DISSERTATION

Jeremy Lucas Hall

The Graduate School

University of Kentucky

2005

DISENTANGLING COMPONENTS OF INNOVATION CAPACITY AND INNOVATION OUTCOMES IN ECONOMIC GROWTH AND DEVELOPMENT IN THE U.S. STATES

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Kentucky

By

Jeremy Lucas Hall

Science Hill, Kentucky

Director: Dr. Edward T. Jennings, Jr., Professor of Public Administration

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The field of domestic economic development policy is dominated by competition among the U.S. states for firms, new jobs, and the wealth and quality of life that they bring. This dissertation consists of four primary phases: to examine the role of public administration in economic development through a literature review, to examine recent efforts to measure state status in the knowledge-based economy and develop a new theoretical paradigm for measurement, to establish a longitudinal measure of innovation capacity and commercialization capacity in the U.S. states, and to examine the effects of such capacity on innovation outcomes and economic output over time.

Economic and political motivations for economic development are considered in Chapter Two. Chapter Three examines efforts by other researchers that develop indices and measures of state performance in the new economy and continues to develop theory to guide the following analysis. Chapter Four utilizes one year of most recent data to establish the feasibility of a longitudinal study. Factor analysis is used to categorize innovation capacity by groups into human and financial capacity, and the relationships of capacity to outcomes are then examined using linear regression. Chapter Five turns to the task of assembling a longitudinal dataset and developing a new index of innovation capacity, and a separate index of commercialization capacity. Factor analysis is used in this step once again, and three common factors result in the innovation capacity index: human capacity, federally-funded financial capacity, and state/local-funded financial capacity. One common factor results in the innovation capacity index. Chapter Six focuses on testing the theoretical relationships established in Chapter Three. In this stage, the measures developed in Chapter Five are used as inputs in a cross-sectional time-series analysis using panel-corrected standard errors. Lags of responses are incorporated up to five years to examine the effects of capacity on outcomes over time, and results are reported.

Overall, the hypothesized relationships are confirmed, though not all inputs are significant in all models. The strength of the observed relationships varies from moderate to strong. Appendix A provides factor scores that demonstrate the change in state innovation and commercialization capacity over time.

KEYWORDS: Economic Development, Innovation, Public Policy, State Capacity Economic Growth

April 26, 2005

Dedicated to my family, for their unending encouragement and support.

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The Pilot and the Woodchopper

Ohio passed a law prohibiting anymore Kentuckians from moving to Ohio, but someone pointed out that Ohio got a lot of doctors, lawyers, teachers, nurses, and such from Kentucky. So, they amended the law to allow skilled people to enter. Police would stop people at the state line and question them.

A fellow drove up and stopped. They asked, "What do you do?"

"I'm a pilot," he said, and they let him go in.

The fellow just behind him drove up and they asked him the same question. "I'm a wood-chopper," he said.

"You can't come in," the policeman said. "We already have more wood-choppers than we need."

"But you let my cousin in that red pick-up in," the man said.

"Yes but he's a pilot."

"Well, he can't pile it if I don't chop it," he said.

Jim Hinsdale, Warsaw, KY (Jones & Wheeler, 1995: 92)

Consumers in the Twenty-First Century are highly selective in their market decisions. The public sector is not particularly different from the private sector in terms of the approach consumers take to selecting goods and services, other than the fact that the selection of public goods requires citizens to relocate to the jurisdiction that provides the level of service that they prefer. Alternatively, citizens are faced with the possibility of undertaking the long and difficult process of changing public policy through the democratic institutions of government to arrive at the desirable level of public service. States compete for residents by offering favorable levels of service and by creating a desirable living and working environment.

Following Tiebout, state and local governments understand that citizens "vote with their feet," and in order to retain or attract citizens, governments improve services. States have a vested interest in maintaining population—their tax base depends on it.

States strive to attract above-average citizens—such as skilled workers, technicians, and managers—because these individuals earn higher wages, and contribute more to the government tax coffers. The stage is thus set for latent competition among the states for knowledge workers. Water and sewer service, parks and recreation, and clean streets are all useful in creating an attractive environment, but people follow jobs. Thus, what Teske, et al (1993), refer to as marginal consumers—individuals weighing a residence decision—do not consider all of the possible communities. Rather, they focus their decision on communities where they will be able to find a job with a competitive salary. The jobs demanded by these skilled workers are not available universally. The onus for creating attractive employment opportunities also falls to the states, and this competition is far fiercer than that over the level and cost of public services provided.

States compete for taxpaying workers by creating jobs to attract them, and to a lesser extent, by providing quality public services at reasonable costs. States have long been engaged in economic development activities to attract new businesses and industry (and the associated jobs) to their jurisdictions. During the 1960s and 1970s, smokestack chasing led to state-created tax breaks and other incentives to draw manufacturing branch plants into localities within their jurisdictions (Eisinger, 1988). Manufacturing provided jobs for low-skilled or unskilled workers, and enabled them to generate income, improve their standard of living, and contribute to the local economy and the government tax coffers.

The economic efficiency and overall effectiveness of these policies has long been questioned, as have concerns of equity for existing businesses (Bartik, 1991). The huge outlays for infrastructure combined with large tax breaks burdened governments with no immediate returns on investment. Taxes make up only a portion of a business's cost structure, and turn out to be far less important in locational decisions than the cost of labor, raw goods, and transportation (See Gabe & Bell, 2004, and Ihlanfeldt, 1999, for example). As noted by Reeder & Robinson, "critics…can point to a large body of literature arguing against the effectiveness of tax incentives in influencing industrial location decisions" (1992: 264). As a result, many branch plants recruited during these years subsequently departed for preferred locations, often overseas, leaving behind low-skilled workers without jobs. The unemployment benefit payments combined with the revenue lost from these workers' income taxes created an additional burden for governments.

Governments today continue to compete for jobs and workers, but the emphasis of their activities has expanded to include new-line development strategies that focus on development from within, entrepreneurship, and innovation—strategies that move the focus from just creating jobs to creating jobs for highly-skilled workers. Concurrent changes in the economy have made this approach more and more feasible. Drastic reductions in transportation costs (except recent increases in gasoline prices) and the increased utilization of information technology have contributed to a new economy in which people and products move freely. More importantly, the nature of products created has also changed from tangible to intangible, with services and information climbing to a new prominent position. Amid these changes, knowledge and innovation are essential aspects to economic growth and development today, and states and localities have moved to harness their benefits by developing business and workers that utilize them. "Instead of relying on the zero-sum game of attracting successful firms from other regions through financial incentives, the new strategies attempt to create an environment that favors entrepreneurship and the creation of new firms" (Feldman and Francis, 2004: 135).

Consider briefly the comical anecdote with which I introduced this work. Two workers—possessing certain trade skills, albeit low—set off to improve their fortunes by traveling from their home state of Kentucky to neighboring Ohio. The state of Ohio in this example represents the savvy state which desires to improve its skilled workforce, and simultaneously prevent the entry of unskilled workers into its labor force. Comically, one of the workers manages to unintentionally convince the Ohio state authorities that he is a skilled worker (a pilot) and they gladly accept him. Whereupon they discover, through conversations with the second man, that they not only took a low-skilled worker (literally, a "pile-it") inadvertently, but they took the lesser-skilled of the two. Of course states do not really have such restrictions and barriers to entry, but they are legitimately able to do things to attract high-skilled workers to their jurisdictions. A subtle point that should be mentioned is equally powerful—Kentucky, in the example, didn't do anything to keep the two men from leaving. The presence of too many unskilled workers could be a negative characteristic if there were not enough jobs to keep them all occupied. Indeed, workers frequently cross state lines in search of jobs and better economic opportunities.

Following authors such as Felbinger & Robey, there is an important conceptual distinction between economic growth and economic development; the former refers to simple expansion of an existing economic structure through the addition of employment and increases in product outputs, and the latter refers to a qualitative change in the fundamental economic structure of an area through the creation of new products, new production processes (and increased productivity), and new uses for old products. This distinction may be less relevant to economic development policymaking and practice, as the desired outcomes of such policies, whether grounded conceptually in growth or in development, are very similar. To summarize the conceptual distinction, economic development results directly from innovation in the marketplace and alters the mix of products created and businesses operating within a geographic area. These changes lead to additional employment and economic expansion over time. Such fundamental changes can be identified in rapid shifts that took place during the industrial revolution, after the discovery of electricity, after the invention of the automobile, and, more recently, with the rapid development of telecommunications and computer technology.

The United States presently operates in an economy more dependent on knowledge and skilled workers than ever before. Cheaper labor overseas has caused many basic manufacturing sectors to move offshore, resulting in a new wave of competition among states and localities for industry. Take for example the American Bag Corporation, grown and matured in rural McCreary County, Kentucky. Their products are not plastic bags nor paper bags; rather, they were once one of the premier automotive airbag manufacturers in the world. This plant, once employing nearly 400 people, closed its doors in July, 2004—unable to compete with Mexican airbag manufacturers (Schmidheiser, 2004).

Why do we care about economic development? Because we care about people; we care about their well-being, their standard of living, and the opportunities that they will have to do the same for future generations. Economic development policies are legislated and implemented broadly in the U.S. states, and by the U.S. and other nations in developing and (especially) third world nations. William Easterly (2002), a former employee of the World Bank, points out in his recent book that many of our development efforts in these impoverished places, though well-founded in theory, simply have not been successful. Nonetheless, we continue—nay, strive—to enact programs and policies that will bring the standard of living to a higher level for millions of people who are quite literally starving (Ibid., 14-15).

The fascinating discovery Easterly draws out is that places are different, and thus economic opportunities are different; there is no universal policy that can be applied to resolve these problems. Economic development is, at its core, a local issue. The several U.S. states lack the severity of economic problems that can be seen in developing nations throughout the world. Starvation is not the problem of most imminent focus for domestic economic development practitioners. Nonetheless, there are needs in this nation; there are dreams of making even this first world nation a better place. Though very different in terms of the level of need, the U.S. states share many similarities with the rest of the world. Many places face the same set of economic problems, such as unemployment, low personal income, poor housing quality, and others. Economic opportunities, however, are often unique to a geographical location based on the specific set of resources (land, labor, capital) that a place possesses. Economic development is an issue with a very local (or regional) focus, as resources such as labor, capital, and other inputs vary in type, quality, quantity, and cost from one place to another.

Technological change has been the primary benefactor of developed economies throughout history. The industrial revolution in particular marked the beginning of our modern economic era, with new processes, new products, and new ideas leading the way for new markets to be developed and economic prosperity to ensue. Central to technological change is the concept of innovation.

Innovation is important to the growth and development of economies on a large scale, and to the success and well-being of nations and their constituent states. Innovation drives economic development, and resultant shifts in economic production further drive economic growth. In recent years, due in part to the focus placed on the new economy and the perceived effects it wrought on the global economy, there has been renewed interest in the role of innovation in economic performance.

Seldom has there been an issue as politically salient as the economy—a fact demonstrated by the plethora of policies promulgated at the state and local level to attract firms and generate new business activity within their jurisdictions. The political popularity of economic development efforts drives elected officials to focus on short-term efforts that generate lots of attention, such as branch plant recruitment. The effects of policies seeking to incite innovation are realized over a slower period, and their effects are not always plainly manifested—nor is there a certain return from these efforts. As a result, policymakers have been more reluctant to invest in intangible goods, such as knowledge and human capital, in exchange for greater attention to physical capital, such as roads, sewers, and speculative buildings. That being said, the fact remains that, through the 1990s, "science and technology became institutionalized within state government, as the knowledge economy was seen to drive all regions and all industries" (Plosila, 2004: 119). Evidence of such institutionalization exists in the legislative creation of new administrative units such as Kentucky's Office of the New Economy (ONE).

"Throughout the 1990s, states increasingly realized that science and technology were not extraneous variables or factors they could or could not consider, but critical factors important to their future economies, affecting all industries" (Plosila, 2004: 119). As states have taken these important factors into consideration in their economic development plans, developing measures that better reflect the available resources and the expected outcomes will serve states well in creating policies that are better acclimated to their bundles of economic and social resources. The interest at the state level is focused in part on creating industry clusters, as they are viewed to be the source of innovation and growth.

Cluster formation is important to state economies, and clusters are indeed machines of tremendous innovation and economic progress; however, the focus thereon is not important for the present study. "Entrepreneurial activity is inherently creative and pioneering; therefore, the specific needs of entrepreneurs cannot be predicted a priori" (Feldman and Francis, 2004: 130). Thus, cluster formation cannot be caused, but it can be assisted. "No general set of conditions generated particular industrial clusters in the United States; instead, unique factors appeared to be associated with each" (Feldman and Francis, 2004: 129). It is the same set of resources that leads to innovation that is responsible for the creation of clusters as innovations are realized and spin-offs occur and new enterprises are created over time.

The "critical mass" resulting from a series of such innovations in a given industry (such as automobiles in Detroit, or semiconductors in southern California, historically) establishes a city or region as the "place to be" for that industry, and the agglomeration leads to the cluster being further strengthened (Ibid., 130). In short, clusters may lead to innovation, but innovations led to the cluster forming in the first place. Feldman and Francis further dilute the state economic development focus on clusters by pointing out that targeting specific industries or technologies, as a state policy, is probably less effective than creating the conditions under which firms would be able to grow and prosper (2004: 135). In other words, general resources necessary for innovation and for entrepreneurship are important in that they may assist particular clusters, but also with regard to the fact that they may lead to the development of clusters and businesses that have not yet been (or that cannot be) conceived. In short, clusters are meaningful representations of active innovative capacity, leading to a common perception that innovations are associated with industry clusters.

Innovation has been a topic of much interest of late in the popular media and, to a growing extent, in academia, with numerous individual researchers and organizations having developed measures that represent the innovativeness of states (and in some cases metropolitan statistical areas). The presumption behind these indices and rankings is that states that show greater innovation should be well-positioned to harness greater economic development within their respective jurisdictions in the near future. Some work has been performed in recent years to measure the innovativeness of an economy; such efforts have focused on nations (Porter, 1990; Porter & Stern, 2001), states (Progressive Policy Institute), and metropolitan areas (Huggins, 2003). These efforts have linked numerous variables into indices that are purported to measure innovation, or innovativeness. The differences among these studies are pronounced, due in part to the audience to which they are targeted, in part to the availability of data, and in part to the failure to draw on previous theoretical research related to what constitutes innovation and how it should be measured. The result is a smattering of studies, with great overlap, that fail to achieve great consensus and fail to add to our theoretical knowledge of innovation and its impacts on the economy.

There is no general consensus on the appropriate level of analysis for an innovation study; some observe nations, some states, and some metropolitan areas. Each may be useful in its own right, but this study approaches innovation and innovation capacity from the state level. From a policy perspective, this is an important consideration, as the policies that are enacted to affect economic development, or its innovation capacity precursors, are largely carried out at the state level. States are the primary actuators of economic development efforts in the U.S., and most policies that govern local efforts are derived from state authority. That is to say, state governments have the competitive impetus to pursue such efforts, and they are able to do so through their own financial means, or through shepherding federal funds that are available to projects of their choosing. Because the political and budgetary decisions that affect economic development efforts reside at the state level, and because data are less problematic for assessing innovation capacity and innovation at the state level than sub-state areas, states will be the unit of analysis for this research. None of this is at all intended to diminish the very important role of the federal government in economic development. The federal government impacts state economies through military bases, defense and space research, transfer payments, employment, transportation facilities, and many other areas. In fact, many of the financial variables to be considered in this analysis represent federal dollars. Thus, while federal agencies may be supplying funding, the project design and implementation is likely to be conceived and directed by state or local governments. According to the Progressive Policy Institute, "States' economic success will increasingly be determined by how effectively they can spur technological innovation, entrepreneurship education, specialized skills and the transition of all organizations—public and private—from bureaucratic hierarchies to learning networks" (1999: 4). Note, in particular, the emphasis the Progressive Policy Institute places on the role of the state in this policy arena.

The state-level analysis in this research will enable policy makers to consider a more complete picture of the entire state's position, and they will be able to make policy choices that better reflect their state's strengths and weaknesses. Markets and economies do not respect borders; politics and policy do. While imperfect, then, this method is feasible for its practical implications in the competitive environment of the states.

What is innovation capacity, and why is it important? The Oxford English Dictionary defines 'capacity' as "the ability to produce," or, alternatively, "the power, ability, or faculty for anything in particular." In the context of the present study, then, innovation capacity shall be construed as the power, ability, or faculty to produce innovations. In a more practical sense, innovation capacity is a collection of resources that might result in innovations, for having the ability to produce does not alone imply that the ability is utilized. In other words, innovation capacity is important because it is necessary, though not sufficient, for innovation to result. Connected to this importance is the notion that states may have latent capacity that is being underutilized, suggesting that the state may need to focus efforts on using capacity rather than building it. An important question that will be addressed in the latter chapters of this work asks whether innovation capacity yields results. Actual innovations are expected to increase as a result of increased innovation capacity, as measured by patents issued. Although patents are the choice measure of innovation in the present research, it is also likely that innovation capacity may affect the economy in other positive ways, such as through industry spin-offs and service sector growth.

Within the changing economy, states are faced with the need to better understand their own capabilities in designing economic development programs. This dissertation incorporates three main research elements. First, it sets out to define and assess the dimensionality of innovation capacity in the states. Second, it models the relationship between innovation capacity and innovation outcomes. And, third, it attempts to better understand the effects, over time, of latent innovation capacity in a given year.

This introductory chapter will briefly assess the existing efforts to define and measure the constructs of innovation and innovation capacity, leading to a discussion of the theoretical reasons that suggest the two should be separated—something other indices have not attempted to do. The relationship between innovation capacity and actual innovations will be considered in the logical framework of a traditional production function. That is, increases in innovation capacity (inputs) are expected to be converted into greater innovations (outputs); innovations in the economy lead to economic change and growth as the products are commercialized and standardized in the market. Thus, innovation capacity, in the end, is expected to produce positive economic performance as technological change is actualized.

Michael E. Porter has extensively researched innovation resources and economic growth of nations, but he has also developed innovation profiles for the fifty United States. Porter's work examines each state comprehensively on a variable-by-variable basis without creating a tool for overall comparison. This study will compare states according to categories of innovation capacity rather than statistic-by-statistic. The approach taken is to compile measures within theoretically-related categories of resources that, while making use of numerous variables, may be useful for comparisons of overall capacity by a few categories or comprehensively, without disaggregating to the variable level for comparisons and analysis. Porter's state-level research provides rankings and comparisons against national measures that enable one to compare how states fare in the national picture and in relation to their state counterparts. While this is useful, it does not provide a quick analysis of whether states have what it takes—in each category of innovation resources—to make new economy growth a reality. Variable-by-variable comparisons provide useful detailed information, but they do not generate summary comparisons by category of resources at the state level, nor do they address critical resource deficiencies by category.

Porter & Stern examine the explanatory power of their index of nations in explaining a single output measure—international patents per capita (2001). Their study considered firms' external environment as a determinant of innovation; this translated into national environments for innovation including variables such as the number of scientists, aggregate Research and Development spending, and higher education spending. Their measures were able to explain more than 99% of the variation in international patenting in 17 OECD countries over a 25 year period (Porter & Stern 2001).

Porter is not alone in his approach; other researchers have used similar techniques to create rankings and "report cards" that indicate state performance in innovation and economic growth. Along this line, the Milken Institute has developed a knowledge-based economy index which aims, like the present study, to discern "which states are in the best position to take advantage of the opportunities for growth in the new economy" (Milken Institute, 2001). Unlike this study, however, the Milken Institute does not provide a focus on absolute levels of resource categories that are associated with new economy development. Rather, the study compares a composite index score from state to state in a simple ranking fashion. This technique is not very useful in helping to identify strengths and weaknesses within states, and it does not help to inform the evaluation or development of state economic development policies.

The Milken Institute has transitioned its index over time, making it difficult to examine changes from year to year. Their 2000 and 2001 knowledge-based economy indices used only twelve variables; prior to this, the index was called the new economy index. For 2002 and 2004, the Milken Institute introduced the State Technology and Science Index. These latter indices include more variables, and they are categorized by topic. The Milken Institute refers to one of these categories—Technology Concentration and Dynamism—as an outcome measure, but they include it in their composite total score which is used to determine state ranks, again blurring the relationship between capacity and actuality in innovation. One of the strengths of the Milken Institute's Technology and Science Index is that researchers performed between-category analyses to show the explanatory power of their model using regression and various econometric techniques (DeVol, et al, 2004: 6). Devol, et al, measure how much of the Technology Concentration and Dynamism composite could be explained in a statistical sense across states on the basis of movement in the other four composites. This equation was able to explain nearly 84 percent of the variation in that measure (2004: 51).

The Development Report Card for the States (Corporation for Enterprise Development 2002) rank measures individual variables at the state level without grouping them into categories or analyzing the states' overall capacities for development. For example, this source specifically presents Federal research and development spending, Small Business Innovation Research (SBIR) grants, the number of Ph.D. Scientists and Engineers, and University Research and Development spending—many of the same variables considered in this study—but on a variable by variable basis. In other words, Kentucky receives a numerical rank (between one and fifty) for each variable, and then receives a letter grade representing the state's resources. Because this type of instrument does not provide information on specific resources or categories of resources, it may not be useful for policy analysis or development of new policies. The Corporation for Enterprise Development does not indicate any empirical analysis was performed to examine the power of their index.

In other words, if a state receives a 'C' on the report card, then it would seem that the state's innovation capacity is average, but the absolute and relative measures of key resources are not provided, so policy analysts and elected officials may not find the rankings to be practically useful. Receiving an 'A' or being ranked '#1' provides a nice publicity piece for a state economic development agency, but does not provide much practical knowledge to guide economic development efforts (Sampson, 2004). The structure of the present study attempts to overcome this problem.

With the exception of the letter grades, and with the addition of a larger number of pertinent variables, the Progressive Policy Institute's State New Economy Index (Progressive Policy Institute, 2002) has similar shortcomings. The New Economy Index (PPI) is an overall measure, and one of the component measures it includes is innovation capacity. The combination of inputs and output measures reduces the explanatory power of such an index. The PPI report does not indicate any use of empirical analysis to test the efficacy of their index.

An additional innovation study that seeks to assess and rank state competitiveness has been compiled by the Southern Growth Policies Board (Clinton et al, 2002). This work uses state-level analysis, but has only measured and ranked states in the Southeastern U.S.

These studies also vary greatly in terms of what variables they include, and how their measures are compiled. One recurring theme in such studies is the absence of a theoretical distinction between innovation capacity and innovation outcomes. A logical relationship exists between these two distinct concepts, and theory suggests a natural causal relationship wherein capacity leads to greater actual innovation. I address this problem with existing indices more thoroughly in Chapter Three. The existing indices, though they purport to measure similar constructs, vary considerably in the rankings that result; nonetheless, many of the same states appear in the top and bottom segments—though in different positions—of the different rankings. The following figure (Figure 1.1) demonstrates these differences.

Figure 1.1
Comparison of State Innovation Rankings

	Hall (Composite Index)		PPI (SNEI 2002) (excludes DC)		Milken (STSI 2002) (excludes DC)		CFED (DRCS 2002: Dev. Capacity) (excludes DC; in alphabetical order)	
Highest Capacity								
	California	5.32056	Massachusetts	18.58	Massachusetts	84.9	Colorado	A
	District of Columbia	4.39875	California	17.41	Colorado	80.58	Connecticut	A
	Maryland	2.8075	Colorado	17.14	California	80.37	Maryland	A
	Massachusetts	2.26837	New Jersey	14.8	Maryland	77.86	Massachusetts	A
	New York	2.08449	Delaware	14.72	Virginia	73.33	Minnesota	A
	Texas	1.42284	Maryland	14.22	Washington	71.81	New Jersey	A
	Pennsylvania	1.23667	New Mexico	13.77	New Jersey	69.95	Pennsylvania	A
	New Jersey	0.99376	Washington	13.41	Connecticut	68.58	Utah	A
	Michigan	0.85032	Connecticut	13.34	Utah	68.26	Virginia	A
	New Mexico	0.74869	Idaho	13.07	Minnesota	65.87	Washington	A
Lowest Capacity								
	Montana	-1.08896	Alabama	7.15	South Carolina	38.98		
	North Dakota	-1.09489	Nevada	7.03	Nevada	38.61		
	Wyoming	-1.12741	South Carolina	6.7	Hawaii	33.98		
	Kentucky	-1.21457	Kentucky	6.64	Louisiana	32.45		
	Mississippi	-1.25077	West Virginia	6.62	North Dakota	31.72		
	Maine	-1.29706	South Dakota	6.54	Kentucky	31.12	Arkansas	F
	Nevada	-1.33505	Wyoming	6.53	South Dakota	30.5	Louisiana	F
	Arkansas	-1.5503	Louisiana	6.35	West Virginia	30.17	Mississippi	F
	West Virginia	-1.56203	Arkansas	6.07	Mississippi	28.73	South Carolina	F
	South Dakota	-1.5635	Mississippi	5.9	Arkansas	22.8	West Virginia	F

To assess actual variance among the indices, correlations of the index ranks and scores were performed. The Milken Institute's Knowledge-Based Economy Index, the Progressive Policy Institute's State New Economy Index, the Corporation for Enterprise Development's Development Report Card for the States, and Hall's (2003) year 2000 Capacity Index all report on data from approximately the same period. The state rank correlations for these indices are displayed in Figure 1.2 below. The indices are significantly related, but the strength of the correlations varies. The Progressive Policy Institute and Milken Institute indices have the highest correlations, indicating that their results are the most proximate. The Hall index is significantly correlated with the other indices, but to a lesser extent; this may result from the parsimony of the model, or it may result from the fact that Hall excluded outcome measures from his index scores. The Corporation for Enterprise Development index ranks have the lowest correlations with other index ranks.

Figure 1.2

Correlations Among 1999 or 2000 Knowledge-Based Economy Index Rankings for U.S. States

		PPI	Milken	CED	Hall
Progressive Policy Institute 1999 Rank	Pearson Correlation				
	Sig. (2-tailed)				
	N				
Milken Institute 2000 Rank	Pearson Correlation	.908**			
	Sig. (2-tailed)	.000			
	N	50			
Corp. for Enterprise Dev. 2000 Rank	Pearson Correlation	.678**	.772**		
	Sig. (2-tailed)	.000	.000		
	N	50	50		
Hall Capacity 2000 Rank	Pearson Correlation	.681**	.824**	.785**	
	Sig. (2-tailed)	.000	.000	.000	
	N	50	50	50	

**. Correlation is significant at the 0.01 level (2-tailed).

The state score correlations for these studies were also computed, and are reported in Figure 1.3 below. Note that these correlations are also significant, and that the Hall (2003) year 2000 index is the least correlated with the others. Again, use of fewer variables or exclusion of outcome measures may have led to this result. Because the Corporation for Enterprise Development provides a letter grade rather than a score to represent a state's capacity, the values used to derive this correlation matrix were imputed using the mean of a standard 10-point grade scale. That is, A=95, B=85, C=75, D=65, and F=55. Obviously, this imputation is imprecise, and the F scale is probably weighted favorably for the states, but it provided a ready quantification for the correlation analysis.

Figure 1.3

Correlations Among 1999 or 2000 Knowledge-Based Economy Index Scores for U.S. States

		PPI	Milken	Hall	CED
Progressive Policy Institute 1999 Score	Pearson Correlation				
	Sig. (2-tailed)				
	N				
Milken Institute 2000 Score	Pearson Correlation	.903**			
	Sig. (2-tailed)	.000			
	N	50			
Hall Capacity 2000 Score	Pearson Correlation	.662**	.756**		
	Sig. (2-tailed)	.000	.000		
	N	50	50		
Corp. for Enterprise Dev. 2000 Imputed Score	Pearson Correlation	.702**	.784**	.633**	
	Sig. (2-tailed)	.000	.000	.000	
	N	50	50	50	

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations were also computed for three of these indices that were updated in 2002. The rank correlations (Figure 1.4) and score correlations (Figure 1.5) are both significant, as they were using 2000 data, and the same observations apply as noted above. That is, the Milken Institute and Progressive Policy Institute indices are highly correlated, and the Corporation for Enterprise Development is correlated to a lesser extent.

Figure 1.4

Correlations Among 2002 Knowledge-Based Economy Index Ranks for U.S. States

		PPI	Milken	CED
Progressive Policy Institute 2002 Rank	Pearson Correlation			
	Sig. (2-tailed)			
	N			
Milken Institute 2002 Rank	Pearson Correlation	.924**		
	Sig. (2-tailed)	.000		
	N	50		
Corp. for Enterprise Development 2002 Rank	Pearson Correlation	.614**	.617**	
	Sig. (2-tailed)	.000	.000	
	N	50	50	

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 1.5

Correlations Among 2002 Knowledge-Based Economy Index Scores for U.S. States

		CED	Milken	PPI
Corp. for Enterprise Development 2002 Imputed Score	Pearson Correlation Sig. (2-tailed) N			
Milken Institute 2002 Score	Pearson Correlation Sig. (2-tailed) N	.613** .000 50		
Progressive Policy Institute 2002 Score	Pearson Correlation Sig. (2-tailed) N	.580** .000 50	.926** .000 50	

**. Correlation is significant at the 0.01 level (2-tailed).

Hall (2003) attempted to measure composite innovation capacity using a series of variables condensed through factor analysis. That effort demonstrated the value in separating innovation capacity from innovation outcomes, and it proved effective in developing an index and ranking of composite capacity through categories of resources. Two things are worthy of note with regard to this point. First, though the ranks and scores are somewhat varied, most of the states in Hall's (2003) top and bottom categories also appear in the top and bottom categories of other studies listed. The more important point is that this association is deceiving. What was revealed in Hall's work was that the capacity fell into two categories, determined through factor analysis: financial capacity for innovation and human capacity for innovation. Some of the states that appear to have the highest capacity are dominated by one of those categories, and actually have little or no significant capacity in the other categories.

One of characteristics that will be analyzed in this research is the manner in which various components of innovation capacity work together in interesting ways to lead to economic growth. Without observing the categorical resource capacities as has been indicated, a study or index leaves much to be desired for analysts and policymakers. Hall's (2003) work does not incorporate variables that represent all of the components of capacity (such as venture capital and skilled workforce); this deficiency is resolved in the present work through a more thorough examination of the relevant literature and inclusion of representative variables.

