 'grad'

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.7248	0.3761	4.586	0.000
SD	1.4086	0.3752	3.754	0.001
WD	3.1880	0.3837	8.308	0.000
bustax	-0.93369	0.3871	-2.412	0.021
wage	-0.27682	0.1162	-2.382	0.022
energ	-0.38670	0.1289	-3.000	0.005
urban	-0.018393	0.005765	-3.191	0.003
temp	0.066939	0.02342	2.858	0.007
strwedhi	0.00009024	0.00004336	2.081	0.044
gradlo	0.023049	0.01897	1.215	0.232
constant	0.63859	2.924	0.2184	0.828

Table A-1-9

Results of Regression Equation (7) Including the variable 'transfer'

Variable	Estimated Coefficient	Standard Error	T-ratio	p-value
MWD	1.7864	0.3785	4.720	0.000
SD	1.2959	0.4000	3.240	0.003
WD	3.1754	0.4198	7.564	0.000
bustax	-0.89428	0.4032	-2.218	0.033
wage	-0.28684	0.1177	-2.444	0.001
energ	-0.43286	0.1257	-3.444	0.001
urban	-0.018107	0.006211	-2.915	0.006
temp	0.057076	0.02644	2.158	0.037
strwedhi	0.000045755	0.00002182	2.097	0.043
transfer	-0.036619	0.06062	-0.6041	0.549
constant	2.7165	3.061	0.8876	0.380

Appendix A-2

Calculation of the Net Effects of Increases in Streets/highways and the Tax Increases to Finance Them.

This Appendix outlines the calculation of the net effects, on employment growth, of the balanced-budget policy package experiment the results of which are shown in Table 4 in chapter V. The calculations are made for the most grown 23 states because the coefficient of streets/highways is statistically significant for that cross-section of states.

Table A-1-6 shows that the coefficient of 'strhi' is 0.000076619. The variable 'strhi' is defined as the dollar amount of state and local public infrastructure capital stock on streets/highways per one non-farm private employee in the high growth states in 1988. Therefore, the coefficient measures the change that occurs in the dependent variable 'empgrow' if 'strhi' is increased by one unit. One unit here is $1 per private non-farm employee. In other words, if state and local public capital stock on streets/highways is increased by $1 per private non-farm employee in the mean state of the most 23 grown states, in 1988, the state average growth rate of private non-farm employment for the years 1988-1993 would have increased by 0.000076619.

Suppose 'bustax' was increased by 0.01, in 1988. By the definition of 'bustax' as the ratio of business tax revenue to corporate profit, this means an increase in tax revenue by 0.01 times corporate profit. To illustrate by an example, for New Hampshire this would generate revenue of 0.01 x 1,234,000,000 = $ 12,340,000. Dividing this amount by

nonfarm employment for New Hampshire gives 12,340,000/529,000 = $ 23.327,032 . This is the amount by which 'strhi' would increase. Thus 'empgrow' would rise by 0.000076619 x 23.327,032 = 0.0017872939. By the end of the fifth year, 'empgrow' would rise by more than 5 x 0.0017872939 = 0.0089364693. But the tax increase would cause 'empgrow' to fall by 0.0093003. The net effect is thus 0.0089364693 - 0.0093003 = -0.00036306 , which is the corresponding net effect for New Hampshire as shown in Table 4 in Chapter V. The net effects for the other states are calculated the same way. The net effect, calculated for five years period, is positive for eight states and negative for the remaining fifteen states. (Refer to Chapter V for the discussion on how this does not constitute a basis against a policy of tax increases to finance public infrastructure.)