One of the better thought-out designs among indices comes from a study of competitiveness in the United Kingdom by Robert Huggins (2003). As Huggins (2003) points out—similar to the aforementioned arguments—many other studies examine relevant factors in isolation, failing to develop a composite index. It should be noted that the Progressive Policy Institute and the Milken Institute both provide composite indices that also present component measures as well. Huggins defines Competitiveness, essentially, as the capacity to innovate and achieve an "advantageous position over other nations" (2003: 89). Huggins addresses the central concerns associated with competitiveness research in asserting that "measuring such competitiveness…is no easy matter" and "area competitiveness cannot be measured by ranking any one variable in isolation" (2003: 90). Indeed, the main purpose of the present research is to generate such an index for the U.S., relying on extant literature to ascertain what elements should be considered for inclusion in this difficult-to-measure construct.

Although Huggins emphasizes the utility of one single index, the efficacy of such an instrument is somewhat limited. As pointed out above, there are multiple facets of capacity that should be considered; as will later be explained, these elements of capacity work together to generate innovation and economic growth. A composite index that includes these elements might be deceiving; if a state possesses a wealth of resources in one category, but none in another, the index may show that state to be in a better position that a state with equally divided parts of resources when in fact, it is probably not as fortunate. For example, a state with a large number of doctoral scientists and engineers might have an extremely high human resource score, but it may be lacking in research and development financial capital resources. A composite index that incorporates both these measures would blur this distinction and make the state appear to be average in all categories. An index that separates these concepts so that such nuances can be observed is superior. To develop an index that yields a composite picture, but that simultaneously enables comparison by resource categories, is a further goal of this research effort.

Huggins' model, interestingly, foregoes a focus on innovation, and rather examines business density, presence of knowledge-based business, and economic participation as the determinants of productivity (2003: 91). His three-stage model then examines the impacts of this productivity on economic outcomes such as unemployment and wages. Though the concepts of interest in his study differ significantly from the present study, his model demonstrates the usefulness of considering competitiveness from a multi-stage production function framework. In an interesting decision, Huggins examines the impacts in a causal model of the three elements of the system, but then incorporates all three (with equal weight) into his index, which leaves unexamined the impacts of each stage on the following.

There is value, then, in addressing this relationship from the standpoint of a standard economic production function, where certain inputs (innovation capacity) are expected to lead to related outputs (innovation outcomes). And, furthermore, where the presence of innovations leads to increased commercialization capacity, the combined effect of which leads to growth in state income and wealth. This knowledge provides the structure for the present study.

The primary stages that constitute the research design are as follows: 1) a conceptual definition of innovation capacity, and identification of the theoretical components that should comprise an index of innovation capacity, leading to the development of a new index of capacity that isolates innovation outcomes (patent activity is an exemplary outcome measure that has been often included in knowledge-based economy indices) from consideration; 2) a conceptual definition of innovation outcomes and measurement of patent activity in the states; 3) definition and measurement of the commercialization capacity construct and creation of an index of commercialization capacity; and, 4) using pooled cross-sectional time-series analysis to identify the strength of relationships that exist between innovation capacity and innovation outcomes, and between innovation outcomes and commercialization capacity, and to ascertain the effects these have on state economic output. The fourth and concluding stage will examine the impacts of innovation capacity and innovation outcomes on economic performance using standard measures such as per capita personal income and gross state product, and will end with discussion of the ramifications of these findings for state policymakers.

This chapter has provided an introduction to and background information on the process of economic development and innovation in technological change, and existing efforts to examine innovation in the states. From this starting point, the following chapters provide the theoretical foundation, empirical analyses, and findings that are central to the research project. Chapter Two expounds on the practice of economic development from a broad public administration perspective, bringing into focus the importance of economic development policy to elected officials and economic development practitioners, and highlighting some of the challenges and constraints they face in administering these policies and programs. Chapter Three provides the theoretical development and background that justifies the inclusion of particular measures, and the expected relationships among the constructs examined.

With the background and theory established, Chapter Four represents a rudimentary exploratory analysis of a single year—the most recent year—of available data to examine the framework for the time-series analysis to follow. Chapter Five details the process of compiling data for the longitudinal analysis and reports the outcomes of the factor analytic processes used in developing the state indices of innovation capacity and commercialization capacity. Modeling and testing the effects of innovation capacity over time is the subject of Chapter Six. The state-year index scores of capacity are used as independent variables in a pooled cross-sectional time-series analysis to explain the effects innovation capacity has on innovation outcomes, the effects of innovation outcomes on commercialization capacity, and the combined effects of innovation outcomes and commercialization capacity. Chapter Seven concludes with a discussion of results and findings, and their implications for economic development policymaking and practice.

Chapter 2 –Economic Development: Public Administration Perspectives

Introduction

Economic development, conceptually, lacks the perfection of clarity. What do we mean by 'economic development'? Inevitably, the response to this question depends on the characteristics of the individual of whom it has been asked. State economic development officials, national policymakers, county officials and private citizens are all interested in economic development, but the term may signify different things to different people, and it is necessary to engage in conceptual clarification to aid our understanding of the topic. In this chapter, I consider economic development from a public administration perspective, clarifying the concept in political and economic terms, specifically considering policy types, purposes, implementation, and administration, from an intergovernmental perspective.

What is Economic Development?

Economic Development has been conceptually defined in many different ways over time. A key distinction in the literature pertains to that between economic growth and economic development (Wolman and Spitzley, 1996). Schumpeter argued that the economy can be characterized in one of two states—a circular flow, or a discontinuous change (Felbinger and Robey, 2001). Economies in such a circular flow are characterized by maintenance of the status quo, wherein they continue to provide the same goods and services, though in larger quantities. Schumpeter labeled such an increase in wealth and employment as 'economic growth' (Ibid). Economic *growth*, however, is distinct from economic *development*, and Schumpeter argued that real increases in the standard of living could come about only through economic development (Ibid). So what is economic development? Economic development is a condition of "'spontaneous and discontinuous'" change that causes a disturbance in the economic equilibrium (Ibid). As such, economic development results from an upheaval in the economic system, and a change in the local production function, wherein resources may be combined in new ways to create a new array of products and/or services. It is important to note that such innovation cannot be predicted, and the recombination of resources necessary for innovation to occur also cannot be anticipated (Schumpeter, 1983).

In addition to Schumpeter's conceptual distinction between growth and development, other similar distinctions have been drawn. For example, economic growth has been defined as an increase in output, while development goes beyond growth to also include improvements in the material well-being of individuals and the distribution of income, casting a human emphasis on the term (Wolman and Spitzley, 1996). Wolman and Spitzley (1996) further note that economists tend to view economic development in terms of increases to area employment, income, or both. Given the Schumpeterian distinction above, this implies that many researchers purporting to investigate economic development actually study economic growth. In fact, Wolman and Spitzley agree that "most of the literature on the politics of local economic development is not actually concerned, at least conceptually, with development but with growth" (1996: p. 116).

"Growth constituted a legitimate American objective," because it was "simply a process by which a society augmented an already abundant economy" (Eisinger, 1988: p. 39). Eisinger indicates that adopting the notion of economic development was "late in coming" to the U.S. (1988: p. 39). He defines economic development as a "qualitative increase in collective well-being," and goes on to state that economic development policy has "turned from the task of simply creating more jobs to one that evinces concern for creating long-term, stable, remunerative employment in the industries of the future" (Eisinger, 1988: p. 39-40).

Using the definition of economic development above—an alteration to the production function of the local economy, or a qualitative change to local production—the key characteristic necessary for development to occur is innovation in local products and production processes. It is interesting that economic development can be viewed as the result of a sudden disequilibrium in the economy—innovation. An accepted theory of policy change suggests that long periods of stability and incremental change in a given policy area will be interspersed with short periods of dramatic change. This model of policy change is known as punctuated equilibrium. The rise and fall of policy subsystems brings individual issues into the attention of the public arena, causing drastic and sudden policy change. The parallel between economic development and this theory of policy change comes in the form of brief punctuations in otherwise long periods of stability. In the case of public policy, an issue arises and drastic policy change follows; similarly, in the case of economic development, an innovation occurs and the local production function changes dramatically. Though the long-term changes in both cases are dramatic, the response is not instantaneous in either. The policy process must be followed in the former example; the business cycle must be followed in the latter.

I have thus conceptually defined economic development, and demonstrated how it can be understood by comparing it to a popular model of policy change. But, what is economic development policy? Is it logical and practical for governments to pursue economic development policies?

If economic development, as opposed to economic growth, is the only way to generate real increases in the standard of living in a locality or region, then it must be the case that economic development policies are those that seek to alter the local production function by using resources differently, or causing new goods to be produced. Schumpeter has argued, as noted above, that the innovation can not be predicted, and resources can not be recombined in anticipation of a specific innovation. This being the case, it appears that there is nothing a government can do to *cause* economic development to occur, thereby eliminating the utility of considering development as a policy option. That is, a government can institute a policy to alter the use of resources, but without the innovation, economic development will not occur.

Why can't economic development be caused? Local production is primarily a function of larger and increasingly global markets. As such, the ability of governments to influence resource use or firm location is tightly restricted by the firm's motivation to generate profit. Profit-seeking firms will move to locations, and they will generate those products or services, that maximize their revenue in response to consumer demand. Governments have minimal impact with regard to resource endowments, location, proximity to markets, and other key variables that affect firm profits. Given the "greatly reduced cost of transport of high-value products and transmission of information," service trades are able to effectively "serve the demands of not only the local area, but also much larger areas—the nation, continental regions, and the globe" (Isard, et al, p. 23). With global markets providing overseas opportunities for cheap labor and low taxes, and with transportation becoming more and more affordable, U.S. domestic local economic development efforts are less dependent on government decisions than ever.

For this reason—government inability to cause changes in the local production function—the attention of researchers, and the goals of economic development practitioners have been oriented toward growth policies (often under the guise of economic development). The focus of so-called government economic development policies has thus been on creating jobs and wealth in the community as opposed to the true focus of development, which should be to alter the set of products or services that make up the local market. Such government policies, and particularly in areas experiencing economic growth, may inadvertently lead to economic development when they are characterized by efforts to provide a hedge against possible future disinvestments in one or more economic sectors, resulting in an alteration to the local production function through diversification (Eisinger 1988: p. 53). Stated differently, growth and development policies have become intertwined in practice, and development has come to be nearly coterminous with growth in the policy arena.

While government policies may not be able to cause innovation, and thus economic development, it is important to note that certain activities can be undertaken to increase the *likelihood* that innovation will occur. That is to say, governments can engage in activities that are permissive of development, but they will find great difficulty identifying or undertaking activities that cause development to occur, as pointed out in the earlier discussion of market versus government roles. Education, research and development, entrepreneurial training, and other activities may act as catalysts leading to innovation. They are the tools that enable people—the real driving force of the economy—to identify new production methods, new products, new ways to use existing resources, and new services that make up the basis of economic innovation and cause long-term economic development. Likewise, governments can invest in other important permissive policies that might permit development to occur. Agranoff and McGuire (2000) refer to rural development policy as a "policy without a home," because the "responsibility for developing rural communities does not rest with any single agency, department, or office, or even a single set of designated agencies" (p. 390). Likewise, Fosler identifies seven cross-cutting foundations that are critical to the economic development process, including human resources, physical infrastructure, natural resources, knowledge and technology, enterprise development, quality of life, and fiscal management (p. 314-315). It is clear that economic development policy occurs across substantive fields, and thus similarly across agencies and organizations.

The most common example of a policy that is permissive to economic development is transportation infrastructure development, which, when in place, substantially reduces the cost of transporting resources and products from one place to another, and thereby expands the opportunities available to a local economy. Comparative advantage should be "considered the resulting force of two components: a production advantage and a transportation advantage" (Kraft, Meyer, and Valette, 1971: p. 12-13). It follows that two regions with equivalent production advantage compete only in terms of their transportation advantage. Lowering transportation costs and transport time thereby create a locational advantage, and justify public investment in infrastructure improvements.

The unfortunate corollary of low transport costs for rural regions is that as those transportation costs decline, the importance of production advantage grows, calling to question the absolute effectiveness of transportation improvements in the long term. There is a direct relationship between the adequacy (or inadequacy) of the transportation network and the importance of production advantage in firm location decisions such that, where adequate transportation already exists, the importance of production advantage in relation to location advantage is much higher. This should not, however, discount the importance of such improvements for economically depressed regions. Where such regions lack adequate transportation, comparative advantage can be achieved through transport cost reduction, and they may be able to generate viable export activity. As Hoyle states, transportation enables a region to "capitalize on its economic endowment for generating exports (p. 23), but "transport is only one of many factors conditioning locational choices" (p. 31). Domestically, the United States has witnessed the effects of transportation costs on the economy over time. The textile industry was once rooted in the Northeast, close to the population and thus the market for its products. Over time, manufacture moved South where labor was cheaper, and closer to the primary input—cotton. With passage of the North American Free Trade Agreement specifically, and as a result of cheaper transportation costs more generally, textile industries have again uprooted and moved to new sources of cheap labor and raw materials—overseas. Transportation infrastructure may aid local economies when it allows free flow of exports, but may impact economies negatively if firms and jobs relocate.

Similar to transportation, utilities such as electricity and telecommunications have played, and will continue to play an increasing role in enabling localities to produce new goods or share information that may improve the way production occurs. "Telecommunications make possible more far-reaching locational alternatives than previously confronted manufacturing" (Glasmeier and Borchard, p. 13). In reference to the internet, Childress, Schirmer, and Smith-Mello note that such a tool holds potential to help Kentucky's business, and "particularly rural ones far from major markets" (1998: p. 15). Thus, utilities, and especially electricity and telecommunications have become particularly important as factors that permit economic development to occur.

The 'smokestack chasing' policies of many states were successful as a result of the availability of cheap and abundant power. For example, Alcoa, Tennessee, bears the name of its largest employer, an aluminum smelter whose most important (and expensive) input is electric power. Cheap electric power, provided through the Tennessee Valley Authority, was the enabling factor that brought this new industry to the area. The market role again manifests itself in this arena—firms seek the environment in which they can maximize profit. ALCOA is an international corporation with many overseas locations, the newest of which is to be in Iceland. In search of cheaper power, the company struck an accord with the Icelandic government in 2003 to invest over $3 Billion (US) to construct a system of hydroelectric dams that will impound an ice-melt supplied lake that will generate vast quantities of inexpensive power (Lyne, 2002). For Iceland, the project is viewed as economic development; for ALCOA, the project is viewed as smart business. ALCOA was not interested in how much the government spends or on what—they are interested in the cost to them for electricity relative to the cost of transportation.

In summary, economic development policy appears to cut across a number of substantive policy fields (education, transportation, energy, etc.) to achieve a set of public goals. As such, economic development could be considered an overarching policy that encompasses, to some extent, all other policy areas to the degree that those policies permit development to occur.

If governments, through economic development policy, can only act permissively to allow innovation to occur, why do localities invest such tremendous resources into the recruitment of branch plants and traditional manufacturing enterprise? These policies most likely seek to achieve economic growth through increases in employment and wealth as opposed to economic development through a change in the local economic production function (in spite of these policies typically being labeled as development efforts). These policies are often based on the need to reduce unemployment and poverty, and in fact do represent efforts to improve the quality of life and standard of living—if not for the population as a whole, at least for the individuals impacted by the new jobs.

Local recruitment efforts often involve improvements to transportation, utilities, police and fire protection, and other public services utilized by the residents of the locality. These changes affect not just firms that have been recruited, but all individuals in the community. As such, recruitment efforts too can help improve the standard of living in an area. Moreover, the addition of a new branch plant does add to the diversity of local production, and it inevitably alters the local production function, if only mildly. It is therefore probably most appropriate to consider economic policies at the state and local level collectively, rather than attempt to differentiate between *growth* policies and *development* policies. However, recruitment is risky business compared to developing new business from within; an industry once recruited holds potential to be recruited elsewhere again. Businesses developed locally tend to have ties to community that make them less susceptible to relocation—especially during the early stages of their startup and expansion.

If economic development is the true goal, why do local leaders invest so much time and resources into growth programs such as recruitment? The answer is often very simple: politics. Elected officials in local government may be motivated to pursue economic development goals for a number of reasons, including community values and commitment to citizens to have good jobs and quality of life. However, local elected officials also face the reality of fixed terms of office, and therefore face the very real concern of winning reelection upon the completion of their initial term. Recruitment may be particularly expensive as a policy option, but it also has the potential of a very real, highly visible, payoff that may become the political capital necessary to win an election bid. "As economic development has moved to the forefront of state and local policy in the United States, mayors and governors now measure their performance, however crudely, by plant announcements and job creation. The Reagan era's New Federalism thrust industrial recruitment to the top of the state and local policy agenda" (Ledebur & Woodward 1999: 51). Essentially, recruiting a firm is a tangible result that takes place in a relatively limited amount of time. Buildings appear, people get jobs, and it is obvious to a concerned electorate that they are generating returns on their tax investment.

On the other hand, the cost of recruitment policies is often staggering, and recruitment efforts are often unsuccessful. It might be in the best interest of the locality or state to focus on education, research, and those policies that are likely to lead to innovation in local production that might work to the long-term economic advantage of the community and its residents. Nonetheless, the long timeframe associated with implementing such policies is greater than the term of elected office, and elected officials are less likely to support programs with large immediate costs and low immediate payoffs. Projects with long-term payoffs are disadvantageous to the political goals of elected officials.

An interesting quandary is here observed; how do recruitment efforts really benefit local residents? It is actually the case that new jobs resulting from recruitment will not accrue entirely to current residents of the locality; rather, they will cause in-migration of residents or commuting workers who will fill those new jobs, and/or positions left by current residents taking jobs with the new firm (Eisinger 1988: p. 43). This leads to public service burden in the form of increased demand on the local transportation system, utilities such as water and sewer, and has the negative effect of creating congestion, reduced infrastructure lifetimes, and so on, to the extent that "the costs of servicing new development may be more than the taxes it generates" (Ibid, p. 41). Other private costs are also realized as a result of development, most notably through increased housing and land prices that come about through increased demand for these limited resources (Ibid, p. 45). Nonetheless, residents (and thus politicians) continue to view recruitment as a good thing. The argument follows that the long-term costs and negative effects are overshadowed by the more immediate benefits.

The very mobility of capital that makes possible local government recruiting efforts simultaneously decreases the feasibility of efforts aimed at stimulating development. Programs that seek to improve the workforce in various ways, but especially through training and education, are often ineffective. Why? The investment benefit accrues to the individual participating in the program. People are highly mobile, and upon receiving education or training in an environment absent sufficient opportunities to utilize that training, they are likely to seek out higher-wage opportunities elsewhere (making use of the locality's high-quality transportation system for an unintended purpose). In the end, the local investment drifts to other localities and creates a scenario where a distressed locality pays for training and education to the benefit of a more prosperous, and very likely urban locality. Human mobility reduces the likely return on investment of education and training programs, and leads economic development practitioners to invest government resources in physical capital, such as roads, utilities, or speculative buildings, as opposed to the human capital that is most needed to stimulate the innovation necessary for true economic development to occur.

Economic development and economic growth have been distinguished on theoretical grounds, only to have the distinguishing characteristics blurred and both concepts lumped together into a general policy type that more closely resembles growth than development. Practical aspects of economic development policy will now be examined from political and economic perspectives.

Political Characteristics of Development Policy: The Locus of Economic Development Policymaking, Implementation, and Administration

Economic development policy is an area of public policy with intergovernmental ramifications. In the U.S. federal system, national, state, and local governments, as well as special districts, often have overlapping roles in delivering services to any given locality or population. Largely, however, economic development efforts are seen as functions of state and local governments. An environment of intergovernmental competition for industry "dominates policymaking processes because capital freely migrates across political boundaries within a fragmented system of governments" (Saiz, 2001: p. 203). In other words, self-interested local and state governments strongly desire to maintain or enhance their economic position, and they therefore engage in activities geared toward attracting business activity within their jurisdiction (Ibid.). Peterson argues that local governments and state governments are naturally acclimated to developmental activities because of capital's natural mobility, whereas national governments possess the ability to focus efforts on redistributing wealth and income (1995). This works well in principle; people, firms, and capital are able to move with great freedom from one locality to another.

In order to maintain their tax bases, populations, and general vitality, local governments seek to offer the lowest possible corporate taxes while providing opportunities for employment for their residents. The result is a competition among local governments to enhance their comparative advantage. Similarly, there is a low cost to crossing state lines, and states very closely resemble local governments in this respect—they compete to keep capital and population within their boundaries. At the national level, however, the costs are disproportionately high to change citizenship, to relocate a business overseas, etc. As such, it is very costly to cross national boundaries in an attempt to avoid taxation, which enables national governments to engage in redistribution of wealth from the rich to the poor. Those who have assets are more likely to succumb to the higher taxes rather than incur the cost of relocating to another country. The efficacy of this argument, while still rational, is declining as the economy becomes increasingly global. Tax havens are not only possible, but popular, particularly for those firms whose products are intangible—information and other services. The federal role in economic development has shifted over time from one of protectionism to free trade in the global context; national policy may indeed work to the detriment of local economic development efforts.

The key point to take from Peterson's argument is that there are certain functions that are better performed by higher levels of government, and there are some that are better performed by lower levels of government. Blakely (1994) echoes this point as follows: "locally based economic development and employment generation is likely to be successful if initiated at the community/local level rather than elsewhere...[c]ommunity leaders can identify the situation their area faces and place it within a larger context" (p. 27). As such, it is reasonable for local, state, and national governments to all play meaningful roles in economic development efforts through the system of fiscal federalism. States and localities have the interest and the competitive desire to pursue activities that improve their status, and thus engage in developmental activities, recruitment or otherwise. The national government is able to redistribute wealth from affluent communities to those in distress through taxation and grant-making activities. The result is a system that permits targeting national resources to localities that most need assistance to aid their efforts toward economic development, improving their status in the interest of equalization. In other words, federal resources through many programs are filtered to distressed areas to meet local needs.

It is not surprising to find that most economic development efforts are carried out at the local and state levels, often making use of federal resources that target geographic areas based on need. Together with tax revenue and government debt (bonds), grants play a significant role in the total financial package that funds local economic development programs. As a result, economic development efforts become the products of intergovernmental cooperation, though economic development decision making remains largely in the hands of state and local governments, as Peterson's argument suggests it should.

The role of the federal government in economic development activity has been diminishing over time since the late 1970s, with the beginning of a general trend away from revenue sharing that necessitated a return by the states and local governments to own-source revenues in financing government programs, including development efforts. Fosler (1988) takes a positive view of this change, noting that the federal retrenchment "has not so much given economic powers back to the states as revealed the substantial power states already had to affect economic performance" (p. 17). Moreover, the scaling back of federal expenditures and programs created a new incentive for local governments to engage in economic development to generate revenue to fund programs and services.

Agranoff and McGuire surveyed 237 cities in Illinois, Indiana, Michigan, Ohio, and Wisconsin to determine the characteristics of development operations, and perceptions about the role of various potential players in the development process (1998). The results of this study "suggest the clear importance of state government for economic development," and "are just as clear in illustrating the diminishing importance of the federal government for economic development" (Ibid, p. 154). Only five percent of the cities they studied consider the federal government to be the most important external government for development (Ibid). These findings support the notion that the federal role has declined and that the federal government plays a very minor role in economic development efforts overall (Ibid, p. 152).

A key point demonstrated by Agranoff and McGuire is the notion that development activities are envisioned, developed, and implemented by a network of organizations at the local level, including city and county governments, nongovernmental organizations such as private developers and not-for-profit organizations, and so on; the "analysis depicts the vertical intergovernmental context as complex and involving multiple partners" (Ibid, p. 156, 158). McGuire notes in a later work that "adopting specific policy approaches to economic development policymaking and administration is associated with increased levels of collaborating and coordinating tasks with multiple actors by the city's economic development professional(s)" (2000, p. 288).

There remains a problem with the competitive state structure, however. Namely, economic activities do not respect state boundaries or local government boundaries (Fosler: 1988, p. 5). Economic development is contingent on the ability of a locality or a state or a region to trade with other such regions. Economic regions do not respect state boundaries (as they would international boundaries where trade limitations exist, for example), thereby calling into question whether states are the appropriate level of government to consider economic issues. Of note, it is the variation in state policies that makes possible the competitive economic environment, however, so it is unlikely that states would willingly relinquish control of this role. As the economy has become more and more global, Fosler suggests that the role of state institutions in shaping and increasing the competitiveness of regional economies has become a central issue (1988, p. 6). As such, states remain the predominant players in the economy, but in so doing address issues that transcend their boundaries.

Given that economic development is carried out primarily at the local level, it is logical to consider those governments' motivations to engage in such types of activity. In their survey of the literature surrounding the politics of economic development, Wolman and Spitzley (1996) identify a number of factors that are likely to motivate a community and its leaders (elected, appointed, or otherwise) to engage in economic development activities. Local leaders tend to view economic prosperity as a requirement for protecting the community's fiscal base and allowing the delivery of quality public services to its constituents (Ibid). Stated differently, by enhancing the community's economic position through economic development activities (creation of new businesses and jobs, etc.), the result is an increase to the local tax coffers, which translates into resources that can be used to improve education, roads, utilities, parks, museums, and other publicly provided services that may be desired or demanded by local residents and businesses. Thus, the desire to maintain or enhance the level of public services can act as a motivating factor to engage in economic development activities. Along this same line of thought, properly-motivated local leaders tend to view their community positively, and they make efforts to do things that are good for the community (Ibid). This leadership vision seeks to ensure the continuation of a fiscally-healthy city through economic development programs.

Good intentions for the community explain only a portion of the motivation to engage in economic development. Less positive rationales include the electoral goals of individual politicians who seek to gain reelection as a result of demonstrated success during their current or previous terms in office. To this end, economic development can be viewed as a collective benefit that will accrue to an official's electoral success. Wolman and Spitzley (1996) describe economic development as a politically popular government effort, and they describe several factors that enter into the political calculus of the individual leader. Among these factors is the high-visibility nature of the projects; large land use projects, including construction, tend to be noticed in the community and are viewed as the result of government desire to improve the labor market and quality of life in the community (Ibid).

What about large, noticeable, economic development projects makes them so politically popular? Simply put, elected officials like to claim credit for activities they undertook while in office to the furtherance of their electoral goals, even if those activities resulted in no true public benefits. That is, building an industrial park is a logical step to creating jobs and recruiting business, and as such, developing such a park and constructing speculative buildings seems to be a responsible step for an elected official, even if no firms are recruited and no jobs are established. This results in part from the counterpart to credit claiming—blame avoidance. Local leaders may feel that they have to do something, even if the expected results are tenuous. In other words, the political and electoral consequences to the leader for sitting on their hands and not taking an action could far outweigh the consequences of building an industrial park to which no firms have been recruited (Ibid). Leaders feel that they must do *something.* In light of public pressure to do *something*, local leaders are left with little choice in the matter, and are more likely to undertake visible projects with low expectations of job or business creation than no project at all.

Two other factors contribute to the decision to undertake economic development—invisible costs of the project, and a mismatched time horizon between the costs of the project and its expected flow of benefits. How can such costs be invisible? This statement reflects the reality of government accounting procedures for localities and states, in that budgets for economic development are often maintained apart from the general fund, and may in many cases rest with a semiautonomous public or private organization (Wolman and Spitzley, 1996). The separation of these institutions from government affords them greater flexibility to act in the interest of economic development (Blakely 1994, p. 230). For example, a not-for-profit organization may exist to engage in economic development on behalf of the community, thereby concealing the agency's funds and adding ambiguity to ascertaining what the government is actually spending on such projects. Local leaders are still able to claim credit for the results of these efforts while many costs are concealed through off-budget arrangements.

The final factor, a mismatch between project costs and benefit flows, brings to bear negatively on issues of economic efficiency. This concern centers on the fact that economic development activities often require the issuance of municipal debt, such as Industrial Revenue Bonds, which generate cash flow in the present time period to undertake capital improvements necessary for a project to succeed. These large up-front expenditures benefit local leaders seeking reelection as they demonstrate action. In an inter-temporal sense, however, the picture is less rosy. The debt for such projects, and the interest payments on that debt, must be born by the local government and its taxpayers over long periods of time. Taking on debt leads to fiscal constraint for local government, and may diminish the level or quality of public services offered over time.

Characterized in terms of James Q. Wilson's famous typology of policy types, such a policy reflects a scheme of client politics, wherein "most or all of the benefits of a program go to some single, reasonably small interest but most of the costs will be borne by a large number of people" (1989, p. 76). Such projects demonstrate concentrated benefits, but very diffuse costs, often to generations of citizens not yet born. This characteristic is less important if such an activity leads to a successful development with a new stream of employment and tax revenues; however, many recruitment efforts also include tax abatement that may call into question the relative costs and benefits of an activity.

Somewhat similar propositions explaining local government motivation to engage in economic development activity have been put forward by Fosler (1988). He indicated that there are three primary environmental factors that have shaped the context within which development occurs: the dynamics of change within regions, political and economic developments over the past half century that have shaped the conventional state role and conditioned thinking about it, and world and national forces that are transforming the economy, the regions, and public responsibilities for economic policy (page 8). Dynamic regional change refers to the development of economies around a pool of resources—labor, capital, organization, natural resources—and the creation of new industries as a result of innovation within these resource endowments. By political and economic forces, Fosler means the increasing role of state governments and the simultaneous decline of federal government importance. The latter of Fosler's points refers largely to international economic changes such as increasing international trade (globalization and international competition) and the general shift away from manufacturing industry toward service sector and information-based business (1988, p. 14-16).

Having considered the political motivation to engage in economic development and environmental change that has affected that motivation, I now turn to the question of what determines state economic development policy adoption? Saiz (2001) provides three conceptual frameworks for explaining variation in economic development policy adoption; these being (1) a competitive context wherein governments seek to lure businesses from other jurisdictions or prevent existing businesses from leaving, (2) an environment of fiscal stress that stimulates policy adoption in an effort to increase government revenue, and (3) views of the proper role of government in society (p. 205). Fosler (1988) indicates that there is no "quick-fix" to the economic development problem, and state development efforts have come in waves with the latest fad (p. 4, 5). It is the case that policy may be adopted on the basis of a combination of both internal and external factors. Berry and Berry (1990) characterize these factors as state innovation, or development of new policy ideas from within, and diffusion, which refers to the adoption of a policy by states in a geographic sequence following innovation. As such, Fosler might characterize a new policy as a fad when it has been adopted (as an innovation) by one state, and then spread via competitive ambitions to contiguous and other states.

McGuire (1999) finds that policy adoption comes about as a result of the economic development context of a jurisdiction, but he advises that the "proper selection of these paths requires an accurate recognition of the types of problems facing the jurisdiction" (p. 168). McGuire's point, to summarize, is that "policies are not necessarily applicable across all contexts," which is to say, policies that work in some jurisdictions may fail in others where the context varies (Ibid). Combining the factors contributing to adoption heretofore mentioned, a state may recognize an economic development problem and innovate a solution to meet the needs associated with alleviating the problem. Following this stage, the policy will diffuse to other states as word travels through media and word of mouth. Through this diffusion, jurisdictions will have the opportunity to adopt the policy. Such adoption alone does not determine success; rather, through analysis of the needs and characteristics of the area, the policy may be appropriate, or it may not. Thus, adopting a policy for its own sake, and not for its presumed efficacy in addressing the problem at hand, may lead to fiscal burden and other problems for the government adopting it. It is clear that economic development policy comes about through a combination of internal and external environmental factors that change over time and vary from jurisdiction to jurisdiction.

In considering state motivations to pursue economic development activity, it is also useful to recognize the extant categorizations of economic development policy types from which governments may choose. The general trend in the literature suggests a key distinction between traditional strategies that focus on recruitment of manufacturing industry, often referred to as 'smokestack chasing,' and new-line strategies that are geared toward development from within, entrepreneurship, small business development, innovation, and incremental expansion of existing industry. This distinction has been characterized in numerous ways, and to varying degrees of specificity. Several prominent characterizations of this difference are presented below.

Blakely (1994) discusses four strategic options that face communities considering development policy—locality or physical development, business development, human resources development, and community-based development (136-139). The first of these strategies, locality development, reflects the permissive activities of local governments; that is, the development of infrastructure (e.g. highways or telecommunications) that is necessary for (but that does not directly cause) development to occur. The second strategic option, business development, is comprised of activities intended to lure new business to an area, such as the development of industrial parks, etc.; it focuses on meeting industry demands. Human resource development, Blakely's third category, reflects an attempt to supply the necessary workforce for firms to successfully operate in the area. The fourth category, community-based development is geared toward creating opportunities to meet very localized needs of communities, such as providing alternative employment opportunities to local residents and/or providing special skills training to make residents employable in new sectors. One fact is readily obvious—there is overlap of Blakely's four strategies in most economic development programs—which reflects a typical presence of multiple needs in an area. It is also important to note that the focus of these categories is on the *purpose* for a specific development activity as opposed to the *method* through which development would occur. (For example, an activity might focus on building the skill level of workers in the community; the purpose is to increase human capital, but the method might be technical education or apprenticeship programs in skilled trades.)

Bartik (1991) has developed a typology of development policies that are aimed at directly assisting business. His schema differentiates between traditional economic development policies that are targeted toward branch plant recruitment and 'new wave' policies that are focused on assisting small or existing business (Ibid., p. 4). According to Bartik, traditional policies include such activities as marketing an area as a potential branch plant location, providing financial incentives to firms, and providing nonfinancial incentives (such as customized training) to branch plants (Ibid). On the other hand, new wave policies might include capital market programs, information and education provision for small business, research and high technology programs, and export assistance (Ibid.). As such, Bartik clearly sets apart old line strategies from efforts that more closely reflect the changes that have taken place in the international economic marketplace.

Similarly, Eisinger (1988) devotes his entire book to explaining the rise of a new entrepreneurial state. This work lays out the conceptual framework for considering economic development policy in terms of development from without versus development from within. In Eisinger's words, supply-side strategies are efforts that seek to lure firms to a location by artificially lowering their production costs; these strategies are based on attracting mobile capital through governmental competition (1988, p. 12). In contrast, demand-oriented strategies focus on development from within, specifically aimed at the creation on new capital through innovation, business formation, and small business expansion (Ibid.). In essence, these two strategies closely parallel the typology presented by Bartik, and similarly parallel the distinction between traditional manufacturing recruitment efforts and new strategies that reflect the rise and dominance of the service sector and the role of information in the global economy.

The increasingly popular distinction between old-line and new-line economic development policy types, interestingly, mirrors the aforementioned distinction between economic growth and economic development presented by Schumpeter and others. That is, old line strategies that focus on incentives and luring existing industry to a jurisdiction in effect create growth, whereas newer entrepreneurial or demand-oriented strategies seem to focus on innovation and the creation of new capital by building upon the unique resources of a local area. In this way, economic development policy has parted ways with the philosophy of recruitment and taken root in economic development proper, expecting growth to occur from within through the development associated with a natural business cycle. This is not to say that states have abandoned their traditional old-line development strategies, as they have not, but rather to suggest that there has been an expansion of the state development toolkit to include significant efforts in the way of new-line strategies as well.

With this conceptual understanding of economic development, the practical application of development into numerous government policies of various types, and the reality of political expectations that promulgates the need for and adoption of such policies, I now briefly summarize the economic reality of development efforts.

Economics of Development Policy

While politics is central to development policy, it is also the case that governments are often tightly restrained in their options by the external economy facing their jurisdiction. This is particularly salient in that true development policy should aim to adjust resource allocation among products and create new uses for existing resources.

However, market forces dictate resource allocation, and business profit motivation severely limits the actual amount of control a government can exert in its attempt to incite economic change. It becomes readily apparent that the national and global economies have incredible influence on the options local governments are able to pursue. Given the clear connection to the economy, and given the desired economic impacts of development policy, the remainder of this chapter is focused toward key economic issues that are of importance in the economic development literature. Namely, these are the efficiency of economic development efforts, the equity of such efforts, and the distribution of costs and benefits of economic development efforts.

Is economic development a zero-sum game? The classic argument against economic development efforts stems from the notion that recruiting a firm to one location necessarily means a loss of jobs at another. This is of particular concern as a result of the vast government expenditures and debt undertaken to lure industry to an area. Not all researchers in the field agree that this is the case. Bartik (1991), for example, argues that there are positive benefits associated with competition for economic development among state and local governments; namely, an increase in economic efficiency results from the geographic redistribution of economic activity towards depressed areas that need growth the most (206). Moreover, Bartik argues that widespread use of economic development subsidies may encourage national employment expansion, thereby decreasing the national unemployment rate (206-207).

Drawing on the previous discussion of policy types, Eisinger's (1988) distinction between old-line recruitment strategies and newer entrepreneurial development efforts is key. That is to say, new employment can be created locally through increased productivity and innovation without necessarily bringing undue hardship on the government coffers, and certainly without directly reducing employment elsewhere. As such, economic development efforts do not necessarily constitute a zero-sum game. However, taking from the conceptual distinction developed above, branch plant recruitment efforts are much more likely to characterize zero-sum games than economic development efforts aimed at stimulating innovation, entrepreneurship, and development from within.

As was mentioned before, political benefits accrue to elected officials, and economic benefits accrue to the firms that take advantage of government programs. As such, the concentrated nature of the benefits suggests inequity in the fulfillment of such policy. However, when one considers the jobs created and the income generated in the local community as a result of these efforts, it becomes more logical to consider the benefits as being somewhat more diffuse than they were previously characterized. Families obtain income, and their exchange of that income for goods in the marketplace leads to economic multiplier effects that create benefit for the whole community.

This being the case, it is somewhat unexpected to find that very few empirical studies of the distribution of costs and benefits of local economic development activities have been performed (Wolman and Spitzley, 2001). Bartik (1991) has undertaken one of these few studies, though his approach is innovative in that he considers not the effects of economic policies per se, but rather the effects of economic growth—the presumed end product of the policies governments undertake. Bartik's findings are modest; he determines that faster local growth results in stronger effects on the annual real earnings of blacks and individuals with less formal education. These differences are quite pronounced, with the effects being 20% and 15% greater, respectively (p. 206). These facts lead Bartik to conclude that such policies probably have a progressive effect on the distribution of income. The key caution raised in this work is against overspending by local governments to create new employment opportunities. That is, development policies that cost a great deal per job will require higher public tax burden, which will inevitably fall to members of lower income groups. Likewise, if programs are financed in a regressive manner, such as through wage and income taxation as opposed to property and wealth tax bases, lower income individuals will bear an inordinate share of the costs of the development (Ibid).

Another important consideration pertains to intergenerational equity in development policies. Consider the following example. A large investment is made in a capital project to lure firms to a locality. The investment is financed through bond issues, leading to large amounts of government debt and debt service. Moreover, the strategy results in the recruitment of a branch plant to the community which creates 250 assembly line jobs. If the bonds are to be repaid over thirty years, it is the case that the next generation of taxpayers will be responsible for repaying some of the debt undertaken by individuals at an earlier time under different economic conditions. The problem comes when globalization, through cheap transportation and labor, leads the firm to close and relocate overseas after only 15 years at the location. In effect, the citizens must pay for the mistake of their predecessors in making such an unwise investment; mobile capital is just that—mobile—and any firm that locates to a community is equally likely to relocate elsewhere in the future. The point of this argument is simple; decision makers should consider the probable costs and benefits they may be inflicting on future generations of residents in the same manner they consider the costs to current community residents.

Summary and Conclusions

In conclusion, economic development is a unique and complicated concept that has remained somewhat amorphous in practice through implementation of government policies aimed at generating economic growth and economic development. These policies are motivated by several political and economic characteristics of the internal and external environments of the local community in which they are adopted. Policies have taken a number of forms as a result of varied purposes and intents, and different strategies they were designed to fulfill under differing local conditions. Governments, given their political emphasis in seeking reelection, should carefully consider the policies they adopt in terms of the economic impact of key constituent groups. If economic development efforts result in undue hardship to the persons they are intended to help, then the policy, no matter how big its splash, is without merit. Cautious analysis and government planning are necessary in the adoption of policies intended to sustain or improve a jurisdiction's competitive economic standing.

This chapter brings into focus the importance of innovation in economic development, and the importance of developing and administering policies that take into account the conceptual distinction—and the connection—between economic development and economic growth. As pointed out above, states have expanded their traditional economic development programs (which parallel growth) to include policies and programs that are more in-tune with the new-line strategies that parallel economic development. Although there is an important conceptual distinction, and although the authors cited above indicate there is a distinction between old-line and new-line development strategies, the practical distinction is less clear. The outcomes of both economic growth and economic development in the long run are very similar, with expectations of increased employment, wages, income, and quality of life. Therefore, in trying to assess the impacts of policies, it is not practical to distinguish the two types. In the reality of state policy, development versus growth may be a distinction without a difference.

The role of state and local governments, through their own actions, and through collaboration with private industry and nongovernmental organizations, should be weighed in terms of internal and external contextual variables. Governments, policymakers and administrators should be knowledgeable about the relative strengths and weaknesses of their communities, and they should take into consideration the bundles of resources they have available when planning economic development and undertaking new projects. The following chapters provide a framework of analysis for states to assess such resources and to guide their economic development efforts in a more responsible manner.

Chapter 3 — Using Theory to Improve Innovation Capacity Measurement

Introduction

If states differ significantly in terms of their capacity to innovate, how do we go about assessing that capacity, and how do we compare one state to another? In the theoretical production function (or cause and effect) framework that has been introduced, innovation capacity is the central contributing factor that should predict and determine the level of innovation outcomes in a state, and consequently, the level of economic growth and performance. As clarified in Chapter Two, economic development occurs when a discontinuous change takes place in the local economy; this change has been characterized as innovation. It is important to develop a better understanding of innovation capacity so that it may be observed holistically, taking into consideration all of its components, and so that each component may be observed in its own right, identifying strengths and weaknesses that might aid or obstruct an area from realizing the benefits of its existing capacity.

Innovation Capacity can be thought of as a set of resources that make it possible to innovate. In other words, all things being equal, states that possess higher levels of innovation capacity should demonstrate greater levels of actual innovation as a result. Capacity for innovation, then, is capacity for economic development, as innovations represent discontinuous changes in a local economy. So what constitutes innovation capacity, and how should it be measured? A review of the literature identifies several key aspects that, when considered individually, contribute to innovation capacity. When considered individually, one learns about the aspects of capacity, but does not gain a considerable appreciation for composite, or overall innovation capacity in a place. The central challenge of this segment of the research project is to identify all of the relevant contributing factors associated with innovation capacity and to determine if innovation capacity is unidimensional, or rather, if it consists of multiple distinct dimensions that should be taken separately. Theory suggests that innovation capacity does consist of multiple dimensions, but also that the strongest capacity comes from a healthy proportion of resources across such dimensions (Porter & Stern, 2001).

Firms today do not require the same inputs that traditional manufacturing entities did in the past, and the relative importance of inputs has also changed. For example, in the case of "high-technology firms, skilled labor services and proximity to sources of knowledge and expertise are much more important than factor cost reductions" (Feldman and Francis, 2004: 128). High technology firms are used as an example; all innovation is not necessarily high-tech, and innovation can certainly occur across sectors and industry types. The measures of capacity can be categorized into several general areas, including human capital and a skilled workforce, research and development spending, capital for commercialization (venture capital), and entrepreneurship.

Some of these measures—most notably human capital and entrepreneurship—have overlapping components. The following excerpt helps to explain why it is important to consider innovation capacity and entrepreneurial capacity as distinct concepts in spite of the similarities in their causes.

> Innovation, entrepreneurship, and technological change are distinct concepts that are interlinked in such a way that providing the conditions for one component does not necessarily guarantee the development of the others. Innovation without entrepreneurship cannot result in regional development. Regions may develop sophisticated innovations, but without entrepreneurs to develop and market them, the profit of the

> innovation will be reaped by entrepreneurs in other locations. Entrepreneurship without innovation cannot result in technological change (Feldman and Francis, 2004: 130-131).

For example, Freshwater and Goetz (2001) studied entrepreneurship in the states, with financial capital and human capital being two of the key concepts. They measured financial capital as venture capital commitment per person and Small Business Investment Company funds disbursed per person, while their measure of human capital was the percent of persons 25 and older who were college graduates (Freshwater & Goetz, 2001). This overlap notwithstanding, the variables are not identical, and as we continue to disaggregate them, the relationships will be drawn out more clearly.

Let us consider first the human capital component of innovation capacity. As already mentioned, Freshwater and Goetz (2001) used the percentage of college graduates as a general measure of human capital. This is not uncommon, and there are strong reasons to include such a broad measure. Innovation is not restricted to laboratories and research centers; a workforce with general skills is better prepared to provide the flexibility necessary to meet the opportunities of a situation, or to deal with a problem. Moreover, general skills are highly valuable in commercializing new products and services and bringing them into the wider marketplace.

Arora, et al (2000: 2) contend that the "location preferences of workers are an important factor in the location of firms, particularly for firms where individuals with high levels of human capital—so-called knowledge workers—constitute a primary input to production." Their research finds a clear association between places with higher endowments of human capital and higher than average quality-of-place, which they measure using culture, recreation, and climate measures (Ibid., 3, 16). According to their assertion, nice places attract knowledge workers (human capital), which coalesce to generate innovations and long-term economic growth.

While the Arora, et al, study focuses on the geographic distribution of amenities (and thus knowledge workers and firms), a key underlying premise of their work is that knowledge workers lead to economic growth in an area. The measures of human capital they employ include the percent of individuals with the following education levels: less than high school, high school, some college, college graduate, graduate degree (Ibid., 16). To the extent that quality of place attracts (or helps to retain) knowledge workers, it is also important to economic growth. In other words, places with high quality of life and lots of amenities possess the capacity to attract knowledge workers and realize economic development.

It should be noted that human resources alone, like so many individual measures, are not sufficient for economic growth to occur; however, when high human capital capacity exists, stronger innovations should be expected. Take, for example, Feldman and Desrochers' (2004) description of the technology transfer culture at Johns Hopkins University. Billed as the nation's first private research institution, and presently receiving the most federal Research and development funding of any institution in the nation, the institution focuses on knowledge for its own sake. That is, they innovate and they create, but they do not engage industry in commercialization. The result is that much of their innovative efforts can be (and have been) capitalized in other regions.

Continuing with the theme of human resources as a knowledge catalyst, Varga finds in a study of metropolitan areas that "concentration of high tech employment is the most important factor promoting local academic knowledge transfers" (2000: 289).

Varga's measure of high-tech employment consists of the concentration of employment by industries within five two-digit Standard Industrial Classification (SIC codes) (Ibid., 295, 299). (Specifically, Varga (2000) uses SIC 28 & SIC 35-38, which are Chemicals & Allied Products, Industrial Machinery & Equipment, Electronic & Other Equipment, Transportation Equipment, and Instruments & Related Products, respectively.) There are two important findings from this study. First, the presence of a university (complete with its employment of knowledge workers) is not sufficient to stimulate knowledge transfers into the local economy (measured by innovation citations in technical and trade journals). Rather, and the second important point, is that "innovation productivity heavily depends on agglomeration" (Ibid., 302). In other words, large numbers of knowledge workers employed by industry, and particularly an industrial cluster, are important in that they utilize available university research to generate new innovations in the economy. More than once in this study the term "critical mass" is used to reflect the importance of skilled workers in an economy, and a comparison of four tiers of cities is conducted to demonstrate the effect; nonetheless, no estimates of high-tech employment requirements are given (Ibid., 290, 291, 299). The ideas of critical mass and absolute size are also raised by Hauger in his study of National Science Foundation Experimental Program to Stimulate Competitive Research (EPSCoR) effectiveness, noting that these issues necessarily play a role in development planning and policy (2004: 99).

Hauger includes measures of human resources in his comparison of EPSCoR/non-EPSCoR state capacity; the variables he uses are as follows: the percentage of the workforce with a recent bachelor's degree in science or engineering, the percentage of the workforce with a recent master's degree in science or engineering, and the percentage of the civilian workforce with a recent Ph.D. in science or engineering (2004: 99). While this measure is useful, it fails to account for all of the science and engineering training by focusing on only recent degrees; moreover, it doesn't readily measure general knowledge in the states.

Stephan, et al, note the essential role of graduate students as a component of innovation capacity: "Graduate students are key inputs in knowledge production and are crucial to the role that universities play in the creation of knowledge and technology transfer" (2004: 152). Among the productivity-enhancing attributes these graduate students take with them upon entering industry are knowledge and access to networks (Stephan, et al, 2004). The university role in research and development is important, but it should also be noted that "R&D expenditure data fail to capture certain dimensions of innovation that can be measured by human resource data" (Ibid,. 160). In part, the geographic location of science and engineering graduates supports the notion that state investments in human capital are mobile. Thus, while graduate students are an important part of the state's innovation capacity while they are attending school, the study by Stephan, et al (2004), suggests an inclination for these individuals to relocate in other states upon completion of the degree program. Stephan, et al, note, in particular, that these graduates are locating to the Pacific coast and to the northwest; "people are going different places than the R&D data suggest" (2004: 164). As such, states capture only "a portion of the benefits of a trained Ph.D. workforce" (Ibid,. 164).

Huggins uses human capital as one of the key inputs to his competitiveness index of the United Kingdom, but his choice of measures leaves something to be desired; namely, he states that "economic activity rates currently provide the most robust measure of the 'raw' human capital available at an area level" (2003: 91). Economic participation rates refer to the percent of persons employed or seeking employment; they are very similar to labor participation rates. Indeed, such a measure may provide information about participation of the available population in economic activities, but it fails to address the qualitative aspects of what skills people possess, what education levels they have, and what technical experience they bring to the table. The type of people working in an economy, it seems logical, should be considered with equal importance to the number of people.

Although human resources are indisputably essential components of innovation capacity, financial resources are also of great importance. Primary among these measures is research and development spending. Research and development effort is highly important to the concept of innovation capacity because of its place in the product cycle. "A transitional scheme from an initial R&D-intensive stage of product design development through an era of rapidly rising output and sales terminating in a stabilizing, mature sales/output regime is the basic theme of the product cycle framework" (Seninger 1985: 260). Research and development activities, both in industry, and in academic settings, result in product and process innovations that are ultimately commercialized, standardized, and generate local economic development and growth.

The nature of these activities places a strong relationship between financial and human resources. For instance, some of the funding for R&D almost certainly goes to hire skilled workers, and thus the human and financial aspects are intertwined to a limited extent. The risk associated with R&D (due to knowledge externalities) discourages individual firms from engaging in an efficient amount of research and development activities. Thus the public role in R&D through government spending, or government performance (through universities and federal research labs) is very important to bolstering the local capacity for innovation. The skilled workers considered to be part of the aforementioned human resources for innovation are integral, as they are necessary to perform these activities. There is an interesting upshot of the product cycle theory, however, which affects the locus of economic outcomes resulting from the local elements of innovation capacity.

Through the R&D, innovation, and small-batch production phases of the product cycle, production typically remains at the site of the research and innovation, or within close geographic proximity. Once a production process is developed, the standardized product can generate greater profits from locations with cheap, low-skilled labor. In other words, firms seek out alternative locations with cheap and low skilled labor for assembly line production of the product, and thus the jobs, wages, and economic benefits of the product are reaped by other locations. "An earlier reliance on location near major research centers and a highly-skilled labor pool with strong locational preferences is superceded by an industry foot-looseness of branch plants toward cheap labor markets" (Seninger, 1985: 261). This trend holds not only for manufacturing industries, but also for service industries as well. Computer processors are manufactured overseas where labor is cheap, but telephone call centers are able to operate in foreign locations where labor costs are cheaper as well.

During the late 20th century, southern states were viewed as fertile ground for branch plant locations. After the North American Free Trade Agreement, and with globalization generally playing a more important role in the U.S. economy, such firms are more likely to locate in other nations. The economic development policy question here may be disturbing; states can not compete very well for these manufacturing plants as they once could, because domestic labor costs are too high to sustain the profit motives of the firm. The consequence is the conflict that one must either accept that loss of jobs to cheaper places or accept lower wages and lower skill levels among the domestic workforce—both unpalatable options to be sure. To the extent states are able to maintain innovative R&D activities, based on the U.S.'s international comparative economic advantage, the former seems more appealing than the latter. A potential goal might be to strike a balance wherein the high-skilled knowledge activities in the economy are sufficient to keep the state's lower skilled workers employed in support and service roles.

Varga uses two measures to account for research and development expenditure: private industry R&D and university R&D. The measure used for industry R&D was professional R&D employment; for university R&D, NSF-collected data on research expenditures in hard science and engineering departments was used (2000: 294).

Stephan, et al, indicate that university R&D expenditures are a common measure of knowledge sources (2004: 157), and they add that "public knowledge sources are often measured in terms of university R&D expenditures" (Ibid., 160). It stands to reason that private knowledge can be measured by industry research and development spending. Stephan, et al, are largely concerned with knowledge and the human capital aspects of these expenditure data, and that is certainly important (as I have noted above). However, R&D expenditure data, while including salaries that support the human element, also incorporate capital, equipment, and supply expenses that reflect on the capacity for innovation. As such, the financial elements of research and development spending contribute additional information not contained solely in the human resource data.

Government investment in research and development is extremely important to overall performance of the market. Research and development funding has a positive effect on private firm behavior and subsequent economic growth. In other words, government subsidies provide firms with incentives to engage in R&D activities to a greater extent than they would otherwise. The social benefits from research and development are greater than the private return captured by the innovating firm; this market failure should be met with government subsidization of R&D activities (Feldman, 2002). The more important effects of government R&D funding include knowledge spillovers in an area (which aid innovation), and the signaling effect they have for subsequent R&D investment by nongovernmental sources. Feldman finds that government R&D complements, and does not displace, private R&D; she notes that the displacement observed by other studies may have been tied to negative incentives associated with the programs under study (2002: 22).

Aside from research and development spending in particular, there are other financial resources that affect state innovation capacity. With regard to public higher education in particular, there is reason to be concerned that too much emphasis on R&D spending is a bad thing. Feller finds that universities tend to invest strongly in technology-based academic research in order to attract federal and private industry R&D funding (2004: 147); such focus may be a beneficial bolster to innovation capacity, but if the funding for general educational infrastructure is displaced, the effect may be negative in the big picture.

Given what is known about the relationship between innovation and entrepreneurship, it takes a talented group of entrepreneurs to commercialize and benefit from the innovations created in the laboratory, without which no economic growth will result. “In terms of their contribution to technological innovation and regional economic growth, universities are far more than sources of licenses, patents, and start-up firms. Their more substantive contributions are in generating public knowledge and pools of educated and trained individuals” (Feller, 2004: 144). Feller reiterates this point more forcefully as follows: “The primary contribution that universities make to technology-based economic growth is through their training and educating of a skilled labor force; with some notable but infrequent exceptions, it is not in producing technological innovations” (2004: 144). Thus, the relationship between spending on R&D and other general education expenditures within institutions of higher education is important to keep in mind. In an environment of declining state shares of higher education revenue, this is particularly salient.

Two possibilities exist for measuring general educational expenditures. First, one might consider public higher education current fund expenditures (state appropriations) for higher education on a per capita basis. Second, the ratio of general education spending to research and development spending addresses the extent to which a state may be allowing the technology focus to supercede its general education purposes. In other words, the proportion of higher education spending on R&D activities to total higher education spending might reveal a distortion of university efforts in favor of producing innovations rather than training individuals to effectively participate in an innovative economy. Innovations without the skilled workforce and entrepreneurs will only lead to economic growth in locations where those general educational benefits exist. Universities are core components of the "'underlying infrastructure for innovation on which the system of knowledge-based capitalism draws'" (Feller, 2004: 144).

While R&D spending, and public higher education expenditures more generally, are important components of the financial capacity for innovation, other financial resources are also very important to economic development and growth. Most notable among them is venture capital. Venture capital spending helps entrepreneurs to spin off businesses from ideas and commercialize products to prepare them for the market. As such, venture capital doesn't represent capacity to innovate, but rather capacity to commercialize. Venture capital spending and the number of venture capital deals have drastically decreased over recent years as demonstrated in Figure 3.1 below. Moreover, venture capital tends to be local; investors want to monitor and maintain tight control over the firms in which they have risked their capital (Feldman, 2001a). Hauger also includes venture capital spending in his measures of capacity (2004: 99).

Figure 3.1: National Aggregate Venture Capital Spending 2000-2003

2000		2001		2002		2003	
# of Deals	Amount Invested	# of Deals	Amount Invested	# of Deals	Amount Invested	# of Deals	Amount Invested
8,303	$107,781,922,500	4,857	$42,919,841,800	3,098	$21,619,481,600	2,876	$18,775,640,500

Source: PriceWaterhouseCoopers MoneyTree Survey:
http://www.pwcmoneytree.com/exhibits/NationalAggregateData95Q1-04Q2.xls

Small Business Innovation Research awards represent publicly-provided commercialization capacity. The federal government's SBIR program makes awards through various agencies (including NASA and the U.S. Small Business Administration). "SBIR is a highly competitive program that encourages small business to explore their technological potential and provides the incentive to profit from its commercialization" (U.S. Small Business Administration). The SBIR website (Ibid) describes the three phases of the SBIR process as follows:

> Following submission of proposals, agencies make SBIR awards based on small business qualification, degree of innovation, technical merit, and future market potential. Small businesses that receive awards or grants then begin a three-phase program.
>
> I) Phase I is the startup phase. Awards of up to $100,000 for approximately 6 months support exploration of the technical merit or feasibility of an idea or technology.
> II) Phase II awards of up to $750,000, for as many as 2 years, expand Phase I results. During this time, the R&D work is performed and the developer evaluates commercialization potential. Only Phase I award winners are considered for Phase II.
> III) Phase III is the period during which Phase II innovation moves from the laboratory into the marketplace. No SBIR funds support this phase. The small business must find funding in the private sector or other non-SBIR federal agency funding.

The description provided indicates that the program is geared primarily toward commercialization. In other words, the idea or the innovation must already exist to merit an award. The movement toward commercialization throughout the program suggests that these federal funds are indeed intended to provide commercialization capacity, not innovation capacity. That being said, process innovations may indeed occur as an externality during research performed under such programs.

Entrepreneurship is associated with innovation, but entrepreneurial activity reflects ambition and desire to profit. New firms are started and business is conducted to capitalize on an idea or a new innovation. As such, entrepreneurial activity is not a key component of innovation capacity; entrepreneurship matters for growth moreso than development, to return to the distinction made in the previous chapter. Feldman (2001a) draws out an interesting clarification: innovation is distinct from entrepreneurship. "Entrepreneurship is one way in which innovation is realized as firms are formed to commercialize and advance new ideas. External environments and resources may make it easier for innovation to be realized but may not be sufficient to introduce new firm formation" (Feldman, 2001a: 887). In other words, research and development can take place, and innovation can occur, but without the technology transfer and commercialization aspects, no development or growth can be expected to result. Said differently, "'the function of entrepreneurs is to reform or revolutionize the pattern of production by exploiting an invention or, more generally, an untried technological possibility for producing a new commodity or producing an old one in a new way'" (Feldman and Francis, 2001: 4). The impetus for this research project is to ascertain how states might focus their resources to stimulate innovation and to spin that innovative activity into growth. Entrepreneurship is not the only way that products are commercialized, however; existing firms continue to innovate and commercialize new products.

In their study of the U.S. capitol region, Feldman & Francis (2001) found that the conditions associated with an entrepreneurial environment lagged, rather than led, the region's cluster development. This demonstrates that entrepreneurs—the skilled workforce we have already taken into consideration—build the resources they need to be successful. The resulting social network continues to enhance itself, leading to further innovation, and to the development of an industry cluster. In the case of Washington, D.C., the dominant clusters included biotechnology and telecommunications. To briefly summarize, entrepreneurship builds clusters, and clusters lead to innovation and growth.

Thus, entrepreneurship is equally important in leading to innovation, and to capitalizing the innovations that are created. The policy implication of this finding is that you cannot cause a particular type of cluster to develop, but putting the necessary resources (such as skilled workforce, etc.) in place will enable an adaptive group of entrepreneurs to establish structures that may lead to cluster development over time. "Over time, a successful cluster becomes entrenched, as the success of the early entrepreneurs attracts resources such as venture capital and specialized labor to the region, and as institutions and government enact policies to promote the cluster" (Feldman and Francis, 2001: 2).

Clusters are representative of innovative activity, and they are likely to occur at the innovation stage in a product's life cycle (Feldman, 2001b). "Among economic activities, location matters most for innovative activity, which by its nature is creative and relies on tacit knowledge. The greatest tendency towards geographic cluster is in new industries, at the earliest stages of their lifecycle" (Ibid, 6). Again, clusters are important engines of economic development and growth; their existence is evidence of innovation, but the integrated components—most notably knowledge workers with entrepreneurial ambitions—that lead to the cluster formation initially, and to sustaining it, are also the elements of capacity for innovation. Thus, even places that have not yet seen clusters develop, but with the underlying resources, have strong innovation potential.