Appendix A-3
Data Table

State	mwd	sd	wd	wage	u	energ	urban	st	sw	ed	pub	pop	transfer	temp	grad	elect	emgro1	emgro2	emgro3	nfam	bustax	indiv	d1	d2
NH	0	0	0	9.97	2.4	9.76	56.3	2510	594	1029	5104	1083	4.44	82.4	39.1	24.24	0.3246	-0.1312	-0.9941	529	0.34626	36432	1	0
VT	0	0	0	9.47	2.8	9.55	23.2	3803	790	1304	6443	550	6.27	81.2	46.6	23.73	0.7884	0.5410	0.1045	256	0.39303	67610	1	0
MA	0	0	0	10.40	3.3	8.94	90.6	1902	1822	1328	7029	5980	10.64	81.8	43.2	22.86	-0.6686	-1.1818	-1.8617	3126	0.32769	71220	1	0
RI	0	0	0	8.64	3.1	8.54	92.6	2085	898	946	5512	996	11.37	82.1	49.5	23.27	-0.5324	-0.8900	-1.2540	459	0.38343	70096	1	0
CT	0	0	0	10.78	3.0	10.01	92.6	2448	1087	1280	6598	3272	7.09	85.0	27.8	24.55	-0.9543	-1.3292	-1.7649	1675	0.40347	53878	1	0
NY	0	0	0	10.43	4.2	9.09	91.2	2679	2161	1620	9445	17941	16.47	83.1	31.7	25.09	-0.5448	-0.7465	-1.0686	8186	0.74064	88014	1	0
NJ	0	0	0	10.86	3.8	8.10	100.0	2253	1083	1217	6148	7712	6.39	84.5	19.3	24.97	-0.1943	-0.4753	-0.9256	3660	0.37761	58535	1	0
PA	0	0	0	10.33	5.1	7.29	84.8	2215	919	1347	6131	11846	6.75	84.4	32.8	20.92	0.5797	0.4965	0.3264	5042	0.31918	56766	1	0
OH	1	0	0	12.00	6.0	7.18	78.9	2346	1158	1297	6454	10799	7.88	83.9	27.1	16.90	1.5512	1.2975	0.9144	4701	0.34947	60083	1	0
IL	1	0	0	10.98	6.8	7.56	82.5	2493	1272	1467	6906	11390	6.51	84.7	27.4	21.49	1.3561	1.1671	0.9054	5098	0.45317	51247	1	0
MI	1	0	0	13.31	7.6	7.39	79.9	2113	1154	1674	6668	9218	9.02	76.7	27.0	19.40	1.5599	1.3979	0.9736	3819	0.48764	68917	1	0
WI	1	0	0	10.61	4.3	7.49	66.5	3196	1319	1583	6599	4822	8.35	79.9	33.5	16.14	2.3709	2.3379	2.1590	2169	0.39635	76422	1	0
MN	1	0	0	10.59	4.0	7.35	66.6	3397	1349	1840	8559	4296	9.42	80.6	32.9	15.79	2.2795	2.1977	2.0398	2028	0.47613	71761	1	0
MO	1	0	0	10.24	5.7	7.58	66.0	2335	987	1135	5789	5082	4.74	89.0	30.9	18.94	1.5904	1.5182	1.1872	2259	0.33777	49533	1	0
KS	1	0	0	10.24	4.8	6.64	53.4	3598	1233	1441	7494	2462	5.10	92.8	32.7	19.22	2.1511	2.0093	1.8287	1035	0.72915	48552	1	0
DE	0	1	0	11.49	3.2	7.98	65.9	3084	943	2087	8015	648	5.19	85.6	32.6	19.56	1.3296	1.0830	0.8985	334	0.29058	44616	1	0
MD	0	1	0	10.71	4.5	7.97	92.9	2611	1297	1615	7853	4658	6.08	87.2	23.2	17.13	0.5460	0.3652	0.0196	2102	0.35689	67631	1	0
VA	0	1	0	9.37	3.9	7.66	72.2	2575	849	1213	5876	6037	4.25	87.4	25.1	16.65	1.4701	1.3601	1.0497	2773	0.24893	56978	1	0
GA	0	1	0	8.65	5.8	7.55	64.8	2091	1517	1246	6458	6316	5.27	88.0	18.9	18.29	2.5062	2.1534	1.5741	2878	0.40043	54414	1	0
FL	0	1	0	8.39	5.0	9.29	90.8	1669	1375	1046	5775	12306	4.04	90.2	19.4	20.70	2.4628	2.2956	1.9362	5067	0.59752	37775	1	0
CO	0	0	1	10.38	6.4	7.12	81.7	2190	1917	1747	7585	3262	5.43	88.2	30.7	17.33	3.6037	3.4165	3.0824	1436	0.53746	56915	1	0
NV	0	0	1	10.08	5.2	7.71	82.6	2697	1039	1182	7245	1075	3.13	91.9	12.5	15.94	5.6655	5.4580	4.5526	538	0.58192	24298	1	0
WA	0	0	1	11.90	6.2	6.63	81.6	2782	4008	1818	10717	4640	7.85	79.2	26.4	10.13	2.7607	2.8953	3.0216	1943	0.68269	45079	1	0