In addition to the various measures discussed above, there are additional measures that have been used to represent capacity, but which do not readily fit into the categories generated above. For example, Hauger also considers business assistance programs (the number of incubators), the amount of IPO funds raised, and the technology intensity of the business base (2004: 99). For the latter concept, Hauger uses the percentage of establishments, employment, and establishment births within high-technology SIC codes (Ibid., 99). Innovation and technological change are important, but the lack of firms in high-technology enterprises does not preclude an innovation from occurring; similarly, innovations and progress are likely to be made in settings other than the specified SIC code industries.

In summary, the various elements of innovation capacity are all highly important, if not necessary, at the earliest stage of the product cycle, and all technological change and economic growth depends on their success. Whether states retain branch manufacturing plants and the associated jobs that result from these innovation activities is a secondary issue. These components—human, financial, and other resources—work together in such a way that the resultant innovation capacity is likely to be greater than the sum of the constituent elements. Each of these elements must be taken into account in measuring and developing an index of state innovation capacity. To recount, innovation capacity is comprised, both theoretically and practically, of distinct constituent groups of resources, such as human resources and financial resources that may vary independently by state. Examples of each group of resources have been provided in the preceding paragraphs, and the following analysis will address whether or not it is appropriate to evaluate innovation capacity in terms of distinct groups of resources or in a one-dimensional composite fashion in terms of their ability to predict future innovation outcomes.

The literature identifies a number of relevant dimensions that represent innovation capacity. Hall's earlier study (2003) utilized factor analysis to confirm a categorization of capacity variables into two groups of resources: human resources, and financial resources. Cortwright and Mayer (2004) advocate the use of multiple complementary metrics, including industry clusters, skilled labor, entrepreneurship, financial resources, and institutions, in shaping the path to innovation and growth. Freshwater (2003) similarly differentiates among five primary types of innovation capacity. Other studies make similar distinctions, including the Progressive Policy Institute *State New Economy Index,* Michael Porter's state innovation profiles (National Governor's Association) and the Southern Growth Policies Board's *Southern Innovation Index* (Clinton, et al, 2002).

Using this knowledge, a new index of innovation capacity will be developed that builds on these findings by grouping variables into multiple dimensions of capacity. This index will be distinct from existing indices in its effort to exclude measures of innovation outcomes. Factor analysis will serve both exploratory and confirmatory roles in the assignment of variables into dimensions for analysis. Thus, the goal shall be to construct an index of innovation capacity that incorporates variables that are theoretically relevant to generating innovation outcomes, while maintaining basic categories of resources that may vary independently from state to state.

Why is it important to develop a measure of innovation capacity that explicitly excludes measures of innovation outcomes? It is important to exclude outcomes in separating cause from effect, and in this research, to separate the dependent from the independent variables. The overall conceptual perspective of the analysis is that of an economic production function, wherein innovation capacity inputs generate innovation outcomes. The above question is important given the argument that innovation outcomes accurately depict capacity; in other words, one might ascertain a state's capacity by observing its patents and other innovation outcomes. Innovation capacity may indeed be somewhat endogenous to certain measures of innovation outcomes; however, there are two primary logical problems associated with failing to separate the two on those grounds. Namely, the measures of innovation outcomes are not likely to perfectly measure innovation capacity; there is likely to be latent capacity that has not been realized in the current period of measurement. Second, capacity changes over time, and states make efforts to improve their innovative capacity as they pursue economic development goals. When combined with the fact that the results of capacity are likely to be realized over a long period of time, it stands to reason that one can not easily detect what effects might have resulted from near-term improvements in capacity versus long-term existing capacity.

As a predictive model for future innovation and economic performance, it is wise to distinguish the innovation capacity and innovation outcome constructs. For example, recent improvements in the science and technology skilled worker measure for a state in a given year reflect capacity for innovation in the future that is not likely to have been captured by the patents and other innovation outcome measures for the same, or even the subsequent year. By collectively measuring the elements of capacity that are theoretically related to innovative outcomes, it renders unnecessary the need to include measures of outcomes as proxies for capacity.

Innovation capacity is very distinct from innovations; to the extent that patents and SBIR awards constitute capacity, it is in the form of the knowledge network that exists as a result of the R&D leading up to the innovation, not the innovation itself. Furthermore, a patent is a data point that represents an actual innovation. The patent is not innovation capacity—rather, it prevents anyone but the innovator from using the innovation for a period of time. One might think of this in terms of stocks and flows, where capacity is the stock of resources, and patents are the outcomes that flow from an existing stock. The actual innovation is, on the other hand, capacity for commercialization and standardization of the product, which create jobs and income and lead to economic growth.

Using the model of an economic production function as a theoretical approach to explain innovation outcomes in the states necessitates the distinction between inputs and outputs, or independent and dependent variables. The measures of state innovation capacity developed will later be considered as the inputs, or independent variables, that explain innovation outcomes. Innovation capacity and innovation should be considered separately, but that does not mean that innovation is not important.

Innovation involves building upon the past to create something better for the future. This is a relatively simple and straightforward conceptualization of innovation, but it connotes the importance of past in technological change. Innovation involves solving problems, but it also involves creating new opportunities that improve our quality of life. To better understand innovation, think of a musical composition. Based on a simple poetic text written by Friedrich von Schiller, the Ode to Joy, Ludwig van Beethoven developed his powerful ninth symphony. The text was Beethoven's inspiration, and although written some forty years earlier, through it he saw an opportunity to convey the work in musical form. Later, Beethoven's tune was again borrowed and set to the text of the modern hymn "Joyful, Joyful, We Adore Thee." From genre to genre, pieces of the past remain as new works are created for different purposes, using different orchestrations, and in different settings.

Johannes Brahms, the famed Romantic composer, frequently used as his material themes borrowed from previous composers. Many of his works bear the title "Variations on a Theme by...," followed by the familiar names of Paganini, Haydn, Schumann, and Handel, for example. In each of these works, Brahms takes a basic musical theme of interest to him, then carries it through a series of permutations and developments, sampling new uses of complexity and harmonic density. Each variation makes new use of the initial theme.

This is not a dissertation about music, but the implicit ideas expressed above are related to product innovations in the modern marketplace, and the musical metaphor may enhance understanding of these relationships. Innovation in the marketplace involves using the tools available, building on the ideas of the past, and creating new products that make our lives better. The automobile utilized the basic concepts of steering, brakes, and passenger compartment as did carriages, buggies, and stagecoaches, but with a superior propulsion system. Over time, many components of the automobile have been added and further improved, all owing to the combined expertise and vision of opportunity that individuals have set to work. The key point is that innovation is an ongoing phenomenon, always building on the past, and combining unique ideas from different sectors into new uses in alternative settings. Perhaps the most notable difference from the previous musical examples is the expectation of profit associated with innovation in the modern world; many composers lived in poverty only to have their fame realized long after their death.

The musical example can be drawn one step further. Composers of art music almost universally possessed additional musical skills that were oftentimes valued more highly than their compositional abilities. As already mentioned, composition was not a rewarding enterprise if recognition and appreciation did not result during the composer's lifetime. As such, many skilled musicians were engaged for two other services that paid their bills—performance and education—and only composed when time permitted or when it furthered the other aspects of the musician's career. Mozart's famed *Twinkle, Twinkle, Little Star* was written as a keyboard teaching tool for one of his children, for example. Venture capital in today's economy assists innovative individuals or firms to commercialize their innovation and move it into the marketplace. This parallels the historical impetus for composition. Wealthy aristocrats would often commission works in their honor, or for special events, and would offer financial support to composers for penning their best ideas in compositional form. Mozart's *Requiem* was composed as a funeral dirge for such an aristocrat. An additional source of support for composition came from a common wealthy benefactor—the Church. Musicians in the employ of the Church, in exchange for their salary, performed and composed sacred music as their primary role, but also provided instructional services as well. Two examples include Johann Sebastian Bach, whose music was almost exclusively sacred, and Gabrieli, famed for the antiphonal style (an important musical innovation) developed at St. Mark's Cathedral in Venice. Financial capital is sometimes necessary to push an innovation into the marketplace, just as financial capital helped to move musical innovations from composer's minds into print and performance for public consumption.

A more thorough and complete definition of innovation is in order. "Innovation is a specific type of economic activity that is concerned with the development of products, processes or organizational methods that create novelty—the stroke of human genius that produces originality and uniqueness. Innovation is typically associated with commercial applications and we draw a distinction between invention, the original idea and innovation as its commercial realization" (Feldman, 2001b: 4-5). Feldman makes a terrific point with her distinction between invention and innovation. The two concepts are integrally related, and in many cases may be inseparable. Nonetheless, invention is the key step—someone develops a new idea. That idea is often recorded as a patent to protect its value to the person who developed it. However, a patent alone is insufficient to generate any economic or employment benefits. Rumors have long circulated about the infamous shade tree mechanics who have developed highly-efficient carburetor systems for automobiles, patented them, and profited from the sale thereof. If there be any truth to such rumors, the remainder of the story makes a keen point—the patents were not bought by automobile manufacturers for commercialization, but to prevent competition, or they were bought by the petroleum industry to protect demand and price for their oil. In these cases, the invention does not lead to economic improvement, growth, job creation, or any of the other expected outcomes. It is indeed the commercialization step that moves the idea forward into new applications in the marketplace, thereby transforming the economy. Though Feldman's distinction is warranted, both invention and innovation are required for economic development to occur; thus, the references to innovation hereafter are intended to incorporate both concepts.

Much effort has been expended describing the importance of innovation capacity, outlining its components, and explaining how they work together. How is it that this capacity leads to innovation outcomes? Another clarification might be in order.

Innovation capacity is not alone sufficient to create innovation. That is, capacity does not cause actual innovations, but it is a requisite catalyst. In other words, the history of a place, the unique circumstances, problems, opportunities, and resources—all extremely difficult to conceive and measure—are the driving factors that lead to innovations. Without the various elements of innovative capacity that have been described in Chapter Three, it is less likely for an innovation to develop. As such, equal parts of innovative capacity would result in different types of results for different places. Two otherwise equal places with different levels of capacity, on the other hand, would see widely disparate patterns of innovation and economic development—the place lacking in capacity would see little or none.

Innovation operates at a unique nexus in the cycle of technological change. Through the coalescence of various elements of innovation capacity, an idea is born and entrepreneurial efforts are undertaken to put the idea to use in the marketplace. This profit-driven decision is straightforward. The usefulness of innovation capacity has not been fully lived out at this point, however. Skilled workers—engineers, programmers, and others—are still very essential to the overall process as the idea is transformed into a prototype, tested in pilot projects, and then commercialized into broader use. Only at the level of mass production does the value of human and financial resources begin to wane. As such, it is the case that many inventions may not become innovations in the same geographic location that they are conceived due to a shortage of necessary capacity. In the jargon of current new economy study, such regions may have bright individuals, but they lack overall competitiveness that would be required to capitalize on the idea.

Understanding how the concepts are related, the task of identifying innovation outcomes that should be taken into account in developing a state innovation index is now addressed. Innovation outcomes identified in the literature include a number of measures. For example, Stephan, et al, recognize the importance of the two most common indicators of innovation—patent activity and Small Business Innovation Research (SBIR) awards (2004: 157). Freshwater also uses these measures in a category he refers to as "idea creation" in his study of Kentucky's entrepreneurial performance (2003: 8). Florida & Lee measure innovation as patents granted over the period 1990-1999 (2001: 4). Reamer, Icerman, and Youtie utilize the number of patents per 100,000 residents as a primary measure of innovation (2003: 70). In a different type of study than those already mentioned, Hauger uses Small Business Innovation Research award dollars, university patent activity, and the amount of university R&D funded by industry as measures of S&T indicators resulting from participation in the NSF EPSCoR program (2004: 108).

Varga uses the innovation counts from the United States Small Business Administration (SBA) innovation citation database, a survey of new product sections of trade and technical journals, to measure innovation outcomes (2000: 294). He points out the obvious shortcoming of this method, however: "their availability is limited to a single cross-section of 1982" (Ibid,. 294). This data is now nearly a quarter century old, and being only a single-year cross-section, it does not provide any usefulness for comparisons or change over time.

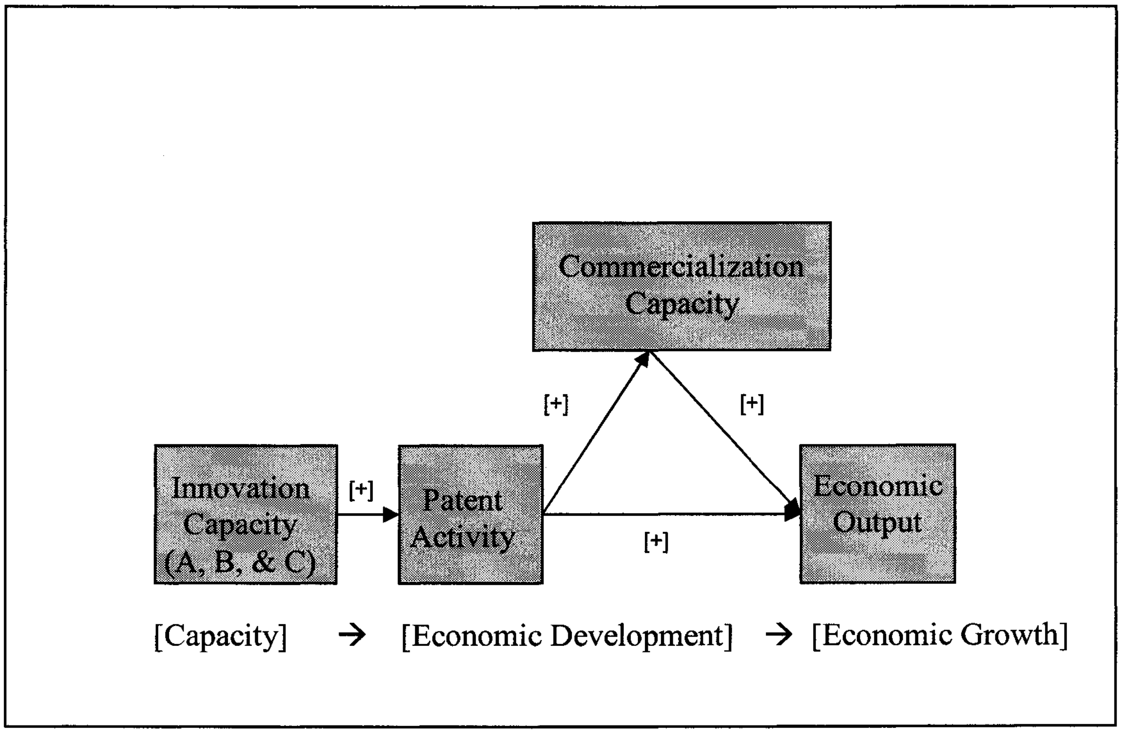
Huggins proclaims GDP per capita to be "the most important measure of the economic activity of an area" and he uses it to represent productivity in the local economy (2003: 91). Other financial measures are important in considering the impacts of innovation. Per Capita Personal Income, Earnings per Job, and Gross State Product are all included in Freshwater's "Entrepreneurial Output" category (2003: 8).

New business formation is a strong indicator of innovative activity. As individuals identify a target niche in the economy—often related to a specialized product or process—they form businesses to market and commercialize their products. "Startup firms are the embodiment of innovation, especially for radical new technologies that are not easily absorbed into existing firms" (Feldman, 2001a: 861). As such, new firm formation is a meaningful measure of innovation activity at the beginning of its commercialization phase. However, many innovations are conceived and commercialized by existing firms of all sizes, so new firm creation may not necessarily reflect the degree of innovation so much as it would the general timbre of innovation taking place in a state.

To summarize, it is expected that there are multiple dimensions of innovation capacity, and capacity should be assessed and compared on that basis rather than in an alternative composite form. Furthermore, innovation capacity should result in innovation outcomes, documented by patent activity. Patents, representing innovations, should lead to increased commercialization efforts, and thereby attract capital for commercialization in the form of venture funding and/or SBIR awards. Patents capture technological innovations fairly well, and may capture service industry innovations if processes are patented, but this variable does present a measurement issue in that some innovations will not be documented. For example, computer software is copyrighted, not patented; a count of copyrights necessarily includes a great deal of irrelevant material, so it is difficult to include all economic innovations. Patent activity is a documentation of actual innovation, and therefore represents an effect of innovation capacity; however, innovation capacity may also have additional effects on local economies by enhancing the spin-off of new firms and development of service industries through entrepreneurial activity.

Entrepreneurship may be present at the commercialization phase or it may not, depending on who the innovator is. The importance of entrepreneurship is latent within this research, but its specification and measurement presents a task which, of itself, is too grandiose to undertake as part of the present research project. Finally, innovation and commercialization are expected to lead to higher economic output in the states as a result of economic growth. These constituent elements of the theoretical model can be summarized by the following graphical representation, Figure 3.2:

Figure 3.2: The Theoretical Relationship



It is important to note that the theory developed here, based on the model represented above, suggests not only that innovation outcomes should be separated from measures of innovation capacity, but that the relationship is more complex than simple inputs and outcomes. The elements that represent innovation outcomes, as discussed previously, in fact represent different stages in the economic cycle which can be depicted independently. In understanding the impact of innovation capacity on state economies, it is important to maintain as much specificity as possible. That is, innovation capacity may lead to increased economic output in a state, but there are key variables that may mediate the response—variables that states may be able to impact. Therefore, it is wiser to examine the independent components of the model to discern the effect of each stage on the following.

The theoretical model as defined and described above promulgates the following general hypotheses which shall constitute the framework for the time-series analysis in Chapter Six:

> Hypothesis One: Higher levels of capacity for innovation (as measured by common factors) will lead to greater innovation outcomes, measured by the number of Patents Issued to State Residents (PISR).
>
> Hypothesis Two: Higher levels of innovation outcomes (patents) will lead to increased investment in commercialization efforts, measured by the common factor Commercialization Capacity.
>
> Hypothesis Three: Increased levels of innovation outcomes and Commercialization Capacity lead to increased economic output, measured by Gross State Product (GSP) and Per Capita Personal Income (PCPI), with the expectation of greater economic output where Commercialization Capacity is greater.

Prior to carrying out a complete time-series analysis that includes all of the constituent components of the theoretical model, it will be useful to undertake an exploratory analysis to examine the theorized relationships within a single year of data. Chapter Four performs this function; state data for 1999-2000 is examined to establish the framework for developing an index of innovation capacity, and regression is used to examine the effects of capacity on SBIR awards, patents, and financial outcome measures. This framework is used to develop the indices over time in Chapter Five, and to test the relationship among the model's constituent parts over time in Chapter Six.

Chapter 4 — Toward A New Index: Analyzing Most Recent State Capacity

Introduction and Background

This chapter connects the literature and theory of economic development, innovation, and public administration presented in the initial three chapters, and provides an introduction to the data and operational variables that represent the theoretical constructs identified in Chapter Three. This chapter describes the use of the most recent annual data to develop an index of innovation capacity for the states, and then examines the effect of capacity on actual innovations, commercialization capacity, and state income.

Economic development has long been an area of interest to people, communities, and the governments and elected officials that represent them. Through economic development and economic growth, jobs are created, income is generated, and the quality of life is improved in both relative and absolute terms. Research and practice in the modern United States has demonstrated that economic development is politically popular (Wolman and Spitzley 1996), and has led to the creation of numerous state and local economic development policies as well as agencies and instrumentalities of those governments to oversee the implementation of such policy. Since the Great Depression states have vigorously pursued businesses in an effort to foster economic growth (Goss and Phillips 1997). Interstate competition during the seventies, often referred to as smokestack chasing (Eisinger 1995), largely consisted of efforts geared toward recruiting industrial branch plants and other heavy manufacturing industries that provided jobs to predominantly unskilled and low-cost workers.[1]

Three significant economic trends altered our nation's competitive economic position and led to today's "new economy." Namely, increased globalization of the economy hampered state efforts to attract and maintain industry, and resulted in the loss of much previously existing industry to overseas locations (Lackey 2000). Second, the rapid growth of the service sector reduced dependence on manufacturing (Glasmeier and Borchard 1990). Finally, technological advances decreased the time and costs associated with communication, processing information, and conducting business, and simultaneously led to the growth of technology industries and technology-based businesses (Lackey 2000; CSG 2001). As a result of these combined changes, today we find ourselves in a so-called 'new economy' in which knowledge and innovation are the dominant economic forces.

Defining the New Economy: The Concept

The term 'new economy' has become a catchword to describe many different but overlapping phenomena that have impacted the economy of our nation, and its constituent states and regions. As mentioned above, globalization, service sector growth, and technological innovation are the principal components of this new economic regime (Pohjola 2002).

Technological advances have resulted in an increasingly efficient transportation system that has improved mobility and aided the development of a global economy through reductions in transportation costs (Shepard 1997; Lackey 2000). The increase in transportation sector employment likewise contributed to the growth of the service sector (as transportation is a service industry), and demonstrates how the three primary trends behind the new economy are intertwined. If transportation efficiency has permitted globalization of business, the spread of capitalism has been its driving force (Shepard 1997; Clark and Montjoy 2001). That is to say, the effect of market forces, free trade, and deregulation of the United States economy has been an increase in the relative importance of international trade and investment (Shepard 1997).

During the Twentieth Century, and particularly the latter half of the century, the United States experienced phenomenal growth in the service sector. This general shift to service sector business dominance occurred as more and more jobs were created to provide support for traditional manufacturing industries, and as the service industry transitioned from a manufacturing support role to one of generating end-products in their own right (Glasmeier and Borchard 1990).

Technological advancements during the latter part of the Twentieth Century are key contributors to the previously described trends of globalization and service sector growth. In short, the most significant contribution (Zagler 2002) to the dramatic economic change in the U.S. economy is innovation.

Consider the example of information technology. Innovation has led to more efficient production of computer hardware and software, and has led to increases in such production. Likewise, increases in information technology use have come about as a result of these innovations and the tasks that they enable. In combination, information technology production and use have contributed in large part to increases in productivity in the U.S. economy since the early 1990s (Feroli 2001).

The use of information technology often appears in the rhetoric of new economy proponents, and this argument is relevant on two counts: "First, the rapid decline in the price of computing power has spurred huge investments in IT," which, "like any other form of capital spending, should raise the productive capacity of the firms that undertake it. Second, IT has the potential to allow firms to implement efficiency-enhancing changes in the way they do business" (Feroli 2001). The productivity increases resulting from IT investments have played an important role in the overall transition to the new economy. These changes have allowed more businesses to incorporate such technology into their production processes. To state the relationship differently, information technology is a transcendent technology of sorts, very similar to the railroads and automobiles of the nineteenth and twentieth centuries, respectively (Shepard 1997). It is both an output (product) that stimulates economic development and growth and an input that helps other industries stimulate economic development and growth in improving products and developing new ones.

According to a recent report by the National Conference of State Legislatures, "Information, ideas, and technology are the driving forces in this 'new economy'" (2001). In fact, this has always been the case; true economic development comes about as the bundle of products created within the local economy (i.e. the local production function) changes with the addition of new products and services and more efficient methods for producing existing ones. These changes are the result of innovation. Under the old economic regime, proximity to natural resources, capital, and labor were also important contributing factors to economic development; their importance has declined as we have moved into a mechanized information economy. Labor continues to be an important input, but much higher skill levels are necessary from labor today. Former Kentucky Governor Paul Patton described the causality as follows: "The engine of growth is human capital, brainpower, and knowledge. Research institutions incubate entrepreneurs" (Patton 2000).

Even in the wake of the recent economic downturn in the U.S. and abroad, and in light of instability in technology stocks, analysts continue to acknowledge that technological change was a significant factor contributing to the drastic change and phenomenal growth experienced during the latter decades of the twentieth century (Keleher 2001).

Economic Development/Economic Growth Theory

Existing economic development theory provides a basis for understanding new economy development. I will briefly explain existing economic growth and development theories as recognized by the U.S. Economic Development Administration Information Clearinghouse, and then relate new economy-type development to these theories in an effort to demonstrate key differences that support the present research.

1) Economic Base Theory—This theory asserts that external demand for local basic products results in increases to production, output, and income, which leads to economic growth that diffuses into other, non-basic, sectors of the local economy.

2) Staple Theory—Export of products (export staples) from specialized local industrial sectors to worldwide markets results in long-term sustained growth and urbanization that may result in the growth of non staple-related economic activities.

3) Sector Theory—Demand results in labor transitioning from natural resource extraction (primary) and manufacturing (secondary) employment into service sector (tertiary) employment; the more prominent the service economy, the greater the level of development.

4) Growth Pole Theory—New propulsive industries form poles of growth which are initiated and then diffused from central locations, altering the mix of products in the economy as they develop. EDA notes that this strategy has failed as a general theory of development, and it could be added that, in today's world of efficient communication and transportation, diffusion worldwide could take place almost effortlessly.

5) Neoclassical Growth Theory—The rate of personal saving to support investment and capital drives economic growth, as productivity (output) increases because of capital investment. This regional model suggests that locations where labor is cheaper and where the returns on investment are higher succeed in attracting industry. This model depends on efficient flow of goods between regions and thus results in a favorable view of infrastructure investments, transportation, utilities, etc., that produce and offer cheaper inputs for the industry.

6) Interregional Trade Theory—This microeconomics-based theory supposes that free and open markets determine equilibrium prices for commodities. This causes local economies to do what they do best. Those that are able to most efficiently produce a certain good, do so; and those that are not able, do not. Again, improving efficiency reduces costs, which leads governments to pursue numerous infrastructure projects to attract businesses.

7) Product-Cycle Theory—Product life cycles include three stages (new, mature, standardized) which determine the level of development. Innovation causes economic development to occur up through the standardization phase of the product.

8) Entrepreneurship Theory—This theory supposes that economic development occurs as a result of creative people. Again, innovation is the key driving force, but the focus is on the individual rather than the economy.

9) Flexible Production Theory—Economic development under this theory refers to qualitative change in "industrial mix, firm structure, and sources of competitiveness" as opposed to quantitative growth. An inherent shift from price-based competition to "innovation, product differentiation, and niche marketing" is key.

As this summary reveals, a distinction exists between place-based and people-based development strategies, and lively debate exists in practice (Economic Development Administration, 2003). The political goals of development can only be realized within political boundaries. Thus, the rewards can only be reaped if development occurs in those locations, making the place-based set of theories politically popular.

Development efforts in the new economy typically reflect a people-based development strategy as opposed to factor-cost reduction strategies associated with industrial recruitment. However, the shift to the new economy has forced economic development efforts to be undertaken by higher levels of government that transcend geographic boundaries because people are highly mobile and cross political boundaries regularly and at will.

Investment in people is economically inefficient for the local governments, but is more efficient for higher, more inclusive levels of government. Why is this the case? In short, spending tax revenue on individuals to enhance their skills and education may not be repaid through future tax payments, as those newly-skilled individuals are likely to move to other jurisdictions to find employment. The jurisdictions that reap the benefits of future income and property taxes are not necessarily the ones that make the investment, which reduces the incentive for local governments to engage in people-oriented development policies. The cost to an individual associated with moving across county and city boundaries is very low as compared to moving across state lines or national boundaries, so states and the federal government are more likely than local governments to receive a return on people investments.

In the twentieth century, development efforts shifted from industrial recruitment strategies that reflect the manufacturing (secondary) economy to human capital oriented development efforts that more closely correspond to the service (tertiary) economy. We also see a corresponding theoretical shift from price and location advantages to human resources as the most important component of economic development efforts. Human skill, innovation, and entrepreneurship weigh heavily into the development picture, and particularly so in an advanced economy where many products are intangible. Furthermore, the general economic trend has moved away from simple growth (quantitative change) toward Schumpeterian development (qualitative change) as the objective of development efforts.

The importance of this shift to a new economy, and to new economy-based development strategies, is simple. Innovation can be fostered by the policy of our federal and state governments. In fact, innovation separates economic development from general economic growth, as originally argued by Schumpeter (Felbinger and Robey 2001). Investment in the proper human and capital resources is necessary for new economy development to occur. These investments do not *cause* development, but *permit* it to occur when other conditions are appropriate. In the absence of proper human and capital resources, other things being equal, development would not be likely to occur.

Recent trends in state economic policy have shifted in the direction of developing knowledge and innovation industries (i.e. "new economy" industries). Even recognizing that investments may be lost to other areas, most states have nonetheless embraced the new direction to create employment opportunities and improve economic conditions. For example, Kentucky's economy is oriented toward manufacturing and agriculture, but a state Office of the New Economy (ONE) has been established to promote knowledge and innovation industries. Some states possess resources that are better suited to the knowledge economy (the term knowledge economy focuses on the shift to the service sector and intangible goods from manufacturing tangible products) than others. The salient problem for state policymakers is one of practicality and economic efficiency—if a state lacks the necessary resources to stimulate new economy growth, is it worthwhile to invest state funding for the development of such resources? Moreover, policymakers are not readily able to determine which resource categories are deficient and which are not.

This section clarifies the conceptual definition of the new economy through a review of existing literature on the subject. Given its prominence in explaining any period of economic development, but especially the change to the new economy, a measure of state innovation capacity is created for the purpose of analysis.

Previous research regarding state innovation resources for economic development is largely based on state rankings, resulting in measures of innovation capacity that are relative rather than absolute. Moreover, previous attempts to define innovation arbitrarily determine and assign large numbers of explanatory variables into categories. This study seeks to improve the field of innovation research by developing a more parsimonious model of state innovation capacity based on the nominal values of the determinants of innovation rather than relative state rankings. In addition, factor analysis is used to validate the categorization of explanatory variables into types of innovation resources (human resources and financial resources). This methodological approach eliminates the need to arbitrarily assign measures to one category or another. Aspects of state innovation are measured using National Science Foundation Science and Engineering data in conjunction with related data from other sources. Factor analysis converts a large number of variables into fewer dimensions that explain the variability of the original data. The resulting new variables (underlying common factors) represent groups of similar original variables by grouping the variance that they share.

Each original explanatory variable "loads" onto one of the common factors that contains other similar variables because it shares variance with other variables that associate with that factor. Factor loadings, or weights, indicate the relationship of each variable to a resulting category of innovation resources (a common factor). Factor scores are computed for each resulting factor, and for each state in the dataset. These scores are then used to classify states into four innovation resource categories— lagging, low, developing, and progressive —a scale that represents the degree to which states possess new economy capacity needed to further their developmental goals. Each common factor represents a different aspect of innovation (human or financial), and each state has a score for each area of resources. These scores reveal state strengths and weaknesses in different capacity areas. To determine how states fare in overall innovation capacity, the two scores are added to provide a composite innovation capacity rating. A series of regression analyses are performed to test the effect of each group of innovation resources on observed innovative activities and overall economic performance in the states.