CA	0	0	1	10.80	5.3	7.90	95.7	1496	1527	1125	6283	28464	8.85	79.1	21.0	23.42	0.4140	0.1075	-0.0620	12103	0.55804	56842	0	1
ME	0	0	0	9.31	3.8	8.00	36.1	2689	863	1114	5515	1204	7.47	78.8	27.5	19.65	0.4285	0.1866	-0.2770	527	0.39724	73468	0	1
IN	1	0	0	11.00	5.3	5.99	68.1	2223	873	1631	5625	5492	5.34	85.5	30.9	16.53	2.1596	2.1018	1.8674	2396	0.35777	59569	0	1
IA	1	0	0	10.56	4.5	6.81	43.4	4190	1215	1592	7954	2768	5.74	86.7	40.1	17.59	2.3210	2.2407	2.0477	1156	0.62880	57307	0	1
ND	1	0	0	8.36	4.8	5.86	38.4	5073	895	1908	9095	655	7.60	84.4	40.4	16.88	2.3341	2.3276	2.0914	257	0.95332	36034	0	1
SD	1	0	0	8.09	3.9	7.22	29.1	5731	1230	1550	9060	698	4.85	86.3	35.0	17.56	3.7442	3.7658	3.7040	266	0.89290	35728	0	1
NE	1	0	0	9.38	3.6	6.86	47.6	3804	4753	1487	10905	1571	4.92	87.9	35.1	15.54	2.4529	2.4639	2.2005	688	0.63025	50989	0	1
WV	0	1	0	10.81	9.9	5.73	36.5	4259	468	1306	7100	1830	4.95	85.7	26.2	14.10	1.7393	1.7082	1.3760	610	0.47161	44646	0	1
NC	0	1	0	8.12	3.6	8.57	55.4	1722	1070	1126	5182	6481	4.03	88.5	24.8	18.04	2.1149	1.9911	1.6867	2987	0.34586	60684	0	1
SC	0	1	0	8.30	4.5	7.97	60.5	1457	1230	1257	5137	3412	3.39	91.6	21.3	16.40	1.8709	1.7575	1.6377	1449	0.42873	51934	0	1
KY	0	1	0	10.16	7.9	7.26	46.1	3322	810	1334	6581	3680	5.07	87.0	20.5	15.08	2.5071	2.4448	2.3007	1382	0.39238	48644	0	1
TN	0	1	0	8.96	5.8	7.70	67.1	2407	1644	1175	6403	4822	4.52	90.9	23.0	16.19	2.6067	2.4909	2.1818	2092	0.49442	34909	0	1
AL	0	1	0	8.95	7.2	6.55	67.5	2282	804	1346	5926	4024	2.66	91.3	25.5	16.34	2.1017	2.0350	1.9528	1559	0.30864	40931	0	1
MS	0	1	0	7.83	8.4	6.98	30.5	2837	529	987	5586	2580	3.92	92.4	20.3	18.20	2.6487	2.7903	2.2706	896	0.68051	33617	0	1
AR	0	1	0	8.07	7.7	7.28	39.7	2244	570	1255	5143	2343	4.45	92.4	20.1	18.76	3.0743	3.0225	2.8222	865	0.39154	44180	0	1
LA	0	1	0	10.94	10.9	5.06	69.2	3207	961	1336	7379	4289	5.73	90.6	23.0	17.30	2.3223	2.1964	1.8762	1512	0.85937	28904	0	1
OK	0	1	0	10.35	6.7	6.46	58.8	2419	1088	1501	6437	3167	6.07	93.4	28.0	16.20	2.1547	2.0711	1.9561	1132	0.66083	41942	0	1
TX	0	1	0	9.97	7.3	5.49	81.3	2295	1590	1553	6641	16667	4.09	95.1	21.9	16.58	2.6686	2.5199	2.3048	6678	0.64924	36435	0	1
MT	0	0	1	10.68	6.8	6.97	24.2	5299	638	1596	9221	800	5.40	83.3	38.1	12.09	3.1273	3.1093	2.8722	283	1.07963	34798	0	1
ID	0	0	1	10.00	5.8	7.20	20.0	3272	447	1404	6175	986	3.38	90.2	21.8	10.84	4.5675	4.7503	4.6019	349	0.44736	52640	0	1
WY	0	0	1	10.27	6.3	5.96	29.2	7381	1435	3221	15009	465	3.48	82.2	22.7	12.82	2.1958	2.3314	2.1310	189	2.17794	14224	0	1
NM	0	0	1	8.87	7.8	7.65	48.9	3015	937	1870	7322	1490	4.32	92.5	21.1	21.75	3.3553	3.0774	2.7025	548	1.14700	38636	0	1
AZ	0	0	1	9.85	6.3	9.70	76.4	2364	2408	1774	8044	3535	2.47	105.9	23.7	21.74	3.3369	2.9966	2.2593	1419	0.81634	50995	0	1
UT	0	0	1	10.11	4.9	6.68	77.4	2592	2557	2012	8634	1689	3.40	92.2	40.2	18.40	4.6686	4.5165	4.1853	660	0.60417	67539	0	1
OR	0	0	1	10.60	5.8	7.49	67.7	2716	1358	1452	7105	2741	4.38	79.9	29.5	12.62	2.9622	2.7956	2.5138	1156	0.37190	62462	0	1