This analysis helps to understand how the components of innovation work together to further growth in the states' economies. This work builds on, but goes beyond the efforts of the Southern Growth Policies Board (Clinton et al, 2002) and others to measure state innovation by combining multiple variables into composite factors to develop a useful measure of innovation for all fifty states and the District of Columbia.

Michael E. Porter has conducted prolific research into innovation resources and economic growth of nations, but he has also developed innovation profiles for the fifty United States. Porter's work examines each state comprehensively on a variable-by-variable basis without creating a tool for overall comparison. I seek to compare states at both a categorical level and the composite level rather than one statistic at a time. The common factors that result from my factor analysis (human and financial resources) represent areas of resources without disaggregating to the variable level. Similarly, Porter's work uses a benchmarking technique to demonstrate how states fare compared to their similar state counterparts. While this is useful, it does not provide a quick analysis of whether states have what it takes—in each category of innovation resources—to make new economy growth a reality.

Porter is not alone in this field; other researchers have used similar techniques to create rankings and "report cards" that indicate state performance in innovation and economic growth. The Milken Institute has developed a *State Technology and Science Index* to discern which states are in the best position to take advantage of the opportunities for growth in the new economy (DeVol, Koepp & Fogelbach 2001). The study compares a composite index score from state to state in a simple ranking fashion. The Milken Institute assigns a number of statistics into one of five resource categories that focus on characteristics of the new economy in each state, and then compares state rankings at the resource level and at the composite level. The Milken Institute approach is not very useful in identifying strengths and weaknesses within states, or in assessing the feasibility of state new economy development policies, as it combines both innovation capacity resources and innovation outcomes in the same index.

The Development Report Card for the States (Corporation for Enterprise Development 2002) rank measures individual variables at the state level without grouping them into categories or analyzing the states' overall capacities for development. For example, this source specifically presents Federal research and development spending, Small Business Innovation Research grants, Ph.D. Scientists and Engineers, and University Research and Development spending—many of the same variables considered in this study—but on a variable by variable basis. In other words, Kentucky receives a numerical rank (between one and fifty) for each variable, and then receives a letter grade representing the state's resources. Because this type of instrument is so general in nature, it may not be useful for policy analysis or development of new policies. With the exception of the letter grades, and with the addition of a larger number of pertinent variables, the Progressive Policy Institute's State New Economy Index (Progressive Policy Institute 2002) has similar shortcomings.

Figure 4.1

State Ranking Comparison

Hall (Composite Index)		PPI (SNEI 2002) (excludes DC)		Milken (STSI 2002) (excludes DC)		CFED (DRCS 2002: Dev. Capacity) (excludes DC, in alphabetical order)	
Highest Capacity							
California	5.22	Massachusetts	18.58	Massachusetts	84.9	Colorado	A
District of Columbia	4.49	California	17.41	Colorado	80.58	Connecticut	A
Maryland	2.74	Colorado	17.14	California	80.37	Maryland	A
Massachusetts	2.01	New Jersey	14.8	Maryland	77.86	Massachusetts	A
New York	2.01	Delaware	14.72	Virginia	73.33	Minnesota	A
Texas	2	Maryland	14.22	Washington	71.81	New Jersey	A
Pennsylvania	1.25	New Mexico	13.77	New Jersey	69.95	Pennsylvania	A
New Jersey	0.88	Washington	13.41	Connecticut	68.58	Utah	A
Washington	0.62	Connecticut	13.34	Utah	68.26	Virginia	A
North Carolina	0.59	Idaho	13.07	Minnesota	65.87	Washington	A
Lowest Capacity							
North Dakota	-1.12	Alabama	7.15	South Carolina	38.98		
Kansas	-1.16	Nevada	7.03	Nevada	38.61		
Wyoming	-1.19	South Carolina	6.7	Hawaii	33.98		
Montana	-1.27	Kentucky	6.64	Louisiana	32.45		
Mississippi	-1.31	West Virginia	6.62	North Dakota	31.72		
Nevada	-1.33	South Dakota	6.54	Kentucky	31.12	Arkansas	F
Arkansas	-1.47	Wyoming	6.53	South Dakota	30.5	Louisiana	F
Maine	-1.52	Louisiana	6.35	West Virginia	30.17	Mississippi	F
West Virginia	-1.55	Arkansas	6.07	Mississippi	28.73	South Carolina	F
South Dakota	-1.68	Mississippi	5.9	Arkansas	22.8	West Virginia	F

The New Economy: An Operational Definition

In an environment where the federal government dominates economic policy, it is not surprising that the traditional tools necessary to allow commerce to respond freely to market forces are in place in most areas of the nation. For example, the United States has in place a superior transportation system comprised of roads, waterways, airports, rail, and telecommunications. Although states with key ports of entry and financial centers have benefited the most from globalization, today's global economy has touched even the most remote regions of the United States. Products manufactured worldwide can now be easily shipped into rural areas of our nation for distribution by local retailers, and products manufactured in those areas can, in turn, be shipped to and sold in nations around the globe. Globalization provides businesses with certain flexibility in their location decisions, as they are able to communicate globally and obtain their inputs from locations around the world (Kearns 2001).

Much like the effects of globalization, the effects of service sector growth have been realized uniformly across the nation in urban and rural areas alike. Growth in the service sector became dominant within the overall economy even during the early Twentieth Century. As Felbinger and Robey have stated, we should focus policy efforts on developing a flexible workforce because we do not know what skills will be required for the jobs of the future (2001). Moreover, the specific resources necessary to stimulate growth in the service sector are highly dependant upon the type of service under consideration since numerous types of services could be construed as important to the new economy. However, in order to evaluate the present business climate for new economy growth within this construct, efforts would have to be taken to identify the resource environment under which each of those industry groups flourish. Such an effort is beyond the scope of the present analysis.

To summarize, service sector growth and globalization have helped to create an environment that permits new economy development to occur. Innovation, however, has been isolated as the single most important characteristic of growth in the new economy. Innovation has always driven economic development, but the type of products, the focus on knowledge, and the rapid pace of innovation and obsoletion distinguish the new economy from past periods of economic development. "In the new economy, a firm's competitive advantage is based on info, ideas, and technology" (Kearns 2001). If we adhere to the theoretical assumption that innovation has led to the technology boom, the rise of the internet, and the promulgation of technology throughout our homes and workplaces, and that these have resulted in the economic expansion known as the new economy, then it is worthwhile to define and measure the innovation construct.

Resources for Innovation

How do we assess the level of innovation of a state at any given time? The level of innovation should be a product of a state's capacity for innovation. States with higher levels of innovation capacity will show greater evidence of innovation, and greater economic performance than states with lower innovation capacity. Innovation capacity is made up of different types of resources, including both human and financial. In the following sections, I consider each of these types of capacity in turn. Resources for innovation can be classified into two types—human resources and financial resources. Higher measurements for each of these variables are expected to be an indication of economic performance potential. Greater levels of these resources are expected to result in greater economic performance. When knowledge and ideas are the basis for competitive advantage in the new economy (Kearns 2001), state investments in human capital and supporting physical capital are essential components of economic change. So important are human resources to new economy development that one study considers the quality of place as a key determinant to attract knowledge workers (Florida 2000).

The most important human resources for innovation (new economy development) are experienced scientists and engineers, as well as individuals training to become scientists and engineers. These individuals possess the technical skills and abilities to develop innovations in diverse fields from pharmacology to computer science to materials engineering.

The measures of human resources I utilize include the following: the number of doctoral scientists in the state (DS99), the number of doctoral engineers in the state (DE99), science and engineering doctorates awarded in 2000 (SEDA), and the number of science and engineering graduate students in doctorate-granting institutions in 2000 (SEGS). The former two measures indicate the resources available to conduct research and to train doctoral students—the innovators of tomorrow—in science and engineering fields. "The need for scientists, engineers, and other educated and skilled workers is increasing as businesses' intellectual assets become at least as important as their physical assets" (Kearns 2001).

The latter two measures (the number of doctorate degrees awarded and the current enrollment numbers for science and engineering programs in each state) reveal how much states invest into training new scientists and engineers. Current enrollment demonstrates future scientists and engineers that will soon contribute to the state's innovation capabilities as participants in the workforce. Doctoral students do not necessarily come from, nor remain in, the states where they receive their degrees. Nonetheless, this variable does demonstrate the effectiveness of science and engineering programs in the state. Additionally, doctoral students make up a pool of resources from which scientists can draw for assistance in research and development projects ongoing within their academic departments.

Scientists and engineers have a unique ability to create new products and strategies, and their role at the beginning of the product cycle is essential to a state's innovation capacity. To look at the product cycle more generally, the initial innovators are not sufficient to grow products from an idea into a standardized commercial good. A labor force of technical and skilled workers is needed to develop manufacturing processes or otherwise utilize the innovation in ways that lead to economic growth. Because of the specialized nature of the U.S. economy, skilled workers are needed in virtually every occupational classification and industry sector, and statistical measures of the number of individuals in these groups doesn't reveal essential information about their skill level. To focus on specific occupations (such as chemical technicians) that demonstrate high levels of skill overlooks regional differences in industrial composition.

To create a representative index of the number of technically skilled workers is beyond the scope of this research. Nonetheless, it is desirable to include some measure of the relative skill level of the state's workforce. Because of its close relationship to products and services we associate with new economy and innovation, the number of individuals employed in high-tech industries in each state is included (McCarty, 2002). To address the general skill level of the population, 2000 Census percentage of individuals 25 and older who have earned a Bachelor's Degree or higher (BSHIGHER) is used. This measure is less than precise, but it accounts for skill levels across sectors (service as well as manufacturing), and does not give unfair advantages or disadvantages to areas with clusters of particular industries. Doctoral scientists and engineers, as well as science and engineering graduate students, hold Bachelor's Degrees by definition, so there is a degree of redundancy between this measure and the other measures of human resource capacity.

In addition to human resource capacity, several measures indicate the level of financial resources available for innovation. Money is used to support scientists and students, but it also provides the necessary tools of research—supplies, equipment, and powerful computers and software—that equip the research laboratories where innovation is conceived by knowledge workers. The financial measures used in this analysis include total research and development performance (TRDP; this measure represents the total amount of R&D expenditures by all performers), industry-based research and development (IRD), academic research and development (ARD), public higher education current-fund expenditures (PHECF) in each state, total federal research and development obligations to each state for research and development purposes (FORD), and the amount of venture capital spending in the state (VCPTL99) (Heard & Sibert, 2000).

Total research and development includes both academic and industry-based research and development efforts, and summarizes the amount of research and development (financially speaking) that has taken place in each state in a given year (in this case, 1999). Research and development is the driving force behind innovation, but innovation efforts are not limited to higher education venues. In fact, in a free market economy, industries attempting to capture market share and earn profit can be expected to develop new products and improve existing ones. For this reason, total research and development effort by itself is insufficient to understand differences between states' innovation capabilities. In order to address differences in the proportion of research and development that takes place in academic versus industrial settings across states, the dollar amount of effort in both sectors is also included (ARD and IRD).

Public higher education current-fund expenditure has been included as an overall indicator of the level of support for education in each state. General higher education may provide the environment and tools that enable individuals to conceptualize changes and innovations that might not otherwise have been conceived. "While higher education is most organized and can provide most impact by its technology and talent roles, it can indirectly at least affect the issues of capital and entrepreneurship, which go hand in hand…faculty and students can think about spinning their research into new firms and new products that remain in the region" (Tornatzky, Waugaman et al. 2002). "While innovation is global, research converted to technology must be reduced to practice, produced and made in some locality" (Ibid). This leads to economic growth in the locations where such research is commercialized. Finally, "research centers and institutions are *indisputably* the *most* important factor in incubating high-tech industries" (Ibid, p.14, emphasis added). Public higher education spending is a general measure of the state's commitment to education beyond the secondary level.

Federal obligations for research and development (FORD) serves as a measure of the total spending obligations by federal agencies to fulfill existing R&D contracts, grants, and other agreements. This measure is important for three reasons. First, the federal government possesses a tremendous tax base and taxing power that enables it to generate revenue that can be redistributed to research and development projects in each state. For example, the US Department of Defense invests tremendous resources in private enterprise for the development of new weapons or techniques to support national defense objectives. Similarly, the US Department of Agriculture invests resources in biotechnology projects, new farming techniques, and other similar innovative efforts.

Second, federal obligations demonstrate a concerted effort from within a given state to seek and obtain federal support. Defense-related and other federal grants and contracts do not fall out of the sky—firms and labs must compete for them (except in cases of economic monopoly). Likewise, agriculture experts are not handed money freely, but must demonstrate their expertise in competitive grant proposals that are acted upon by the relevant agencies. Generating quality grant applications leads to federal support funding for projects. Application and approval for funding reflects a culture of innovation within a state; researchers have ideas and pursue resources to bring them to fruition through federal agencies that have an interest in new innovations in their substantive field. Federal obligations could be considered the product of human resources.

The third important aspect of federal obligations is that they free up state resources to perform other functions. If a state is committed to research and development but lacks financial resources, the state can use federal funds to carry out R&D activities. The state may also choose to increase the resources for research well above the level of federal efforts. Each of these three scenarios highlights different aspects of federal funding that make it an important variable to consider in studying the resources available for research and development and new economy development in the states.

The final financial resource measure is the level of venture capital spending in the states in 1999. Venture capital is needed for infrastructure and startup expenses as well as operating funds to make the product available for general public consumption. Lack of venture capital may prevent innovations from being used, curtailing future economic growth.[2]

Demonstrated Innovations

The previous sections consider resources that represent innovation capacity in the states; this section focuses on measures of recent innovation accomplishments in the states. The volume of patents issued and number/amount of Small Business Innovation Research (SBIR) awards are indicators of innovations in the states. The number of SBIR awards issued to state residents in 2000 measures two unique facets—development of a new idea, and innovator initiative in applying for federal support funding for ongoing development and implementation of the idea. Though the number of SBIR awards made is a quantitative measure, it represents a qualitative change in the innovation of the economy, signaling true development as opposed to simple growth. SBIR awards are made by the federal government through various agencies including NASA and the Small Business Administration. "SBIR is a highly competitive program that encourages small business to explore their technological potential and provides the incentive to profit from its commercialization. By including qualified small businesses in the nation's R&D arena, high-tech innovation is stimulated and the United States gains entrepreneurial spirit as it meets its specific research and development needs" (U.S. Small Business Administration).

A more common measure of innovation is the patent. The federal government issues patents when inventors' new products or techniques are registered. A patent prevents another person or firm from using the idea, and allows the idea's developer to retain all profits generated from the innovation for a protective period. 'Utility patent' is the term the U.S. Patent and Trademark Office uses to refer to a patent for an invention. The number of utility patents issued to state residents for the year 2000 provides a measure relative patent activity. Like SBIR awards, the number of patents is an indicator of qualitative change in innovation. Each patent represents a new idea—a solution to a problem, a new product, or a new process—that will lead to a qualitative change to the local economy over time. Patents and SBIR awards both signal that an innovation has occurred, and there is new potential for economic development.

Two additional measures of the effects of innovation capacity on the economy are the Gross State Product (GSP) in the year 2000 and Gross State Product per person in 2000. GSP is a simple quantitative measure of economic output. Higher GSP could result strictly from increased production in the economy, but it is more likely due to some combination of increased production and new development. Economic development results from the creation of new products and leads to economic growth over time, so GSP is an important measure to consider in studying the effects of innovation capacity. GSP per person measures the increase in individual productivity in the state economy. While increases in GSP per person could result from increasing production in existing sectors, it is more likely that productivity is increased due to new methods, new products, etc., generated through a highly innovative local economy. As such, GSP per person represents the qualitative change that results from innovations in a local economy.

Controls for State Size

It is unfair to evaluate each state according to the variables described above without taking into account differences in the relative size of each state. To adjust for these differences, the 2000 census population was used as a control variable for many of the measures. The lower a state's population, the lower is its tax base and capacity to fund efforts aimed at generating innovation. Likewise, there are expected to be fewer researchers in smaller states, and the lack of human resources translates into a lack of innovation capacity. For example, federal obligations should be lower in Montana than in California because there are fewer researchers in Montana engaged in innovative efforts to generate federal funding.

To control for population, total research and development effort, academic research and development, public higher education current-fund expenditures, and federal obligations for research and development were each divided by the 2000 census population of the state.

Statistical Analysis

Using the variables above, a database was developed including each of the 50 U.S. states as well as the District of Columbia. The variables were transformed to control for population as described above. The data related to innovation resources were then subjected to a factor analysis to determine if the data could be reduced to fewer dimensions, and to validate the innovation capacity construct. Factor analysis attempts to isolate common variability among a set of variables, and then groups individual variables together into new uncorrelated factors.

Two common factors were extracted, signifying that the data can, in fact, be explained in fewer dimensions. Overall, the two new common factors (which were labeled 'academic human resources for innovation' and 'financial resources for innovation') explain nearly 84% of the variance in the dataset (Please see Appendix: Figure 4.2A). The rotated factor matrix demonstrating the loadings of each original variable onto the two new factors is displayed below (see Figure 4.2). Industry Research and Development is suppressed from the chart because its loading was very low, indicating that it bears little influence on the results. (Please see the Chapter Appendix for additional methodological information.)

Figure 4.2

Rotated Factor Matrix

	Factor	
	1	2
# of Doctoral Scientists: 1999	.969	
# of Doctoral Engineers: 1999	.979	
# of Science/Engineering Doctorates Awarded: 2000	.971	
# of Science/Engineering Graduate Students: 2000	.921	
1999 Total R&D Performance, Per Person		.874
1999 Academic R&D Performance, Per Person		.911
1999 Federal Obligations for R&D		.875
% of the Population with Bachelors Degrees or Higher		.731
1999 Venture Capital Spending	.829	
High-Tech Employment	.987	

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.

Factor Interpretation

Two factors were extracted from the original data (twelve variables). The underlying variability in those data has been summarized into two more readily understandable units. The extracted factors are closely aligned to the original operational divisions in the data. Six variables loaded onto Common Factor One—DE (the number of doctoral engineers), DS (the number of doctoral scientists), SEDA (the number of science and engineering doctorates awarded), SEGS (the number of science and engineering graduate students enrolled), HITECHEMP (the number of persons employed in high-tech positions) and VCPTL99 (dollars of venture capital invested in the state)—

all with approximately the same weights. This factor is labeled "Academic Human Resources for Innovation (AHR)" as it reflects the human element that is present in, or results from, the academic research environment.

Common Factor Two includes the following four variables: TRD (total research and development), ARD (academic research and development), FORD (federal obligations for research and development), and BSHIGHER (the percentage of state residents with a Bachelor's degree or higher). This factor is labeled "Financial Resources for Innovation (FR)" as it appears to represent the available financial capital in each state. Interestingly, total research and development efforts, federal obligations for research and development, and academic research and development are loaded on the same factor. This may indicate that the total research and development effort in a state is driven strongly by the academic research efforts, not industry based research efforts. Again, these variables load with approximately equal weights, signifying a balanced effect on their change with variation in the common factor. Industry-Based Research and Development (IRD) did not attain a meaningful loading on either factor.

The loadings of VCPTL99 (Venture Capital) and BSHIGHER (the percentage of the state population with a Bachelor's Degree or higher) are counterintuitive. Venture capital represents a type of financial resource, and was expected to load onto the same factor as the other financial variables; instead, it loaded with academic human resources. Educational attainment, a measure representing the skill level of the workforce, was expected to associate with the other human resource measures; instead, it loaded onto the financial resources factor. This may suggest that general educational attainment impacts innovation capacity differently than specialized training. Looking ahead to the regression results below, general education may positively impact the overall productivity of other resources in the economy.

State Innovation Scores/Rankings

This study combines two aspects of analysis that make it useful on both theoretical and practical grounds—it considers categories of variables (validated through factor analysis) as well as composite resource capacity. Through this research, the field will benefit from an improved understanding of the way variables are linked as resources for development, and policymakers and administrators will be able to make better decisions about the distribution of resources across policy areas and across policy strategies. The index developed in the present study focuses not only on the composite capacity, but on the relative levels of component capacity; namely, academic human resources and financial resources. Moreover, the states are ranked with an absolute score, not just relative. As a result of these combined techniques, the index developed in this study will be more broadly useful to policymakers and researchers studying innovation than indices such as the Progressive Policy Institute *State New Economy Index.*

Tables of factor Scores for each state in rank order are found in Figure 4.3. Based on these scores, states were categorized into four innovation classifications for each factor, and for a composite score—lagging, low, developing, and progressive.

Figure 4.3
State Factor Scores in Rank Order

State	"HUMAN"	Category	State	"FINANCIAL"	Category	State	"COMPOSITE"	Category
Kansas	-1.01174	1	South Dakota	-0.96019	1	South Dakota	-1.68	1
Montana	-0.88155	1	Maine	-0.93871	1	West Virginia	-1.55	1
District of Columbia	-0.86534	1	Indiana	-0.84023	1	Maine	-1.52	1
North Dakota	-0.86279	1	Nevada	-0.77686	1	Arkansas	-1.47	1
Alaska	-0.84477	1	West Virginia	-0.77374	1	Nevada	-1.33	1
West Virginia	-0.77382	1	Mississippi	-0.76581	1	Mississippi	-1.31	1
Wyoming	-0.76316	1	Arkansas	-0.73302	2	Montana	-1.27	1
Arkansas	-0.74187	2	Oklahoma	-0.68189	2	Wyoming	-1.19	1
Vermont	-0.72823	2	South Carolina	-0.62552	2	Kansas	-1.16	1
Hawaii	-0.72277	2	Louisiana	-0.62404	2	North Dakota	-1.12	1
South Dakota	-0.71825	2	Tennessee	-0.59691	2	Louisiana	-1.05	1
Delaware	-0.64713	2	Kentucky	-0.5954	2	Kentucky	-1.03	1
Idaho	-0.60283	2	Ohio	-0.54239	2	Oklahoma	-1.03	1
New Hampshire	-0.57947	2	Wyoming	-0.4239	2	South Carolina	-1.02	1
Alabama	-0.57806	2	Texas	-0.41736	2	Idaho	-0.83	1
Maine	-0.57681	2	Florida	-0.39367	2	Hawaii	-0.79	1
Nevada	-0.55539	2	Montana	-0.38353	2	Vermont	-0.78	1
Mississippi	-0.54747	2	Illinois	-0.3505	2	Alabama	-0.77	1
Nebraska	-0.51183	2	Wisconsin	-0.34794	2	Tennessee	-0.77	1
New Mexico	-0.46984	2	North Dakota	-0.26072	2	Alaska	-0.72	2
Rhode Island	-0.44991	2	Missouri	-0.22737	2	Florida	-0.71	2
Kentucky	-0.43557	2	Idaho	-0.22621	2	Nebraska	-0.66	2
Louisiana	-0.4238	2	Minnesota	-0.22172	2	Iowa	-0.41	2
South Carolina	-0.39163	2	Alabama	-0.18805	2	New Hampshire	-0.4	2
Utah	-0.38532	2	Georgia	-0.17766	2	Utah	-0.35	2
Oklahoma	-0.34964	2	Arizona	-0.15756	2	Missouri	-0.27	2
Florida	-0.31823	2	Nebraska	-0.15031	2	Oregon	-0.23	2
Iowa	-0.27566	2	Kansas	-0.14707	2	Indiana	-0.18	2
Tennessee	-0.17132	2	Iowa	-0.13829	2	Wisconsin	-0.17	2
Oregon	-0.12775	2	Oregon	-0.10225	2	Delaware	-0.11	2
Missouri	-0.04407	2	Hawaii	-0.0688	2	Arizona	0.05	3
Washington	-0.00367	2	Virginia	-0.05569	2	Rhode Island	0.07	3
Connecticut	-0.00128	2	Vermont	-0.05446	2	Ohio	0.2	3
Colorado	0.01046	3	California	0.01488	3	Georgia	0.38	3
Wisconsin	0.17907	3	New York	0.02661	3	Minnesota	0.43	3
Arizona	0.21119	3	Utah	0.03484	3	Colorado	0.46	3
Michigan	0.30823	3	Pennsylvania	0.07899	3	Virginia	0.46	3
North Carolina	0.30953	3	Alaska	0.12422	3	Michigan	0.48	3
Massachusetts	0.37935	3	Michigan	0.16897	3	Connecticut	0.49	3
Maryland	0.46565	3	New Hampshire	0.17676	3	New Mexico	0.49	3
Virginia	0.51765	3	New Jersey	0.21214	3	Illinois	0.57	3
Georgia	0.55409	3	North Carolina	0.27633	3	North Carolina	0.59	3
Minnesota	0.64909	3	Colorado	0.44879	3	Washington	0.62	3
Indiana	0.66355	3	Connecticut	0.48691	3	New Jersey	0.88	4
New Jersey	0.6728	3	Rhode Island	0.52077	3	Pennsylvania	1.25	4
Ohio	0.74178	3	Delaware	0.53376	3	Texas	2	4
Illinois	0.91957	4	Washington	0.62152	3	Massachusetts	2.01	4
Pennsylvania	1.17055	4	New Mexico	0.96421	4	New York	2.01	4
New York	1.98694	4	Massachusetts	1.62743	4	Maryland	2.74	4
Texas	2.41608	4	Maryland	2.27901	4	District of Columbia	4.49	4
California	5.20538	4	District of Columbia	5.35162	4	California	5.22	4

Legend:
Category 1 "Lagging": Factor Score < -(.75)
Category 2 "Low": -(.75) < Factor Score < 0
Category 3 "Developing": 0 < Factor Score < .75
Category 4 "Progressive": Factor Score > .75

Innovation Capacity v. Observed Innovation: The Model

In the earlier sections, a new index of state innovation capacity was developed and graphs were created to demonstrate the absolute and relative position of states with regard to that capacity. As operationalized above, I hypothesize that innovation capacity is related to actual innovation and to overall economic performance at the state level. I propose the following hypotheses:

H1: Higher levels of Academic Human Resource Capacity (Factor 1) and higher levels of Financial Resources for Innovation (Factor 2) will lead to greater numbers of Patents Issued to State Residents.

H2: Higher levels of Academic Human Resource Capacity (Factor 1) and higher levels of Financial Resources for Innovation (Factor 2) will lead to greater numbers of SBIR awards in each state.

H3: Higher levels of Academic Human Resource Capacity (Factor 1) and higher levels of Financial Resources for Innovation (Factor 2) will lead to greater overall economic performance in a state's economy.

To examine the relationships proposed in the hypotheses above, regression analysis was employed. Each of the regression models is now described more fully. (For additional methodological detail, please refer to the Appendix.)

Using simple linear regression, the two factor scores, Academic Human Resources for Innovation and Financial Resources for Innovation were regressed on PISR00 (patents issued to state residents, 2000), but Financial Resources for Innovation failed to achieve statistical significance. The regression resulted in an adjusted R^2 of .895

and was significant at $p<.001$. There is thus a strong relationship between state academic human resources for innovation and the number of patents issued to state residents, and Hypothesis 1 is partially confirmed. There is no evidence of influence by financial resources for innovation on patents issued.

Table 4.1

Regression Results: Patents Issued to State Residents, 2000

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1667.490	123.195		13.535	.000
	Factor Score 1: Human	2487.673	120.208	.948	20.695	.000
	Factor Score 2: Financial	64.763	127.819	.023	.507	.615

A second regression analysis examined the relationship of the two independent variables with SBIR awards to states in 2000. In this model, both factors were found to be related to SBIR awards. Academic Human Resources for Innovation was highly significant ($p<.001$), and Financial Resources for Innovation was significant at $p<.05$. Overall, the model proved significant at $p<.001$, with adjusted $R^2 = .614$, showing a relatively strong influence by both independent capacity variables on SBIR awards and confirming Hypothesis 2.

Table 4.2

Regression Results: SBIR Awards, 2000

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	87.510	13.432		6.515	.000
	Factor Score 1: Human	114.411	13.106	.767	8.730	.000
	Factor Score 2: Financial	33.508	13.936	.211	2.404	.020

The final regression analyses examined the relationship of the two capacity variables with Gross State Product in 2000. Factor Score 2, Financial Resources for Innovation, failed to achieve statistical significance, but this model proved to be highly significant ($p<.001$), and explained a great deal of the variance in Gross State Product for 2000 (Adjusted $R^2 = .899$).

Table 4.3

Regression Results: Gross State Product, 2000

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.9E+11	1.1E+10		18.443	.000
	Factor Score 1: Human	2.2E+11	1.0E+10	.950	21.158	.000
	Factor Score 2: Financial	-7.2E+08	1.1E+10	-.003	-.066	.948

To control for state size, the regression was performed again using 2000 Gross State Product *per person* (based on 2000 Census population figures) as the dependent variable. This model addresses the overall economic productivity of the state's citizens, and takes away the advantage of states with larger populations in the model. Once again, one of the factor scores, Academic Human Resources, failed to achieve statistical significance. This model showed a strong relationship of Financial Resources for Innovation on 2000 Gross State Product per person, with Adjusted $R^2 = .699$ ($p<.001$). As such, Hypothesis 3 was confirmed, though with an interesting twist. Overall state economic performance, as measured by Gross State Product, turned out to be highly influenced by the available academic human resources for innovation, but with no influence from available financial resources. When examined on a level of individual productivity, though, states with greater financial resources for innovation proved to have higher GSP per person.

Table 4.4

Regression Results: Gross State Product Per Person, 2000

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	35039.41	873.111		40.132	.000
	Factor Score 1: Human	896.440	851.942	.082	1.052	.298
	Factor Score 2: Financial	9814.297	905.880	.840	10.834	.000

Causal Assumptions

The present analysis demonstrates a positive correlation between the innovation capacity (independent) variables and the innovation and economic performance (dependent) variables, but the question of causal direction is not directly discernable from the methodological approach adopted. The models are logical in their present form.

Academic Human Resources lead to SBIR awards and Patents Issued to State Residents; it is not expected that the reverse would be true. The number of patents and awards would not, in the short timeframe of this study, affect the human resource components that comprise the factor—doctoral scientists, doctoral engineers, or science and engineering doctoral students and graduates. The logic is less clear as regards the causal relationship between the two common factors and Gross State Product. It is logical that academic and financial resources, when properly employed, would lead to innovations, and through the natural product cycle, to state economic growth. It is equally conceivable that a high-performing economy would generate the resources necessary to increase both academic human resources and financial resources—the opposite causal picture to those inferred from the models.