pubca=pub*pop
pubcap=pubca/nfam
stre=st*pop
strehigh=stre/nfam
sew=sw*pop
sewage=sew/nfam
edc=ed*pop
edu=edc/nfam
strswage=strehigh+sewage
stredu=strehigh+edu

```
swgedu=sewage +edu
strwgedu=strehigh+sewage+edu
restpubk=pubcap-strwgedu
indtax=indiv/1000000
b=bustax*d1
blo=bustax*d2
w=wage*d1
wlo=wage*d2
e=energ*d1
elo=energ*d2
ur=urban*d1
urlo=urban*d2
te=temp*d1
telo=temp*d2
strwedhi=strwgedu*d1
strwedlo=strwgedu*d2
strhi=strehigh*d1
strlo=strehigh*d2
eduhi=edu*d1
edulo=edu*d2
streduhi=stredu*d1
stredulo=stredu*d2
strswahi=strswage*d1
```

2

VITA

Abbas H. Monofali

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE EFFECTS OF TAXES AND PUBLIC INFRASTRUCTURE ON REGIONAL ECONOMIC DEVELOPMENT

Major Field: Economics

Biographical:

Education: Received Bachelor of Science degree in Economics from the University of Khartoum, Khartoum, Sudan, August 1980. Received Master of Science degree in Economics from Texas A&M University, College Station, Texas, May 1993. Completed the requirements for the Doctor of Philosophy degree with a major in Economics at Oklahoma State University in December 1997.

Experience: Raised on a farm near Khartoum, Sudan; worked on family farm throughout the years of my childhood, school and undergraduate education; employed by the Faisal Bank, Khartoum, Sudan as a research assistant, Dec. 1980 to Nov.1981; AlRajhi Banking Corp., Riyadh, Saudi Arabia, as a translator (English-Arabic), Nov. 1981 to Nov. 1983 ; Abalkhail Consulting Engineers, Riyadh, Saudi Arabia, as a translator (English-Arabic), Nov. 1984 to Aug. 1991; and Oklahoma State University, Stillwater, Oklahoma, as a teaching assistant, Aug. 1994 to Dec. 1997.