Though logically the directional flow of the model could go either way, this problem is addressed in part by incorporating a brief lag in each of the dependent variables. The components of the capacity variable Financial Resources for Innovation are 1999 measures, and the correlated response variable is a 2000 measure. Similarly, two of the components of the common factor Academic Human Resources for Innovation are 1999 measures (doctoral scientists and doctoral engineers), while the other two components (science and engineering doctorates awarded and graduate students enrolled) are 2000 measures. The correlated response variables are all 2000 measures (GSP, SBIR awards, and Patents Issued to State Residents). This fact aids logic in that present GSP would not have affected past academic human resources or financial resources for innovation. As budgets are often incremental, this does not rule out the possibility of simultaneity among the variables in question, but does shed some doubt on that likelihood.

Logic and time lags aside, previous research provides additional support for the directional assumptions employed. State economic development spending may take a number of forms, from infrastructure to human development and technological improvements. Financial resources for research and development constitute a major economic development tool, regardless of whether the funding source is federal, state, or private in nature. Spending funds for research and development is an essential step for innovation to occur, and innovation is essential to economic development in any economy, but most especially in the new economy of the 21st century. Goss and Phillips (1997) examined the relationship between state economic development spending and state economic performance from 1986-1994. Controlling for endogeneity, their study finds that economic development spending is effective in stimulating economic performance, as measured by average per capita personal income (Goss & Phillips, 1997).

The present study considers a similar relationship between a specific type of spending with a specific economic development goal and economic performance as measured by Gross State Product. Per Capita Personal Income and Gross State Product are both measures of economic performance, but they reflect somewhat different definitions of economic development. PCPI is a measure of personal income, while GSP reflects the total productivity of the economy, the gains from which would accrue to some combination of individuals, whether working or not, and corporations and shareholders. These differences aside, it has been shown that investments in economic development do improve economic performance, the causal direction advanced in the present model.

Finally, Berry and Kaserman (1993) investigated the causes of economic growth over a six decade period, finding that, among other causes, state spending on higher education enhances the state's human capital position and enhances economic development. This brings to bear on the causal relationship between the common factor academic human resources for innovation and economic performance. The factor does not examine state spending for higher education generally, but does include four variables that are directly affected by state spending for higher education. Rather than measure spending directly, the factor measures the human capital that has been shown to result from such spending. That human capital is then shown, through regression, to be correlated with economic performance (GSP per person). Although the causal direction is not specifically tested in this empirical framework, a combination of logic and prior research demonstrates that the causal assumptions are feasible.

Conclusion and Discussion

Applying the present findings in light of past research into the effectiveness of economic development spending, state investments geared toward creating a highly-skilled workforce should lead to improvement in those states' long-term economic performance. Such a shift would require many states to rethink their overall economic development strategies, moving away from targeted assistance to individual firms and localities and toward increased spending for higher education. These tradeoffs will likely mean a loss of short-term results, such as new branch plant recruitments, in exchange for uncertain long-term economic impacts. The importance of these impacts to state and local governments and to overall economic performance in the U.S. suggests a need for more research to inform domestic economic development policy decisions.

The general conclusion of this analysis is that large states with large populations, such as California, Massachusetts, and New York, tend to possess the kinds of resources—both human and financial—that are needed to stimulate innovation. On the other hand, rural, sparsely populated states have a much greater challenge ahead if they are to benefit from new economy type economic development. Less fortunate rural states must recognize the scarcity of resources, soberly consider the costs of new economy development programs, and decide whether to pursue them to the exclusion of more traditional strategies. Alternatively, these states may elect to focus on traditional economies as the source of economic growth and development.

Knowing where new economy development is likely to occur may be beneficial to state policymakers in attempts to affect state economies. Following the "ferment of the 1990s," a period in which the direction of state economic development policy efforts was uncertain, states' attempts to coalesce around new policy alternatives should take into account the inherent risks of their current economic environment (Eisinger 1995). Given the very limited effects of economic development efforts (Goss and Phillips 1997; Clark and Montjoy 2001; Saiz 2001), a wiser investment of taxpayer resources is warranted, and particularly so in the current environment of economic constraint. In short, a "realistic assessment of a state's opportunities would include recognition of its geographic, demographic, and economic situation, current trends, and strengths and weaknesses" (Snell 1998). This analysis has identified the levels of resources for innovation in the U.S., and has demonstrated that greater resources do result in better economic performance and greater levels of observed innovations, such as patents.

This chapter has used the most recent year of available data to explore the creation of a meaningful innovation capacity index that excludes innovation outcomes from consideration on theoretical grounds. The initial results of simple regression models demonstrate that innovative capacity does have a meaningful effect on innovation outcomes, including patents, Small Business Innovation Research Awards (commercialization assistance), and state income. The following steps in this research project expand this rudimentary analysis to include a greater number of more specific variables that reflect capacity, to increase the size of the database to incorporate previous periods for identifying and comparing trends in state capacity, and to perform time-series analyses that examine the effects of capacity over time. Furthermore, additional steps will be taken to specify a commercialization capacity construct that incorporates private venture capital in addition to Small Business Innovation Research awards. Chapter Five continues with the development of a longitudinal dataset and indices of innovation and commercialization capacity over time.

Chapter Appendix: Methodology

Factor Analysis

The correlation matrix was used for the factor analysis because of the vast disparity between the values of the variables in the analysis. In short, some variables are measured in single digits, while others are measured in hundreds and thousands. The larger measures would have dominated the analysis and distorted the results if the variance-covariance matrix had been used instead of the correlation matrix.

Principle Axis Factoring was used as the method of factor extraction. This initial analysis resulted in extraction of two common factors. One variable, Public Higher Education Current Fund Expenditures, failed to attain a meaningful loading, so that variable was dropped from the analysis. The remaining eleven variables were then subjected to a second iteration of the factor analysis procedure, again using Principle Axis Factoring.

The method of factor selection employed was the widely accepted technique of keeping factors with eigenvalues greater than 1.0. To confirm this decision, analysis of scree was used to highlight any potential shortcomings (see figures 4.2 and 4.3). Factors with eigenvalues less than one are not significant and were eliminated from the analysis. At least two variables loaded on each factor, so no factors were eliminated on the basis of triviality. Varimax rotation was employed to align the data such that each variable loaded on one and only one common factor.

Figure 4.1A
Analysis of Scree

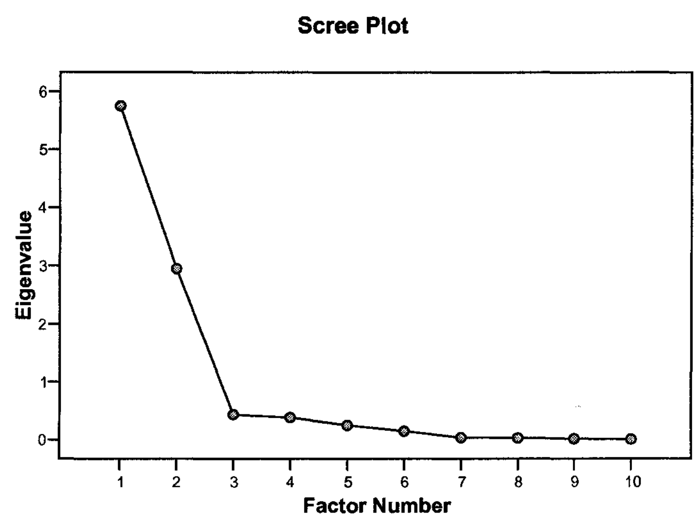


Figure 4.2A
Eigenvalues and Total Variance Explained

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.756	57.557	57.557	5.653	56.531	56.531	5.406	54.055	54.055
2	2.950	29.500	87.058	2.717	27.171	83.703	2.965	29.647	83.703
3	.433	4.334	91.392						
4	.384	3.840	95.232						
5	.249	2.485	97.718						
6	.145	1.454	99.171						
7	.036	.358	99.529						
8	.029	.285	99.814						
9	.014	.142	99.957						
10	.004	.043	100.000						

Extraction Method: Principal Axis Factoring.

Regression

Initially, pairwise scatter plots of each independent and dependent variable were examined to identify any non-linear trends in the data. In each case the pattern of the scatterplot was generally linear, with some minor evidence of broadening in the pattern. To be safe, the independent variables (Academic Human Resources for Innovation and Financial Resources for Innovation) were transformed by inversion (1/original variable). The pairwise plots were regenerated, but did not demonstrate any undesirable patterns.

Each of the regression models was first fitted without the transformed independent variables, and then refitted with the transformed variables to assess any change in the adjusted coefficient of determination. It was determined that the transformation of the independent variable actually decreased the explanatory power of the model (as measured by the adjusted coefficient of determination). Thus, only the original, untransformed factor scores were used in the regression models, because the pairwise geometry, though imperfect in appearance, was linear in trend. In iterations of each model with more than one explanatory variable, multicollinearity was assessed using variance inflation factors, with no problems detected. In each regression model, heteroskedasticity was assessed by examining plots of the dependent variables versus the RStudentized Residuals. None of these plots demonstrated any trends, suggesting that variance around the line of regression was fairly constant. In addition, histograms of residuals were created, all of which were generally normal in appearance.

Endnotes

[1] This is a general observation, as there are many manufacturing industries that require more than a base-level skill—most notably, automobile manufacturing and assembly plants utilize workers with technical skills.)

[2] Venture capital investment is not recorded in the NSF state profiles. State venture capital data for 1999 was obtained from a National Governor's Association report (Heard & Sibert, 2000).

Chapter 5 — Developing Historical Fifty-State Indices of Innovation Capacity & Commercialization Capacity

Introduction

With the above measures having been established as representative of innovation outcomes, this section will now turn to developing measures of innovation capacity and innovation outcomes. Following this discussion, the major development in this stage will be the creation of new indices that measures innovation capacity and commercialization capacity in the states.

As the value appertaining to the development of an index of innovation capacity was considered above, in like manner the value associated with development of a unique index of innovativeness, or innovative outcomes is considered now. Why is it important to develop this separate index, given the previous findings that already suggest the relationship between capacity and outcomes in innovation? In short, previous studies focused on the individual components of innovation capacity, and their relationships to innovation outcomes and economic growth, independently. The value in generating such an index is that it makes possible the comparison of the collective capacity measure with demonstrated innovations separately, and with a collective measure of commercialization capacity. The logic of the model presented in Chapter Three demonstrates how framing the conceptual design suggests that greater clarification is needed methodologically. There are more components in the model than just inputs and outputs; rather, there is a series of inputs and outputs from innovation capacity to innovation outcomes, to commercialization capacity, and on to measures of economic growth and performance.

In forming the index of commercialization capacity, evidence of multiple dimensions will be sought out, just as was done in creating the innovation capacity index previously. With the measures of innovation outcomes and commercialization capacity in place, it will be possible to test the relationship between the states' innovation capacities and innovation outcomes over time. It will also be possible to examine the relationship among the distinct dimensions of capacity and innovation outcomes to determine whether each outcome dimension is equally well-described by the capacity measures established.

Given the theoretical expectation that higher capacity will lead to greater overall innovation outcomes, there is value in empirically examining the relationship between the two. Should it be the case that there is large variation in the effectiveness of states in converting capacity into innovation outcomes, there will be newfound justification for examining alternative factors that may, as mediators, impact state economic performance. In other words, are there other things that alter the time it takes to realize outcomes from capacity? It may well be that leadership, political culture, or other factors such as the notion of critical mass, impact the timeframe associated with state performance. These elements are beyond the purview of the present study, but first understanding the differences among states with regard to the basic questions leads to long term value in the benefits to be reaped from the present research.

Operational Measurement: The Data

Following the lessons of the single year study presented in Chapter Four, the data that are used to measure innovation capacity in the multi-year study represent two categories—financial resources and human resources. Thirteen financial capacity and six human capacity variables will be included in the pooled innovation capacity factor analysis. The variables differ slightly from those utilized in the single year analysis. These differences are of two types; first, where data with greater specificity were available, the more specific data were used, and second, over the twenty year time period, several variables that should be included on theoretical grounds were not due to data availability in the early years of the dataset. The financial variables utilized include the following:

- FORDTL (Total Federal Obligations for R&D, All Performers)
- FFARD (Academic R&D Expenditure, Federally-Funded)
- SLARD (Academic R&D, State/Local Government-Funded)
- IARD (Academic R&D, Industry-Funded)
- INSTARD (Academic R&D, Self-Funded by Institution)
- OARD (Academic R&D, Funded by Other Sources)

  *The Previous Five Variables Sum to Total Academic R&D Expenditures

- FOARD (Total Federal Obligations to Universities & Non Profit Organizations for R&D)
- FOFT (Federal Obligations for Fellowships & Traineeships)
- FOSE (Federal Obligations for Science & Engineering)
- FRDP (Federal Obligations for R&D Plant)
- FSFE (Federal Obligations for Science & Engineering Facilities & Equipment)
- FOGS (Federal Obligations for General Sciences)

– PHECF (Public Higher Education Current Fund Expenditures)

To control for inflation, each of these financial variables has been converted to Real 2000 Dollars using a GDP deflator (see Figure 5.1 below). To control for population, each financial variable was divided by state population and recorded on a Per Person basis. One Variable that was used in the single-year analysis that is not included in the multi-year factor analysis is Industry-Based Research & Development spending (IRD). The National Science Foundation collects this data, but most early year observations are missing or suppressed from the dataset to protect confidentiality of survey respondents; hence, the variable was not included in the analysis.

As indicated above, the variable Total Academic Research & Development expenditures (TARD) was used in the single-year analysis. The Academic R&D data are available by source of funds (Federal, State & Local, Industry, Self, Other), and hence the more specific data are used in this analysis as opposed to the summary data. The variable Federal Obligations for Fellowships and Traineeships was missing values for thirteen observations; these thirteen missing entries were replaced with zero values for the analysis.[1] Two final measurement issues pertain to Public Higher Education Current Fund Expenditures and Percent of the Population with Bachelor's Degrees or Higher. The Public Higher Education Current Fund Expenditure data are only available for select years (1980, 1985, 1990, 1993-1999), so missing values were imputed with linear interpolation. Similarly, educational attainment data were only available for 1980, 1989, 1991, 1993-2003, so missing values were also imputed using linear interpolation.

[1] The thirteen observations that were missing were the following rows in the original data table: 517, 518, 522, 761, 923, 924, 926, 927, 928, 1112, 1117, 1119, and 1354.

Figure 5.1
Gross Domestic Product Chain-Type Index Values

1980	54.062
1981	59.12825
1982	62.738
1983	65.214
1984	67.6645
1985	69.72425
1986	71.269
1987	73.204
1988	75.706
1989	78.569
1990	81.61425
1991	84.457
1992	86.40175
1993	88.3905
1994	90.26525
1995	92.115
1996	93.859
1997	95.41475
1998	96.47525
1999	97.868
2000	100
2001	102.4023
2002	104.0973
2003	106.0035

The six human capacity variables that are included in the longitudinal index include the following:

- SEDA (Science & Engineering Doctorates Awarded)
- BSHGR (% of the Population with a Bachelor's Degree or Higher)
- NPDS (Number of S&E Postdoctoral Fellows)
- NFTGS (Number of Full-Time S&E Graduate Students)
- NSEGS (Total Number of S&E Graduate Students)
- HTEMP (# of Persons Employed in High-Tech SIC Code Industries)

  1) Industrial Machinery & Equipment
  2) Electronic & Electric Equipment
  3) Instruments & Related Products
  4) Chemicals & Allied Products
  5) Communications
  6) Business Services

Two human capacity measures were included in the single-year analysis that are excluded from the longitudinal dataset—the number of doctoral engineers (DE) and the number of doctoral scientists (DS) in the state. The National Science Foundation maintains these data, but observations are available only biennially during the 1990s; hence, the variables could not be included.

One measurement issue arose in this dimension of capacity. In the single-year analysis, the measure used for high-tech employment was obtained from the American Electronics Association, and was dominated by electronics industries. That data was not available longitudinally, so an alternative measure was sought. The Bureau of Labor Statistics (Hecker 1999, pp 20) identified a list of twelve high-tech industries by three-digit SIC code (281, 286, 283, 357, 366, 367, 372, 376, 381, 382, 737, and 873).

Using this list as a starting point, longitudinal employment data were compiled to represent the industries identified in the report. Data were not available at the three-digit SIC code level due to confidentiality concerns associated with the original survey; hence, two-digit SIC data were used as an alternative. SIC 87 (Engineering & Management Services) data were suppressed for approximately half of the years, so that variable was dropped. SIC 28 (Chemicals & Allied Products), 35 (Industrial Machinery & Equipment), 36 (Electronic & Other Equipment), 37 (Transportation Equipment), 38 (Instruments & Related Products), and 73 (Business Services) were included because they encompass the remainder of the three-digit code industries. These data were summed to arrive at a total high-tech employment figure. There are measurement concerns, obviously, with this variable, as it includes not only the high-tech industries of interest, but also additional similar industries that are not in the BEA high-tech classification. In the BEA dataset, a few observations were suppressed for confidentiality and other concerns (D=Not shown to avoid disclosure of confidential information, L=Less than 10 jobs, N=Data not available for this year); these suppressions indicate low employment, and their values were replaced with '0.'

Commercialization capacity measures include three variables; one represents private venture capital investment, the other represents financial support from the federal government. These variables are as follows:

- VCPTL (Real Venture Capital Spending)
- NSBIR (Number of SBIR Awards)
- RSBIR (Real SBIR Award Dollars)

Both venture capital spending and SBIR award dollars have been controlled for inflation and are measured in Real 2000 dollars.

As indicated earlier, Patents Issued to State Residents represents innovation outcomes. Measures of state economic growth include Gross State Product and Per Capita Personal Income (both controlled for inflation and measured in Real 2000 Dollars). The variables are recorded as follows:

- PISR (Patents Issued to State Residents)
- GSP (Gross State Product)
- PCPI (Per Capita Personal Income)

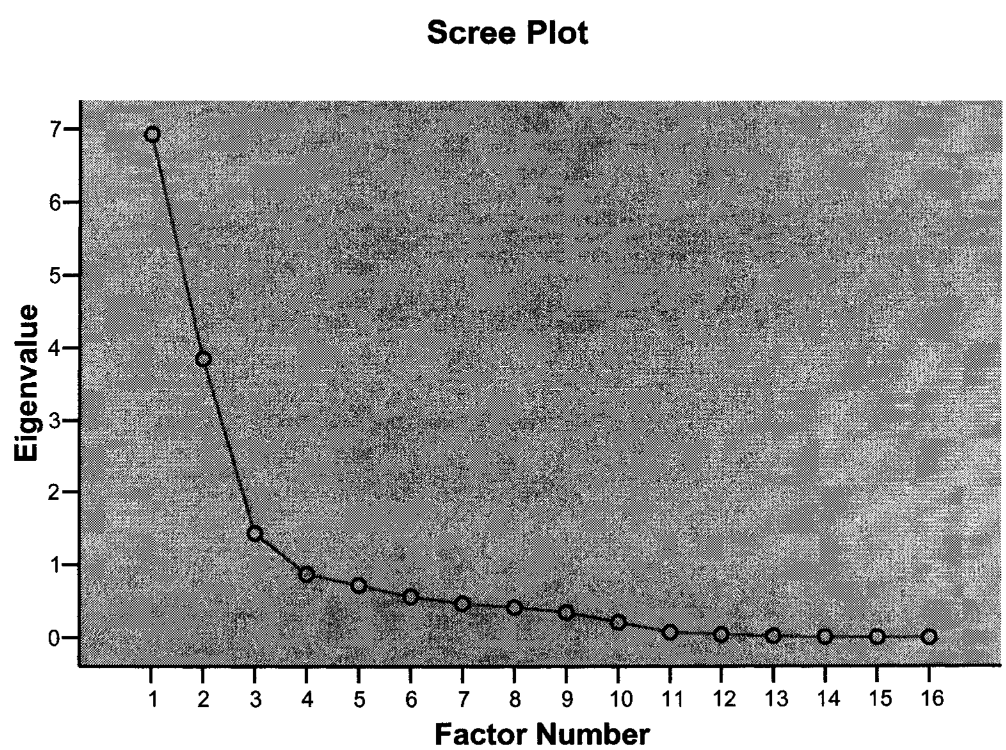
Methodology: Factor Analysis

Using the variables above, a database was developed including each of the 50 U.S. states. The variables were transformed to control for population and inflation as described above. The data representing innovation capacity resources were then subjected to a factor analysis to determine if the data could be reduced to fewer dimensions, and to validate the innovation capacity construct. Factor analysis attempts to isolate common variability among a set of variables, and then groups individual variables together into new uncorrelated factors. The correlation matrix was used for the factor analysis because of the vast disparity between the values of the variables in the analysis. In short, some variables are measured in single digits, while others are measured in hundreds and thousands. The larger measures would have dominated the analysis and distorted the results if the variance-covariance matrix had been used instead of the correlation matrix. Principle Axis Factoring was used as the method of factor extraction. This method was chosen because it does not assume normality in the original variables.

This final analysis resulted in extraction of three common factors. Three of the original nineteen variables were eliminated due to triviality or failure to load in initial iterations of the factor analysis. Two variables, State & Local Government-Funded Academic R&D Expenditures and Federal Obligations for Science & Engineering Facilities & Equipment, were dropped because they were each the only variable to load on additional independent factors; in other words, these variables were dropped because they resulted in trivial factors. These two variables will be included independently in the subsequent analyses along with the three common factor scores. One additional variable, Federal Obligations for R&D Plant, failed to attain a meaningful loading, so it was dropped in the second iteration of the factor analysis, but will be included independently in subsequent analysis as well. The remaining sixteen variables were then subjected to a third iteration of the factor analysis procedure, yielding the results displayed and discussed below.

The method of factor selection employed was the widely accepted technique of keeping factors with eigenvalues greater than 1.0. To confirm this decision, analysis of scree was used to highlight any potential shortcomings. Factors with eigenvalues less than one are not significant and were eliminated from the analysis. At least two variables loaded on each factor in the final iteration, so no additional factors were eliminated on the basis of triviality. Varimax rotation was employed to align the data such that each variable loaded on one and only one common factor. (See Figure 5.2 below).

Figure 5.2
Analysis of Scree: Innovation Capacity



Three common factors were extracted, signifying that the data can, in fact, be explained in fewer dimensions. Overall, the three new common factors ('federal financial capacity for innovation, 'human capacity for innovation,' and 'state/local financial capacity for innovation') explain nearly 72% of the variance in the original variables (See Figure 5.3 below).

Figure 5.3
Total Variance Explained: Innovation Capacity

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.927	43.294	43.294	6.755	42.217	42.217	5.010	31.312	31.312
2	3.849	24.058	67.351	3.686	23.036	65.253	4.985	31.159	62.470
3	1.430	8.939	76.291	.980	6.127	71.380	1.426	8.910	71.380
4	.869	5.434	81.725						
5	.720	4.498	86.223						
6	.563	3.517	89.739						
7	.472	2.952	92.691						
8	.420	2.622	95.313						
9	.353	2.208	97.520						
10	.219	1.366	98.887						
11	.078	.489	99.376						
12	.048	.298	99.673						
13	.025	.159	99.832						
14	.012	.078	99.910						
15	.009	.058	99.968						
16	.005	.032	100.000						

Extraction Method: Principal Axis Factoring.

The rotated factor matrix below (Figure 5.4) provides the loadings of each original variable onto the three new independent common factors. For ease in readability and interpretation, values of secondary and tertiary loadings have been suppressed.

Figure 5.4
Rotated Factor Loading Matrix

Rotated Factor Matrix[a]

	Factor		
	1	2	3
High Tech Employment	.959		
Real Total U.S. FORD per Person, All Performers		.576	
Number of Postdoctoral Fellows	.902		
Number of Full-Time S&E Graduate Students	.990		
Number of S&E Graduate Students	.984		
Percent of Population with Bachelors Degree or Higher		.584	
Science and Engineering Doctorates Awarded	.975		
Real Federally-Funded Academic R&D Expenditures per Person		.959	
Real Industry-Funded Academic R&D Expenditures per Person		.540	
Real Institutionally Self-Funded Academic R&D Expenditures per Person			.746
Real Other-Funded Academic R&D Expenditures per Person		.590	
Real Total Federal Obligations for R&D to Universities and Nonprofits per Person		.972	
Real Federal Obligations for Fellowships and Traineeships Per Person		.749	
Real Federal Obligations for Science and Engineering per Person		.973	
Real Federal Obligations for General Sciences per Person		.353	
Real Public Higher Education Current Fund Expenditures per Person			.629

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

Factor Interpretation

As indicated, the three common factors resulting from this analysis have been labeled "Federal Financial Capacity for Innovation," "Human Capacity for Innovation," and "State/Local Financial Capacity for Innovation." Two interesting things should be noted in the interpretation of the factor loadings. First, theory suggested that at least two common factors would result along human and financial lines, but the inclusion of a greater number of more specific variables resulted in an additional split. Second, the split that occurred resulted in two financially-oriented common factors that reflect the nature of the funding source.

As noted earlier, the variable Total Academic Research and Development Expenditures was included in its component form in this analysis, with five separate categories of fund sources. Only three of those five components loaded onto the federal financial factor. State & Local Government Funded Academic R&D Expenditures was dropped as a result of its loading independently on a trivial factor. In addition, another component of TARD, Institutional Self-Funded Academic R&D Expenditures, loaded on the third common factor—State/Local Financial Capacity—along with the variable Public Higher Education Current Fund Expenditures. Both variables had modestly strong loadings of .746 and .629, respectively. The fund sources included in the variables that loaded on the State/Local Financial Capacity factor reflect effort by states and/or public institutions of higher education to dedicate financial resources to research and development.

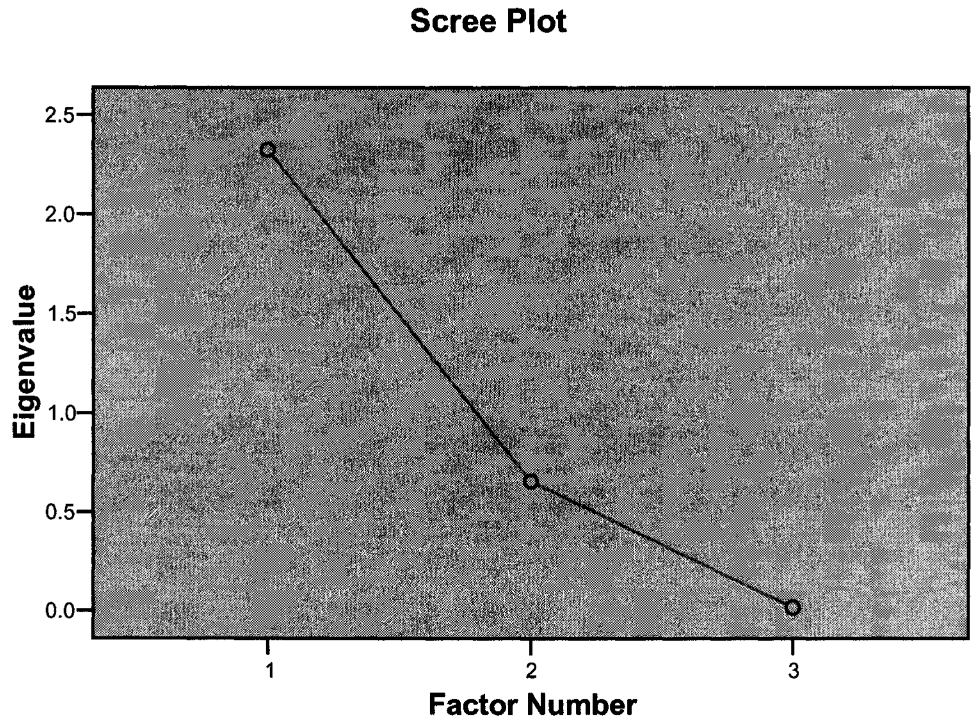
Returning now to the second common factor, Federal Financial Capacity for Innovation, nine of the original variables loaded; they, with their respective loadings, are as follows: Federal Obligations for R&D (.576), Percent of the Population with a Bachelor's Degree or Higher (.584), Federally-Funded Academic R&D Expenditures (.959), Industry-Funded Academic R&D Expenditures (.540), Other-Funded Academic R&D Expenditures (.590), Federal Obligations for R&D to Universities & Nonprofits (.972), Federal Obligations for Fellowships & Traineeships (.749), Federal Obligations for Science & Engineering (.973), and Federal Obligations for General Sciences (.353). As can be seen, three of these loadings are very strong, five are moderately strong, and one is rather weak. One variable's loading on this factor is counterintuitive. The percent of the population with a Bachelor's Degree or higher is a general human resource variable, and was expected to load on the human capacity factor.

The first common factor, Human Capacity for Innovation, reduces five original variables into one capacity measure—with all variables showing equally strong loadings. The variables that constitute the human capacity common factor and their loadings are: High Tech Employment (.959), Number of Postdoctoral Fellows (.902), Number of Full-Time Science & Engineering Graduate Students (.990), Total Number of Science & Engineering Graduate Students (.984), and the Number of Science & Engineering Doctorates Awarded (.975).

The factor scores resulting from this analysis represent three dimensions of innovation capacity in the states. Factor scores for each State-Year were generated and stored for use as inputs in the time-series analysis in Chapter Six. As indicated previously, multiple measures represent the theoretical construct of commercialization capacity, including measures of private venture capital spending and public Small Business Innovation Research Award dollars. In seeking to index this construct in a lesser number of dimensions, the factor analysis procedure was conducted once again using the three variables that represent commercialization capacity—Venture Capital Spending in the states, the number of SBIR awards, and the amount of SBIR award dollars. These financial measures were also adjusted for inflation using the GDP deflator presented above, resulting in real 2000 dollar measures. The Small Business Innovation Research program was only established in 1983, hence, due to data availability, this portion of the analysis uses data from 1983-2002 rather than 1980-1999.

Principal Axis Factoring was performed on the correlation matrix of these variables as it was in the previous factor analysis. All three variables loaded on the same common factor, State Commercialization Capacity; therefore, only a single iteration of the process was required. Because only one factor resulted, the solution could not be rotated. The determination of the number of common factors was once again derived using the number of eigenvalues greater than one, in concert with an analysis of scree (see Figure 5.5 below).

Figure 5.5
Analysis of Scree: Commercialization Capacity



The resulting commercialization capacity factor represents approximately 73% of the variance present in the original three variables, as indicated in Figure 5.6 below.

Figure 5.6
Total Variance Explained: Commercialization Capacity

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.325	77.511	77.511	2.197	73.221	73.221
2	.657	21.915	99.426			
3	.017	.574	100.000			

Extraction Method: Principal Axis Factoring.

The factor loading matrix reveals the loadings of the three variables; this measure is dominated by the dollar amount and number of SBIR awards, with loadings of 1.0 and

.983, respectively. Private venture capital spending loaded moderately, at .481 (see Figure 5.7 below). As had been done for the innovation capacity factors previously, factor scores were calculated for the Commercialization Capacity factor that resulted from this analysis. Those factor scores were also recorded for use in the time series analysis portion of Chapter Six.

Figure 5.7
Factor Matrix: Commercialization Capacity

Factor Matrix[a]

	Factor
	1
Real $ Amount of SBIR Awards	1.000
Number of SBIR Awards	.983
Venture Capital Spending	.481

Extraction Method: Principal Axis Factoring.
a. 1 factors extracted. 10 iterations required.

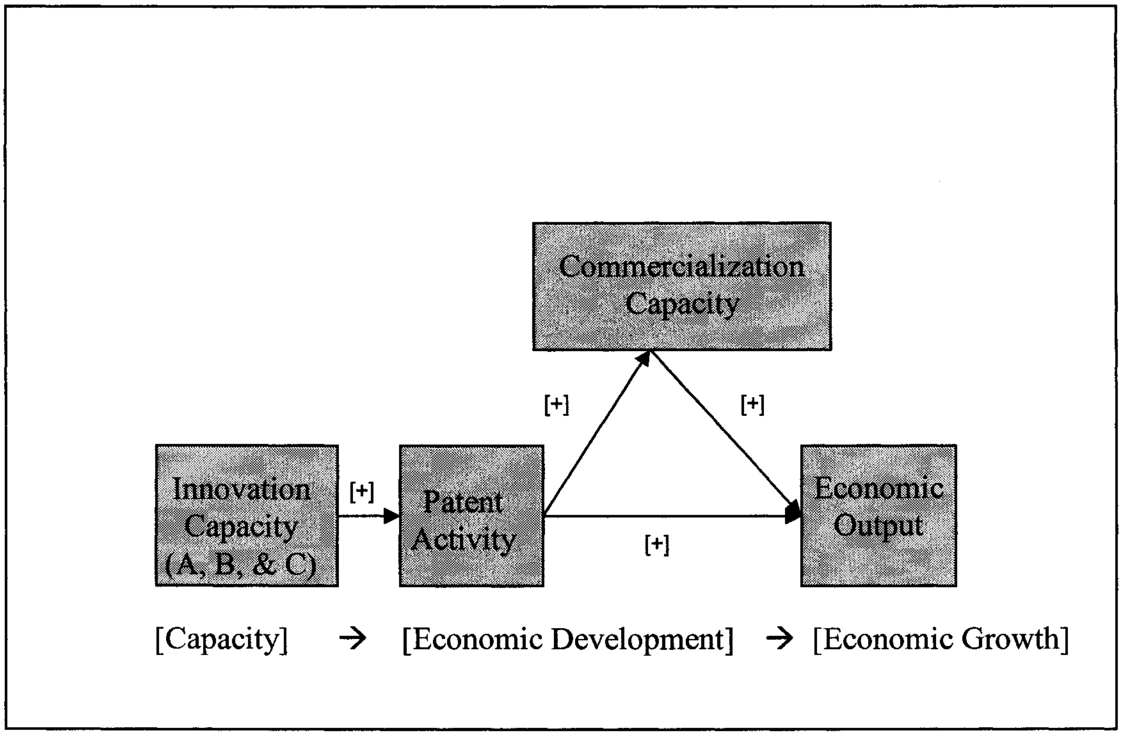
Overall, the development of separate indices of innovation and commercialization capacity, and a measure of innovation outcomes, is important in assessing whether or not, and to what degree, innovation capacity matters in economic growth and development for states and regions. Theory suggests a relationship between these three concepts, and drawing on this theory, it is logical to examine the relationship from the perspective of a standard economic production function wherein inputs lead to outputs throughout the process. In Chapter Six, the measures developed here will be utilized as inputs in a battery of pooled cross-sectional time-series analyses to test the hypothesized relationships defined in Chapter Three, and initially tested in Chapter Four. Tables of factor scores representing the four dimensions that constitute innovation capacity and commercialization capacity developed in this chapter have been provided in Appendix A.

Chapter 6 — Modeling and Testing the Effects of Innovation Capacity Over Time

Introduction

Chapter Five utilized factor analysis to test the dimensionality of innovation capacity and commercialization capacity. The findings were as expected; innovation capacity consists of multiple independent dimensions, and commercialization capacity is one-dimensional. Somewhat surprising, though, was the finding that innovation capacity is comprised of three dimensions, not two. The two dimensions identified in Chapter Four reflected human capacity and financial capacity. The use of more specific data led to the identification of two distinct measures of financial capacity—that driven by federal government spending, and that driven by spending within states using their own-source revenue. A great deal of effort in the previous chapter was dedicated to presenting the capacity scores for the states over time to demonstrate trends and change both within states, and in comparison to others. Chapter Six utilizes those measures that were developed as inputs in testing the overall model presented in Chapter Three. That model is presented below for reference as Figure 6.1.

Figure 6.1
The Theoretical Relationship



This final phase of the research project is the most significant contribution to be made, as it attempts to assess the overall relationship between innovation capacity and innovation outcomes, outcomes and commercialization capacity, and those on economic growth in the states. The model, as mentioned above, is fashioned after a standard production function, thus implying a causal (or catalytic, more appropriately) relationship where the innovation capacity inputs lead to innovation outputs, etc. In other words, the assumption will be made that the presence of higher levels of innovation capacity resources will lead to increases in innovation outcomes. Again, the general hypotheses that guide this research, as indicated in Chapter Three, are:

Hypothesis One: Higher levels of capacity for innovation (as measured by common factors) will lead to greater innovation outcomes, measured by the number of Patents Issued to State Residents (PISR).

Hypothesis Two: Higher levels of innovation outcomes (patents) will lead to increased investment in commercialization efforts, measured by the common factor Commercialization Capacity.

Hypothesis Three: Increased levels of innovation outcomes and Commercialization Capacity lead to increased economic output, measured by Gross State Product (GSP) and Per Capita Personal Income (PCPI), with the expectation of greater economic output where Commercialization Capacity is greater.

These hypotheses will be tested using the pooled cross-sectional time-series analysis method recommended by Beck & Katz (1995), and the discussion will progressively assess the relationships among the variables, and the effect of time on the relationships examined. The indices and measures developed in Chapter Five will be used as inputs in this process. Given the anticipation that innovation outcomes will not be realized simultaneously with innovation capacity, appropriate time lags will be built into the analysis to accurately reflect the causal expectations of the model.

Because endogeneity between the independent and dependent variables is a concern in this analysis, special care will be taken to address it in the statistical models developed. The potential bias stems from the fact that innovation outputs may provide a further basis on which to develop future innovation capacity, thus the two variables may operate cyclically to some extent. The potential bias will be kept in mind in interpreting results. Moreover, building a time lag into the model will enable the changes in both sets of variables to be monitored over time. The pooled cross-section of time series data will present itself well to these tests of effects over time.

States may have other characteristics that lead to innovation outcomes, or that provide an environment conducive to innovation. It is important to take such characteristics into consideration and control for them in attempting to determine how much of the observed innovation outcomes are caused by the independent variables that represent innovation capacity. Such variables may include: population density (a measure of the closeness of the economic space; the higher the density, the more frequently interactions would be expected to occur), political culture (state liberalism), and geographic region of the nation (South/North/West). Although there is a great deal to be learned from exploring these potentially influential variables, such analysis extends beyond the scope of the present study, and will provide the foundation for future research in the field.

In determining the appropriate length of time to consider the effects of capacity, a few individuals have made comment. According to Youtie, Bozeman, and Shapira (1997), investments in technological capability are expected to have significant impacts only in medium- to long-term time frames (in the order of 7-15 years). Exactly what these authors mean by technological capability is not clear, but their reference to incubators, research partnerships, and science and technology suggest that the type of investment programs they have in mind are closely related to, if not exactly, programs designed to enhance innovation capacity and competitiveness. As such, some initial benefits of investment in certain innovation capacity infrastructures may be realized, and the results are likely to persist over time, gradually increasing to a peak and then declining. The largest impacts are more likely to be seen in a ten year time horizon rather than a one or two year horizon. According to the National Venture Capital Association, venture capitalists expect to see high rates of return on their investments within a period of five to seven years, after which they sell their interest and move on to new projects (Thompson Venture Economics 2004, 85). Thus, the effects of commercialization capacity on Gross State Product ought to peak within a period of five to seven years.

Because of limitations associated with data availability, the entire dataset is restricted to a period of twenty years (1980-1999) for issues of innovation capacity and innovation. Going beyond that period historically results in the loss of variables of interest. Hence, there is a tradeoff between inclusion of variables and inclusion of years of observation. As noted earlier in the work, the variable Industry-based Research and Development was dropped because it limited the scope of time that could be considered in the analysis to less than ten years. The available data before 1980 would result in variables being eliminated precipitously. Similarly, historical venture capital investment data is only available to 1980, but as it is a commercialization capacity measure, the limiting variable in that context is Small Business Innovation Research Awards, because that program was only instituted in 1983. From the time estimates provided above, it is obvious that results should be expected over time, and less so in early years than in later years. Because the dataset is limited, examining effects over time is very difficult. Only half as many observations can be included in an equation that considers a ten-year lag as an equation that looks at effects within the same year. Thus, for the purpose of this analysis, annual lags will be examined up to five years.

Beck and Katz (1995) use Monte Carlo simulations to demonstrate that previously preferred methods of time series analysis, such as that suggested by Parks (1967), present significant concerns for reliability and interpretability as a result of overconfidence.

They propose a new method using Ordinary Least Squares regression with Panel-Corrected Standard Errors, and then use Monte Carlo simulation to demonstrate that the method is at least as good as the OLS method when OLS standard errors perform well, and better when OLS standard errors perform poorly (Beck and Katz 1995, 641). As a result, many past studies in political science have presented results that are "either logically impossible to obtain, or are completely a function of numerical inaccuracies" (Ibid, 644). To ensure that the present analysis is robust, the cross-sectional analysis will be performed using panel-corrected standard errors in OLS, as Beck & Katz recommend.

A series of models will be estimated in addressing the key theoretical questions posed by the hypotheses above, and in assessing the change in effects over time. There will be three sets of equations, with each set representing an analysis of a separate component of the model in a given year, and with a lead in the dependent variable up to five years. The first set will examine the effects of innovation capacity on the dependent variable Patents Issued to State Residents. The second set will assess the effects of actual innovations (patents) on the dependent variable Commercialization Capacity. The third set of equations will examine the effects of Innovations (patents) and Commercialization Capacity on economic growth in the state, measured by the dependent variables Gross State Product and Per Capita Personal Income. Each of three sets will include six equations, with the exception of the third set, which includes two dependent variables, for a total of twenty-four models to formulate. The equations are presented below according to the dependent variable of interest.

Innovation Outcomes: Patents Issued to State Residents

Equation 1:

$$PISR_{it} = \beta_1 + \beta_2 Human_{it} + \beta_3 FedFin_{it} + \beta_4 SLFin_{it} + \beta_5 FORDP_{it} + \beta_6 FOSEFE_{it} + \beta_7 SLARD_{it} + \varepsilon_{it}$$

Equation 2:

$$PISR_{it+1} = \beta_1 + \beta_2 Human_{it} + \beta_3 FedFin_{it} + \beta_4 SLFin_{it} + \beta_5 FORDP_{it} + \beta_6 FOSEFE_{it} + \beta_7 SLARD_{it} + \varepsilon_{it}$$

Equation 3:

$$PISR_{it+2} = \beta_1 + \beta_2 Human_{it} + \beta_3 FedFin_{it} + \beta_4 SLFin_{it} + \beta_5 FORDP_{it} + \beta_6 FOSEFE_{it} + \beta_7 SLARD_{it} + \varepsilon_{it}$$

Equation 4:

$$PISR_{it+3} = \beta_1 + \beta_2 Human_{it} + \beta_3 FedFin_{it} + \beta_4 SLFin_{it} + \beta_5 FORDP_{it} + \beta_6 FOSEFE_{it} + \beta_7 SLARD_{it} + \varepsilon_{it}$$

Equation 5:

$$PISR_{it+4} = \beta_1 + \beta_2 Human_{it} + \beta_3 FedFin_{it} + \beta_4 SLFin_{it} + \beta_5 FORDP_{it} + \beta_6 FOSEFE_{it} + \beta_7 SLARD_{it} + \varepsilon_{it}$$

Equation 6:

$$PISR_{it+5} = \beta_1 + \beta_2 Human_{it} + \beta_3 FedFin_{it} + \beta_4 SLFin_{it} + \beta_5 FORDP_{it} + \beta_6 FOSEFE_{it} + \beta_7 SLARD_{it} + \varepsilon_{it}$$

Commercialization Capacity:

Equation 7:

$$CommCap_{it} = \beta_1 + \beta_2 PISR_{it} + \varepsilon_{it}$$

Equation 8:

$$CommCap_{it+1} = \beta_1 + \beta_2 PISR_{it} + \varepsilon_{it}$$

Equation 9:

$$CommCap_{it+2} = \beta_1 + \beta_2 PISR_{it} + \varepsilon_{it}$$

Equation 10:

$$CommCap_{it+3} = \beta_1 + \beta_2 PISR_{it} + \varepsilon_{it}$$

Equation 11:

$$CommCap_{it+4} = \beta_1 + \beta_2 PISR_{it} + \varepsilon_{it}$$

Equation 12:

$$CommCap_{it+5} = \beta_1 + \beta_2 PISR_{it} + \varepsilon_{it}$$

Economic Growth: Gross State Product and Per Capita Personal Income

Gross State Product:

Equation 13:

$$GSP_{it} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 14:

$$GSP_{it+1} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 15:

$$GSP_{it+2} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 16:

$$GSP_{it+3} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 17:

$$GSP_{it+4} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 18:

$$GSP_{it+5} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Per Capita Personal Income:

Equation 19:

$$PCPI_{it} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 20:

$$PCPI_{it+1} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 21:

$$PCPI_{it+2} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 22:

$$PCPI_{it+3} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 23:

$$PCPI_{it+4} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

Equation 24:

$$PCPI_{it+5} = \beta_1 + \beta_2 PISR_{it} + \beta_3 CommCap_{it} + \varepsilon_{it}$$

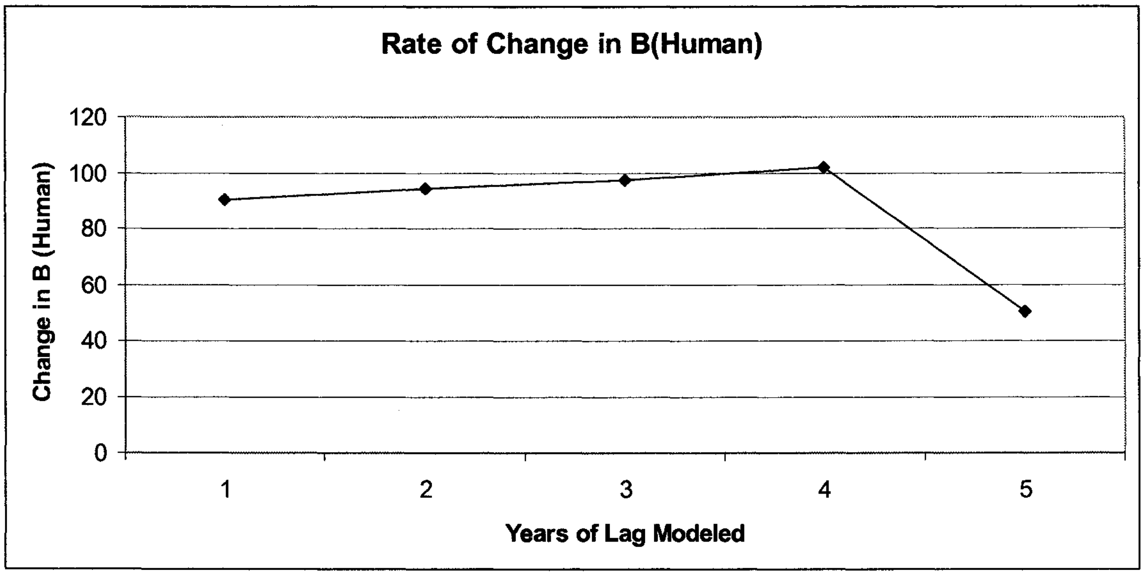
Results

Each of the preceding equations has been tested using Stata, and the results are presented below and discussed in groups according to dependent variable. The first group of equations looks at the effects of innovation capacity on innovation outcomes. As indicated earlier, the dependent variable, innovation outcomes, is measured by the number of patents issued to state residents (PISR), and leads of that particular variable up to a period of +5 years in separate models. The independent variables of innovation capacity are represented by the three common factors derived in Chapter Five: Human Capacity for Innovation, Federal Financial Capacity for Innovation, and State/Local Financial Capacity for innovation. In addition to these three common factors, the three independent variables that failed to load onto common factors in the analysis conducted in Chapter Five were also included. These three independent variables are Real Federal Obligations for Research and Development Plant per person (RFRDPPP), Real Federal Obligations for Science & Engineering Facilities & Equipment per person (RFOSEFEP), and Real State/Local Funded Academic Research & Development Expenditures (SLARD).

Equations one through six begin with innovation capacity and innovation outcomes in the same year, and then move to compare capacity in year (t) with innovation outcomes in future years (t+1 through t+5). Each of the models presented is statistically significant ($p<.001$), with R^2 values ranging, and decreasing, from .84 in Equation 1 to .82 in Equation 6. One of the independent variables is not statistically significant in either of the six models—Federal Obligations for Science & Engineering Facilities & Equipment. State and Local Academic Research and Development Expenditure is only significant ($p<.05$) in the same-year model (Equation 1), and falls out of significance in the remaining equations (two through six). Two independent variables, State/Local Financial Capacity and Federal Obligations for R&D Plant, are not significant in the early equations, but become significant in latter equations. State/Local Financial Capital is not statistically significant in Equation 1 and Equation 2, but is significant ($p<.05$) in Equations 3-6. Federal Obligations for R&D Plant is not significant in Equations 1-5, but becomes significant in Equation 6. The fact that Research and Development Plant obligations only became significant with a five-year gap may indicate that the effects of such investment are slower to be realized than other types of capacity. The same could be said for State/Local Financial Capacity—it becomes significant in predicting innovation outcomes after a two-year period. The two remaining independent variables, Human Capacity for Innovation and Federal Financial Capacity for Innovation, are statistically significant in each model ($p<.01$).

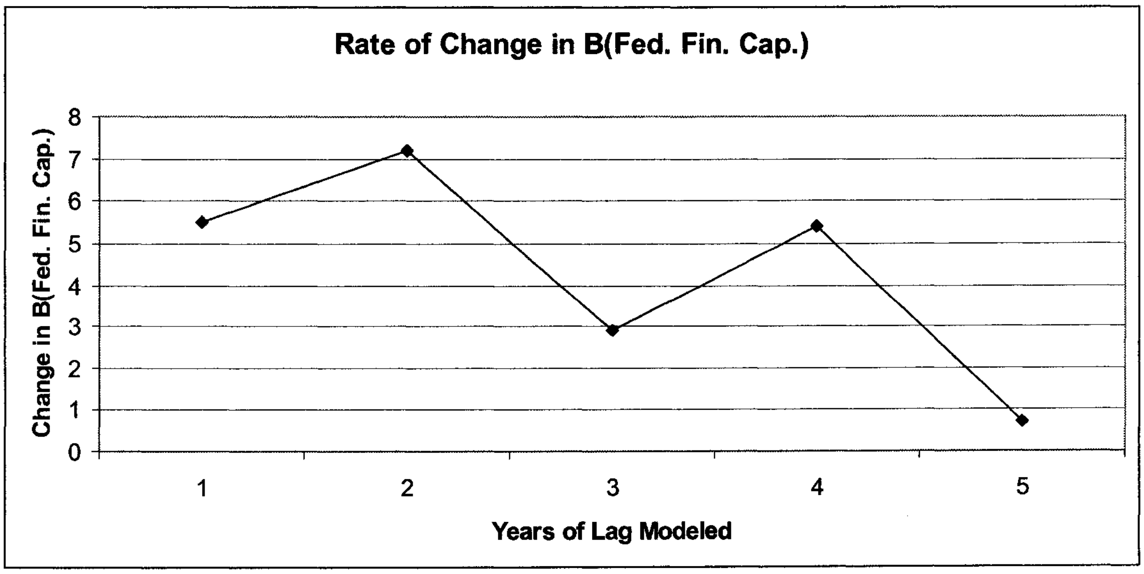
The effects of certain types of innovation capacity on innovation outcomes may be first assessed through measures of statistical significance, but the magnitude of their effect must be examined with respect to the beta coefficients of each independent variable. From Equation 1 to Equation 6, the coefficient of the common factor Human Capacity increases steadily from 1374.4 to 1807.9 (see Figure 6.2 below), indicating that the effects of human capacity in a given year are realized over time, and more strongly at an interval of five years than at an interval of one year or the same year. The rate of change is approximately 90 per year except in the final year, where the rate of growth in the coefficient drops sharply to approximately 50. The decreasing rate of growth may indicate that the effects come to a peak and then decline rapidly; given the limited number of years available for this analysis, it is not possible to test this supposition.

Figure 6.2



This can also be said of the coefficient for the common factor Federal Financial Capacity for Innovation, which increases gradually, but at a decreasing rate from 102.6 in Equation 1 to 124.3 in Equation 6 (see Figure 6.3 below).

Figure 6.3



Of the remaining independent variables, only State and Local Government-Funded Academic R&D Expenditures was significant in the same-year study, but it appears to have a negative effect on innovation outcomes, as the coefficient for this variable is -4.4. It can be said that this variable does not have a positive effect on innovation outcomes in the states in any year, and it appears to have a counterintuitive impact of a small magnitude in the same year. Federal R&D Plant Obligations, as noted above, is only significant in Equation six, which incorporates a five-year time lag from capacity to outcomes. R&D plant has a positive effect on patenting (innovation outcomes) in that year, with a coefficient of 19.2.

The remaining variable is the third common factor generated in Chapter Five—State/Local Financial Capacity for Innovation. This independent variable is significant in Equations 3-6, and it does also have a positive effect on innovation outcomes. The coefficient for this variable declines from 56.7 in Equation 3 (with a two-year time lag) to 43.7 in Equation 6 (with a five year time lag). As such, state and local financial capacity for innovation does play an important role in innovation outcomes in the states, but whereas the coefficient for Federal Financial Capacity increases with increasing time lags, the coefficient for State/Local Financial Capacity decreases rapidly. As such, both sources of financial capacity are important, but the character of that capacity is very different, and is likely realized over different time frames. The impact of Federal Capacity on patent generation is approximately twice that of State/Local Capacity in Equation 3, and approximately three times as great in Equation 6, indicating both greater importance of the federal role, and greater staying power from the federal funds than state funds in terms of impacting state capacity.

To summarize, Hypothesis One has been confirmed; there is evidence that state innovation capacity does have a strong impact on innovation outcomes in the states. Of great importance is the fact that the innovation capacity measures developed in Chapter Five have proven to be both statistically and practically significant in explaining actual documented innovations as measured by patents. The remaining independent variables have proven to have little or no effect on innovation outcomes during the timeframe of this analysis. To recount, Federal Obligations for Science & Engineering Facilities & Equipment does not influence innovation outcomes, and State and Local-Funded Academic R&D influences outcomes mildly and negatively only in the same year, with no future effects. Finally, Federal Obligations for R&D Plant do result in a weak practical influence on innovation outcomes five years after they are obligated. It is possible that this relationship strengthens as time passes, but there is insufficient longitude in this dataset to test that relationship.

As indicated earlier in this chapter, there are independent variables that might be included to control for differences among states in their ability to generate innovations given their existing capacity for innovation. Agglomeration and formation of industry clusters go hand-in-hand. Agglomeration occurs and externalities are capitalized when multiple firms, and their highly-skilled employees operate in a close geographic space, interacting in a network. In other words, the closer together, the more frequent the interaction, and the more likely that creative activities will ensue. One way to compare states would be on the extent to which they are urban or rural, expecting that rural states with equal innovation capacity would generate fewer actual innovations than their urban counterparts where the resources were more likely to interact. A straightforward measure was adopted to reflect the concentration of people within states. Population Density reflects the number of people per square mile of state land area. Thus, human resources are more diffuse in Wyoming or Montana than they are in Delaware or New Jersey. The states with diffuse populations are not expected to use their innovation capacity resources as fully as densely-populated states where interactions are more likely to occur. A supplemental analysis was conducted to examine the influence of population density in states' abilities to generate innovations. Equations 1 through 6 were replicated using the same OLS with Panel-Corrected Standard Errors, but with the addition of Population Density as an additional independent variable. The models representing these relationships follow the pattern of this equation, in the present year, and up to five-year lags:

Equation 25

$$PISR_{it} = \beta_1 + \beta_2 Human_{it} + \beta_3 FedFin_{it} + \beta_4 SLFin_{it} + \beta_5 FORDP_{it} + \beta_6 FOSEFE_{it} + \beta_7 SLARD_{it} + \beta_8 Density_{it} + \varepsilon_{it}$$

The results of the six supplemental models indicate that, as expected, states with greater population density generate more patents with their existing innovation capacity than those that do not. The tables depicting these results are included as Appendix C. To summarize the results, population density does impact state patenting such that in the same year, an increase in density of four persons per square mile will increase the number of patents by approximately three.

Table 6.1
Equation 1

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =      1000
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        20
Autocorrelation:  no autocorrelation                           avg =        20
                                                               max =        20
Estimated covariances      =      1275          R-squared          =    0.8426
Estimated autocorrelations =         0          Wald chi2(6)       =    934.61
Estimated coefficients     =         7          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
        pisr |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    humancap |   1374.355   78.42311    17.52   0.000     1220.648    1528.061
    fedfinca |    102.661   8.327724    12.33   0.000     86.33898    118.9831
    slfincap |   27.44149   21.32945     1.29   0.198    -14.36346    69.24644
     rfrdppp |   1.205674   6.241462     0.19   0.847    -11.02737    13.43872
    rfosefep |  -2.730274   7.761365    -0.35   0.725    -17.94227    12.48172
     slardpp |  -4.379029   2.032183    -2.15   0.031    -8.362035   -.3960225
       _cons |   1026.346   32.44715    31.63   0.000     962.7506    1089.941
------------------------------------------------------------------------------
```

Table 6.2
Equation 2

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =      1000
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        20
Autocorrelation:  no autocorrelation                           avg =        20
                                                               max =        20
Estimated covariances      =      1275          R-squared          =    0.8312
Estimated autocorrelations =         0          Wald chi2(6)       =   1025.23
Estimated coefficients     =         7          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       PISR1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    humancap |    1464.28   90.43455    16.19   0.000     1287.031    1641.528
    fedfinca |   108.1362   8.841622    12.23   0.000     90.80697    125.4655
    slfincap |   43.34456   23.29517     1.86   0.063    -2.313127    89.00225
     rfrdppp |   5.088469   7.035745     0.72   0.470    -8.701338    18.87827
    rfosefep |  -6.307715   8.873861    -0.71   0.477    -23.70016    11.08473
     slardpp |  -2.611473   2.252485    -1.16   0.246    -7.026262    1.803316
       _cons |   1058.048   34.96687    30.26   0.000     989.5138    1126.581
------------------------------------------------------------------------------
```

Table 6.3
Equation 3

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =       1000
Time variable:    year                          Number of groups   =         50
Panels:           correlated (balanced)         Obs per group: min =         20
Autocorrelation:  no autocorrelation                           avg =         20
                                                               max =         20
Estimated covariances      =      1275          R-squared          =     0.8223
Estimated autocorrelations =         0          Wald chi2(6)       =     990.62
Estimated coefficients     =         7          Prob > chi2        =     0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       PISR2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    humancap |   1558.787   101.1034    15.42   0.000     1360.628    1756.946
    fedfinca |   115.3162   9.588465    12.03   0.000     96.52318    134.1093
    slfincap |   56.69095   24.71576     2.29   0.022     8.248953     105.133
    rfrdppp  |   9.203979   7.776529     1.18   0.237    -6.037738    24.44569
    rfosefep |  -6.003951   9.981827    -0.60   0.548    -25.56797    13.56007
    slardpp  |  -.6250962   2.414351    -0.26   0.796    -5.357137    4.106945
       _cons |   1087.993   35.81249    30.38   0.000     1017.801    1158.184
------------------------------------------------------------------------------
```

Table 6.4
Equation 4

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =       1000
Time variable:    year                          Number of groups   =         50
Panels:           correlated (balanced)         Obs per group: min =         20
Autocorrelation:  no autocorrelation                           avg =         20
                                                               max =         20
Estimated covariances      =      1275          R-squared          =     0.8213
Estimated autocorrelations =         0          Wald chi2(6)       =     929.79
Estimated coefficients     =         7          Prob > chi2        =     0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       PISR3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    humancap |   1655.803   105.8812    15.64   0.000     1448.279    1863.326
    fedfinca |   118.1801   9.910526    11.92   0.000     98.75584    137.6044
    slfincap |   56.98704   24.29166     2.35   0.019     9.376247    104.5978
    rfrdppp  |   13.95255   8.375882     1.67   0.096    -2.463879    30.36898
    rfosefep |  -4.607062    10.8037    -0.43   0.670    -25.78192    16.56779
    slardpp  |   .8717177   2.512257     0.35   0.729    -4.052215     5.79565
       _cons |   1125.438   34.83214    32.31   0.000     1057.169    1193.708
------------------------------------------------------------------------------
```

Table 6.5
Equation 5

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	1000
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	20
Autocorrelation:	no autocorrelation	avg =	20
		max =	20
Estimated covariances =	1275	R-squared =	0.8240
Estimated autocorrelations =	0	Wald chi2(6) =	1000.70
Estimated coefficients =	7	Prob > chi2 =	0.0000

PISR4	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
humancap	1757.245	107.3407	16.37	0.000	1546.861	1967.628
fedfinca	123.5647	9.774705	12.64	0.000	104.4066	142.7228
slfincap	51.88032	21.81318	2.38	0.017	9.127271	94.63338
rfrdppp	16.1404	8.875787	1.82	0.069	-1.255818	33.53663
rfosefep	1.069372	11.4682	0.09	0.926	-21.4079	23.54664
slardpp	2.043606	2.539801	0.80	0.421	-2.934312	7.021524
_cons	1168.935	31.5309	37.07	0.000	1107.135	1230.734

Table 6.6
Equation 6

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	950
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	19
Autocorrelation:	no autocorrelation	avg =	19
		max =	19
Estimated covariances =	1275	R-squared =	0.8296
Estimated autocorrelations =	0	Wald chi2(6) =	901.94
Estimated coefficients =	7	Prob > chi2 =	0.0000

PISR5	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
humancap	1807.901	107.093	16.88	0.000	1598.003	2017.8
fedfinca	124.3459	9.509055	13.08	0.000	105.7085	142.9833
slfincap	43.69485	20.46327	2.14	0.033	3.587581	83.80212
rfrdppp	19.22091	8.837175	2.18	0.030	1.900364	36.54145
rfosefep	-2.609275	12.02622	-0.22	0.828	-26.18024	20.96169
slardpp	2.683808	2.583639	1.04	0.299	-2.380031	7.747647
_cons	1201.98	30.82075	39.00	0.000	1141.573	1262.388

The second group of equations tests hypothesis two above by examining the relationship between the independent variable innovation outcomes (measured as Patents Issued to State Residents) and the dependent variable, presence of commercialization capacity in the states. The dependent variable in these equations is the common factor Commercialization Capacity which was developed in Chapter Five. The relationship is examined both in the present year, and with leads of the dependent variable up to a period of +5 years in separate models represented by Equations 7-12. While the relationship examined in the first set of equations was moderately strong, the relationship in this group of equations is only moderate, with R^2 values ranging from .38 in the same-year model (Equation 7) to only .31 in the five-year lagged comparison (Equation 12). Nonetheless, the relationship is statistically significant ($p<.01$), and thus demonstrates that some of the variance in state Commercialization Capacity can be explained by patent activity in the states.

Two facts may explain why this relationship is not as strong as might be expected. First, venture capitalists often like to be involved in the management and operation of the enterprises in which they choose to invest; thus, states (or their neighbors) where more venture capital resources exist might be more likely to be the beneficiaries of venture capital investment. Second, the SBIR program, which constitutes the other major component of the Commercialization Capacity measure, may be skewed, with distribution of funds toward states with fewer innovations as a method of equalization among the states. This aspect of the program is formalized as the Rural Outreach program, but award dollars are still counted in the SBIR award totals. This would mean that some of the funds are geographically distributed to particular states rather than purely competitively distributed to innovators. The following description of this aspect of the program is displayed on the SBA website (U.S. Small Business Administration, Accessed 2005).

> The Office of Technology also awards SBIR Rural Outreach grants to a core group of states based on the underserved criteria determined by Congress (P.L. 105-35). The initiative will broaden the geographical distribution of awards made through the Small Business Innovative Research (SBIR) Program. (…) The following states and territories participate in the Rural Outreach program: Alaska, Delaware, District of Columbia, Idaho, Indiana, Iowa, Kentucky, Louisiana, Maine, Mississippi, Missouri, Montana, Nebraska, Nevada, North Dakota, Puerto Rico, Rhode Island, South Carolina, South Dakota, Vermont, West Virginia, and Wyoming.

From a practical standpoint, the beta coefficients of Commercialization Capacity in each of these models are particularly small. An increase of one patent in the same-year model (Equation 7) results in an increase in the Commercialization Capacity index score of 0.00034, and the same one patent increase results in a Commercialization Capacity index score increase of 0.00044 five years later (Equation 12). This sounds miniscule, but stated differently, its practical implication is a bit more profound. First of all, an increase of 227 patents in a given year would result in an increase in commercialization capacity of 0.1 in year five.; an increase of 2272 patents in that year would increase the commercialization capacity score by 1.0 in year five. To realize the same impact (0.1 or 1.0) in commercialization score one year after the innovation rather than five years after would require an increase of 286 or 2857, respectively.

To demonstrate how this translates into benefit for the states, consider Alabama in 1999, ranked last among the states in Commercialization Capacity with a score of -0.46.

If Alabama had generated 286 more patents in 1998, its Commercialization Capacity score in 1999 would have risen to -0.36, which would have increased its ranking from 50th to 33rd. An increase of 2857 patents in 1998 would have increased Alabama's 1999 Commercialization Capacity score to 0.46, which would have placed it at a national rank of 12th, between Washington and Florida. So, while the coefficients seem small, attainable improvements in Commercialization Capacity can be made by increasing innovation outputs. Based on the information learned from Equations 1-6, states could make such improvements by increasing their Human, Federal Financial, and State Financial Capacities for innovation and by luring Federal Obligations for R&D Plant.

In summary, then, actual innovations (PISR) do have the effect of increasing commercialization capacity in the states. Although the model does not explain a tremendous amount of variance in Commercialization Capacity, with R^2 values of approximately 0.32, there is evidence to confirm Hypothesis Two. Again, this is important as it represents a component of the overall cycle of innovation in economic development—specifically, Commercialization Capacity begins to translate innovative ideas into marketable products that will lead to new jobs and increased sales and incomes.

Table 6.7
Equation 7

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =      1000
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        20
Autocorrelation:  no autocorrelation                           avg =        20
                                                               max =        20
Estimated covariances      =      1275          R-squared          =    0.3755
Estimated autocorrelations =         0          Wald chi2(1)       =    349.97
Estimated coefficients     =         2          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
     commcap |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   .0003353   .0000179    18.71   0.000     .0003002    .0003705
       _cons |  -.3836984   .0269902   -14.22   0.000    -.4365982   -.3307986
------------------------------------------------------------------------------
```

Table 6.8
Equation 8

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =      1000
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        20
Autocorrelation:  no autocorrelation                           avg =        20
                                                               max =        20
Estimated covariances      =      1275          R-squared          =    0.3628
Estimated autocorrelations =         0          Wald chi2(1)       =    318.65
Estimated coefficients     =         2          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
     COMCAP1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   .0003498   .0000196    17.85   0.000     .0003114    .0003882
       _cons |  -.3817011   .0269307   -14.17   0.000    -.4344844   -.3289179
------------------------------------------------------------------------------
```

Table 6.9
Equation 9

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =      1000
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        20
Autocorrelation:  no autocorrelation                           avg =        20
                                                               max =        20
Estimated covariances      =      1275          R-squared          =    0.3447
Estimated autocorrelations =         0          Wald chi2(1)       =    274.66
Estimated coefficients     =         2          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
     COMCAP2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   .0003643    .000022    16.57   0.000     .0003212    .0004074
       _cons |  -.3799218   .0271265   -14.01   0.000    -.4330888   -.3267547
------------------------------------------------------------------------------
```

Table 6.10
Equation 10

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =      1000
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        20
Autocorrelation:  no autocorrelation                           avg =        20
                                                               max =        20
Estimated covariances      =      1275          R-squared          =    0.3323
Estimated autocorrelations =         0          Wald chi2(1)       =    279.87
Estimated coefficients     =         2          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
     COMCAP3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   .0003831   .0000229    16.73   0.000     .0003382     .000428
       _cons |  -.3812089   .0266471   -14.31   0.000    -.4334363   -.3289816
------------------------------------------------------------------------------
```

Table 6.11
Equation 11

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	950
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	19
Autocorrelation:	no autocorrelation	avg =	19
		max =	19
Estimated covariances =	1275	R-squared =	0.3228
Estimated autocorrelations =	0	Wald chi2(1) =	364.83
Estimated coefficients =	2	Prob > chi2 =	0.0000

COMCAP4	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
pisr	.0004105	.0000215	19.10	0.000	.0003684	.0004526
_cons	-.3715303	.0255824	-14.52	0.000	-.4216709	-.3213897

Table 6.12
Equation 12

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	900
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	18
Autocorrelation:	no autocorrelation	avg =	18
		max =	18
Estimated covariances =	1275	R-squared =	0.3079
Estimated autocorrelations =	0	Wald chi2(1) =	459.99
Estimated coefficients =	2	Prob > chi2 =	0.0000

COMCAP5	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
pisr	.0004391	.0000205	21.45	0.000	.000399	.0004793
_cons	-.3642217	.0245652	-14.83	0.000	-.4123687	-.3160748

The remaining equations (13-24) examine the combined effects of innovation outcomes and Commercialization Capacity on certain measures of economic growth in the states, including both Gross State Product and Per Capita Personal Income. The first group of tests (Equations 13-18) focuses on the effects of innovation outcomes and Commercialization Capacity on the dependent variable Gross State Product. As before, the equations examine the effects of the independent variables, PISR and CommCap, on Gross State Product in the present year, and each year thereafter, up to a time period of +5 years.

The explanatory power of the models (Equations 13-18) is very strong, with R^2 increasing from 0.88 in the same-year model to 0.91 in the five year time lapse model (Equation 18). The overall models in each case are highly statistically significant. The two independent variables differ in terms of their impact and significance. First, Patents issued to State Residents (PISR) is statistically significant ($p<.01$) in each of the six equations, and the effect on Gross State Product is in the expected direction and of a substantial magnitude—this aspect of the model supports Hypothesis Three, that innovations lead to economic growth in the states. The patent coefficient increases gradually over the set of models, from 101,000,000 in the same year to 140,000,000 in the five-year lag.

The second component of Hypothesis Three suggests that greater state Commercialization Capacity should lead to increased economic growth as well. This aspect of the hypothesis is not confirmed, as the presence of commercialization capacity has a statistically-significant, negative effect on economic growth, evidenced by the negative coefficient of the Commercialization Capacity independent variable in Equations 13-16. The variable is not statistically significant in Equations 17-18. Moreover, the negative impacts of the commercialization capacity outweigh the positive impacts of patents generated.

The measure of Commercialization Capacity developed in Chapter Five accurately reflects the consequences of the variables it includes. To investigate this counterintuitive relationship, a new model was examined using same-year data. In this model, the original variables were included rather than the Commercialization Capacity common factor scores (the results of this test are not presented below). In this model, the explanatory power was approximately the same as with the factor scores. The model was statistically significant, and each of the independent variables was significant ($p<.01$). The coefficients in this model were as follows for each of the independent variables: Real SBIR award dollars, -2360; Number of SBIR awards, 460,000,000; Venture Capital Investment, -17.4; Patents Issued to State Residents, 112,000,000. So, the factor score measure adequately reflects the original variables, but it is difficult to understand why the dollar amount of SBIR awards and the dollar amount of venture capital spending would be negatively related to GSP, especially while the number of SBIR awards has a positive relationship.[2]

---

2 The use of panel corrected standard errors in the preceding analysis presupposes that variances are not uniform from state to state. To determine if there are state differences that impact the performance of the models tested above, a second series of models was fitted using cross sectional fixed effects regression analysis (with the exception of Per Capita Personal Income). These twelve models were statistically significant, and the coefficients of the independent variables were similar to those coefficients in direction and magnitude, indicating that the original models perform particularly well in describing the theoretical relationships. Two exceptions should be noted; first, in the fixed-effects analysis, State & Local Financial Capacity for Innovation has a negative coefficient in the companion models to 1 through 6 above, which is contrary to the hypothesized relationships. And second, in the fixed effects companion models to 13 through 18, commercialization capacity is statistically significant with a positive coefficient, as was hypothesized. The implication of these findings is that states vary in their innovation outcomes as a result of the influence of some additional variable that is not accounted for in the preceding models.

Table 6.13
Equation 13

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                         Number of obs      =       950
Time variable:    year                         Number of groups   =        50
Panels:           correlated (balanced)        Obs per group: min =        19
Autocorrelation:  no autocorrelation                          avg =        19
                                                              max =        19
Estimated covariances      =      1275         R-squared          =    0.8805
Estimated autocorrelations =         0         Wald chi2(2)       =    780.22
Estimated coefficients     =         3         Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
        RGSP |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.01e+08    3926155    25.76   0.000     9.34e+07    1.09e+08
     commcap |  -1.20e+10   3.82e+09    -3.14   0.002    -1.95e+10   -4.52e+09
       _cons |   3.60e+10   3.66e+09     9.84   0.000     2.88e+10    4.32e+10
------------------------------------------------------------------------------
```

Table 6.14
Equation 14

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                         Number of obs      =       900
Time variable:    year                         Number of groups   =        50
Panels:           correlated (balanced)        Obs per group: min =        18
Autocorrelation:  no autocorrelation                          avg =        18
                                                              max =        18
Estimated covariances      =      1275         R-squared          =    0.8857
Estimated autocorrelations =         0         Wald chi2(2)       =    815.94
Estimated coefficients     =         3         Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       RGSP1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.08e+08    4082636    26.33   0.000     9.95e+07    1.16e+08
     commcap |  -1.04e+10   3.94e+09    -2.63   0.008    -1.81e+10   -2.65e+09
       _cons |   3.50e+10   3.51e+09     9.99   0.000     2.82e+10    4.19e+10
------------------------------------------------------------------------------
```

Table 6.15
Equation 15

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                           Number of obs      =       850
Time variable:    year                           Number of groups   =        50
Panels:           correlated (balanced)          Obs per group: min =        17
Autocorrelation:  no autocorrelation                            avg =        17
                                                                max =        17
Estimated covariances      =      1275           R-squared          =    0.8911
Estimated autocorrelations =         0           Wald chi2(2)       =    981.92
Estimated coefficients     =         3           Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       RGSP2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.15e+08    4103881    28.04   0.000     1.07e+08    1.23e+08
     commcap |  -9.55e+09   3.89e+09    -2.46   0.014    -1.72e+10   -1.93e+09
       _cons |   3.32e+10   3.15e+09    10.53   0.000     2.70e+10    3.94e+10
------------------------------------------------------------------------------
```

Table 6.16
Equation 16

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                           Number of obs      =       800
Time variable:    year                           Number of groups   =        50
Panels:           correlated (balanced)          Obs per group: min =        16
Autocorrelation:  no autocorrelation                            avg =        16
                                                                max =        16
Estimated covariances      =      1275           R-squared          =    0.8993
Estimated autocorrelations =         0           Wald chi2(2)       =   1431.41
Estimated coefficients     =         3           Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       RGSP3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.24e+08    3777666    32.90   0.000     1.17e+08    1.32e+08
     commcap |  -8.34e+09   3.80e+09    -2.20   0.028    -1.58e+10   -8.96e+08
       _cons |   3.07e+10   2.50e+09    12.25   0.000     2.58e+10    3.56e+10
------------------------------------------------------------------------------
```

Table 6.17
Equation 17

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                        Number of obs      =       750
Time variable:    year                        Number of groups   =        50
Panels:           correlated (balanced)       Obs per group: min =        15
Autocorrelation:  no autocorrelation                         avg =        15
                                                             max =        15
Estimated covariances      =      1275        R-squared          =    0.9126
Estimated autocorrelations =         0        Wald chi2(2)       =   3528.85
Estimated coefficients     =         3        Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       RGSP4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.35e+08    2484974    54.44   0.000     1.30e+08    1.40e+08
     commcap |  -5.93e+09   3.13e+09    -1.90   0.058    -1.21e+10    1.96e+08
       _cons |   2.75e+10   1.59e+09    17.22   0.000     2.43e+10    3.06e+10
------------------------------------------------------------------------------
```

Table 6.18
Equation 18

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                        Number of obs      =       700
Time variable:    year                        Number of groups   =        50
Panels:           correlated (balanced)       Obs per group: min =        14
Autocorrelation:  no autocorrelation                         avg =        14
                                                             max =        14
Estimated covariances      =      1275        R-squared          =    0.9103
Estimated autocorrelations =         0        Wald chi2(2)       =   3087.56
Estimated coefficients     =         3        Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       RGSP5 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.40e+08    2703734    51.65   0.000     1.34e+08    1.45e+08
     commcap |  -2.66e+09   3.49e+09    -0.76   0.446    -9.51e+09    4.18e+09
       _cons |   2.84e+10   1.39e+09    20.38   0.000     2.57e+10    3.12e+10
------------------------------------------------------------------------------
```

The final set of equations (19-24) replicate Equations (13-18), except that the dependent variable of interest is Per Capita Personal Income, rather than Gross State Product. This series of models is significant, but the explanatory power of the variables is very low, with R^2 values of only 0.18. The Commercialization Capacity variable was not statistically significant in either of the six models, but patents generated did have a positive and significant effect ($p<.01$) on PCPI. The coefficient for the patent variable varies from 1.1 in the same-year model (Equation 19) to 1.4 in the five-year lag model (Equation 24). In effect, this means that each patent generated in a state leads to $1.10 to $1.40 in annual per capita personal income. So, for a state with a population of 5 million that generates 500 patents in a given year, each person in the state could expect to see an increase in their real personal income of $550 in the following year ($1.10 x 500 = $550). Over the entire state population, this is an increase of $2.75 Billion in personal income per year. That is a substantial amount when considering both personal wealth, quality of life, and from a governmental perspective, increased tax base. Thus, while the explanatory power of this model is very low, the practical implications are particularly significant.

Table 6.19
Equation 19

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                         Number of obs      =      1000
Time variable:    year                         Number of groups   =        50
Panels:           correlated (balanced)        Obs per group: min =        20
Autocorrelation:  no autocorrelation                          avg =        20
                                                              max =        20
Estimated covariances      =      1275         R-squared          =    0.1756
Estimated autocorrelations =         0         Wald chi2(2)       =    408.92
Estimated coefficients     =         3         Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
    pcpireal |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.101245       .0548    20.10   0.000     .9938393    1.208651
     commcap |  -162.0472    156.0507    -1.04   0.299    -467.9011    143.8066
       _cons |   22350.56    621.2992    35.97   0.000     21132.84    23568.29
------------------------------------------------------------------------------
```

Table 6.20
Equation 20

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	1000
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	20
Autocorrelation:	no autocorrelation	avg =	20
		max =	20
Estimated covariances =	1275	R-squared =	0.1756
Estimated autocorrelations =	0	Wald chi2(2) =	341.80
Estimated coefficients =	3	Prob > chi2 =	0.0000

PCPI1	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
pisr	1.103339	.0597326	18.47	0.000	.9862647	1.220412
commcap	-151.9801	157.225	-0.97	0.334	-460.1354	156.1752
_cons	22857.57	620.7215	36.82	0.000	21640.97	24074.16

Table 6.21
Equation 21

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	950
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	19
Autocorrelation:	no autocorrelation	avg =	19
		max =	19
Estimated covariances =	1275	R-squared =	0.1795
Estimated autocorrelations =	0	Wald chi2(2) =	303.50
Estimated coefficients =	3	Prob > chi2 =	0.0000

PCPI2	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
pisr	1.159898	.066695	17.39	0.000	1.029179	1.290618
commcap	-188.7429	157.6201	-1.20	0.231	-497.6727	120.1869
_cons	23060.31	611.7838	37.69	0.000	21861.24	24259.38

Table 6.22
Equation 22

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =       900
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        18
Autocorrelation:  no autocorrelation                           avg =        18
                                                               max =        18
Estimated covariances      =      1275          R-squared          =    0.1808
Estimated autocorrelations =         0          Wald chi2(2)       =    264.28
Estimated coefficients     =         3          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       PCPI3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.200647   .0738797    16.25   0.000     1.055845    1.345449
     commcap |  -149.4195    171.315    -0.87   0.383    -485.1907    186.3517
       _cons |   23287.22   604.0274    38.55   0.000     22103.35    24471.09
------------------------------------------------------------------------------
```

Table 6.23
Equation 23

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =       850
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        17
Autocorrelation:  no autocorrelation                           avg =        17
                                                               max =        17
Estimated covariances      =      1275          R-squared          =    0.1824
Estimated autocorrelations =         0          Wald chi2(2)       =    265.61
Estimated coefficients     =         3          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       PCPI4 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.265614   .0778155    16.26   0.000     1.113099     1.41813
     commcap |  -159.3989   180.8128    -0.88   0.378    -513.7855    194.9876
       _cons |   23494.78   597.9545    39.29   0.000     22322.81    24666.75
------------------------------------------------------------------------------
```

Table 6.24
Equation 24

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =       800
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        16
Autocorrelation:  no autocorrelation                           avg =        16
                                                               max =        16
Estimated covariances      =      1275          R-squared          =    0.1848
Estimated autocorrelations =         0          Wald chi2(2)       =    315.28
Estimated coefficients     =         3          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       PCPI5 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        pisr |   1.357599   .0769757    17.64   0.000     1.206729    1.508469
     commcap |  -200.4786   190.8422    -1.05   0.293    -574.5224    173.5651
       _cons |   23682.28   592.9134    39.94   0.000     22520.19    24844.36
------------------------------------------------------------------------------
```

Stephan, et al, associated the skewed geographic concentration of innovation outcomes with environments where external knowledge sources are present, noting that these resources also tend to be geographically concentrated (2004: 157). The knowledge sources—universities, federal laboratories, and industry research and development efforts—are manifested in a number of financial and human resource variables that collectively represent innovation capacity. Based on the observations made by Stephan, et al (2004), it stands to reason that this collective capacity should show a strong correlation to innovation outcomes.

The results of the preceding analysis confirm this expectation, and shed further light on the effects of capacity over time. Each set of equations above addresses a different component of the cycle that theory suggests should operate to translate innovation capacity from its latent form into innovation outcomes, and those into both economic growth and increased capacity for commercialization. The third and final hypothesis was incorrect in its expectation that commercialization capacity and innovation outcomes would have a positive effect on economic growth. Patents (innovation outcomes) did indeed demonstrate the expected results, and in the expected direction and magnitude. The Commercialization Capacity construct was statistically significant in explaining Gross State Product, but in a negative direction. While still theoretically important in the overall economic development process, there is reason to believe that the measure, as operationalized, fails to capture all of the relevant aspects of commercialization capacity in the states. This finding suggests the need for additional research to examine this topic and its role in the economic cycle. In either event, it remains logical to retain commercialization capital as a distinct element, and not combine it with the elements of innovation capacity. The results of this analysis have revealed these relationships more clearly, and lend greater understanding to the forces at play in the process of economic development in the states.

As Chapter Six has presented an analysis of the impacts of innovation capacity on actual innovations in the states, and of innovation outcomes on both commercialization capacity and economic growth, Chapter Seven will draw these findings into a discussion of the implications for state economic development efforts, and the relative roles of the different levels of government in impacting the economic development process. The research project will conclude with a discussion of practical findings as they relate to the policy process and improving government effectiveness and efficiency in pursuing economic development goals.

Chapter 7 — Summary, Discussion, and Conclusion

This body of research has examined two conceptual issues—innovation capacity, and innovation outcomes—and more specifically, their relationship to each other. A great deal of effort and thought was invested in defining the measures of innovation capacity, and in differentiating among different types of results. Rather than combining the constructs into one general index as has been done in the past, this work has been dedicated to keeping distinct those components that measure aspects that theory construes as outcomes. In a typical evaluative model, a researcher might distinguish between outputs and outcomes, with outputs being the products generated, and with outcomes representing a change in the conditions in the environment as a result. From that perspective, the innovation capacity inputs in the model developed here should lead to outputs in the form of patents issued to state residents. The actual innovation in this case is the idea for a new product, a new process, or a new use for a product, resulting from the environment in which the idea was conceived. Patents represent a measurable outcome that would be expected of persons who wish to have their ideas documented, whether for profit or pride.

If patents are the outputs, the outcome should be increased economic performance over time, as innovations are commercialized and businesses create new jobs and increase profits through sales. In fact, in the present model, both the outputs and the outcomes represent qualitative changes. Patents represent a qualitative change to the economic environment, and introduce new bundles of products that define the economic production function of the local or state economy. In the global perspective, this also means additional products will be available to consumers locally and perhaps globally, which may increase their personal utility and enhance their quality of life. The economic growth that results represents a qualitative change as the overall quality of life improves in a community or state. Sales increase, wages and salaries increase, and individuals are faced with additional discretionary income that enables them to consume those things that increase their utility.

These measures are not perfect; however. Patents are applied for very often by corporations as well as individuals; after all, investments in research and development can only be recouped if firms can protect the results of those efforts through patenting. There are two general problems with the use of patents as a measure. First, firms may apply for patents on variations of existing designs to restrict competition rather than to protect the true innovation. Such patenting is not beneficial in that it may limit efficiency by restricting new product introduction. A second more profound problem with the use of patents as the measure of innovation comes from the nature of products that are patented. That is, designs for products and processes are patented, but there are many aspects of economic productivity in today's economy that are not. Consider computer software—frequent innovations occur which make workers more productive and have genuine economic benefits. However, software is not patented, but copyrighted. In addition, service industry is not accounted for in this model, as there is not a universally accepted measure of services that can be utilized. In the history of economic development, economies transition from extraction to manufacturing, and then transition to service industries.

Considering the literature presented in Chapter Two, there is substantial evidence that constituents support economic development, and economic development policy is politically popular (Wolman & Spitzley, 1996). Given the political popularity of these policies, elected officials feel that they need to pursue policies that will have realizable results during their term of office. As a result, they tend to pursue recruitment and other policies, such as infrastructure improvements that are highly visible and have immediate results. The empirical models in this research confirm that that the effects of innovation capacity are realized over time, and more slowly than might be acceptable in the timeframe of a term of political office.

It is incredibly important to point out that the innovative capacity also has demonstrated benefits during the first four years after its creation. However, even though innovation capacity has effects up to, and likely beyond, five years from its creation, new economy development strategies are still not likely to be the type of policies local elected officials prefer to pursue for two reasons. First, as pointed out earlier, investment in the new economy means investment in people, who are mobile. Second, investment in the types of resources that lead to innovation is not transparent. Traditional investment strategies yield definite, tangible results, such as buildings. Many research and development efforts do not succeed, and the results are intangible to the governments that might make such investments; such is the nature of goods and knowledge in today's economy.

An additional consideration to revisit concerns the respective roles of different levels of government in the U.S. federal system. Based on Peterson's functional theory of government, economic development policy is best reserved for state and local governments, with the federal government providing financial support through its broader tax base. Indeed, federal grant programs are largely responsible for much of the innovation capacity in the states. The variables included in the analysis in Chapter Five range from Federal Obligations for Research and Development to Federal Obligations for Fellowships and Traineeships. The federal government makes available large sums of money for states to pursue development of innovative capacity. Indeed, the federal government makes such money available, but it falls to the states to pursue the funds and undertake the types of activities that lead to their acquisition.

Moreover, the distinction between the two types of financial capacity (Federal Financial Capacity for Innovation and State/Local Capacity for Innovation) discovered in Chapter Five indicates that there is a role for state and local governments in financing economic development activities out of their own-source revenues. The trend associated with each type of financial capacity is different, with effect of State/Local Financial Capacity gradually decreasing in impact over five years, and the effect of federal financial capacity gradually increasing over five years. States that are effective at building economic development programs that strive to create innovation and economic growth from within will be most effective if they are able to assess their own existing resources, and then assemble a package of support that includes leveraging federal financial support while also using their own funds to support innovative activities. In part, this includes supporting the development of human resources that are necessary for innovation to occur—graduate students, Ph.D.s, and skills training to prepare people for high-tech jobs, for example.

The findings in this work lend credit to the fact that the federal government plays a large role in financing economic development efforts through research and development and other efforts. State governments have come to rely on own-source revenues to supplement or to be used in lieu of federal funds as well. States and local governments continue to play a primary role in implementing economic development policy. It may be possible in future research to develop a model that examines the level of interaction among local, state, and federal governments in funding and implementing economic development efforts in particular states or localities. Such a model would better represent the presence of federal research laboratories, such as that at Oak Ridge, Tennessee, or space program activities, such as those at Huntsville, Alabama or Cape Canaveral, Florida—efforts which surely play a significant role in the local economy from both employment and income perspectives, but also in terms of innovation.

States differ tremendously in the quantity and quality of resources they have available to support economic development activity. The literature on cluster development suggests that innovative activities take place when the necessary resources are present, but they take place more efficiently, and with greater effect when the geographic concentration of such resources is high, and externalities are shared among firms and innovators. Some states possess few resources, and to make matters worse, their resources are scattered across broad geographic areas. Many states that are largely rural, or that have traditionally depended on natural resource extraction, may find that their resource levels are too low to incite meaningful economic development through innovation. These places may continue to benefit from recruitment activities, or from focus on amenities-based development such as tourism. Mining and timber harvesting that may be the backbone of such rural economies present a serious challenge to amenities-based development. There may be as much value to the existence of a resource as to its extraction, and these two economic interests are likely to present challenges one to another as states attempt to create effective and broadly palatable economic development strategies.

Whatever the place, and whatever the resources, states and localities will undoubtedly find their resources to be scarcer than desirable, and they will face tradeoffs among many options. Undertaking a resource analysis will provide states with the knowledge necessary to target their resources to the best possible use. The results of this research project provide important understanding of the components of innovation capacity and also the relationship of innovation capacity to innovation outcomes. However, this study is an initial work, and the results raise more interesting questions than they answer. A great deal of work remains to be done in understanding the processes behind economic development such that states, localities, and the federal government can design economic development policies and undertake strategies that best reflect their existing resources, their goals and priorities, and the wise use of the public funds they have at their discretion.

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Appendix A

State Factor Scores

State Indices

The results of the two factor analytic procedures in Chapter 5 were used to compute factor scores for each state by year for each of the four resultant common factors (three innovation capacity + one commercialization capacity). These scores provide a glimpse into the longitudinal trends in innovative capacity (federal financial, human, and state/local financial) in the states from 1980 to 1999 and in commercialization capacity from 1983 to 2002. The following pages present graphical representation of the trends in each state over time, beginning with the innovation capacity scores, and continuing with the commercialization capacity scores.

State Innovation Capacity:

State Human Capacity for Innovation by Year: 1980-1989

1980		1981		1982		1983		1984		1985		1986		1987		1988		1989	
Rank	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
CALIFORN	3.99952	CALIFORN	4.16502	CALIFORN	4.01632	CALIFORN	4.14663	CALIFORN	3.79808	CALIFORN	3.87662	CALIFORN	3.93449	CALIFORN	4.06051	CALIFORN	4.41386	CALIFORN	4.56378
NEW YORK	2.4292	NEW YORK	2.52202	NEW YORK	2.55453	NEW YORK	2.54511	NEW YORK	2.437	NEW YORK	2.43177	NEW YORK	2.54797	NEW YORK	2.59562	NEW YORK	2.76809	NEW YORK	2.76861
TEXAS	1.07902	TEXAS	1.14351	TEXAS	1.25279	TEXAS	1.41653	TEXAS	1.38821	TEXAS	1.37121	TEXAS	1.45586	TEXAS	1.46535	TEXAS	1.5201	TEXAS	1.68174
ILLINOIS	1.03839	ILLINOIS	1.02957	ILLINOIS	1.02672	ILLINOIS	1.10093	ILLINOIS	1.06538	ILLINOIS	1.11792	ILLINOIS	1.21444	ILLINOIS	1.28519	ILLINOIS	1.43266	ILLINOIS	1.49985
MASSACHU	0.8471	MASSACHU	0.88643	OHIO	0.86129	OHIO	0.92382	MASSACHU	0.82302	OHIO	0.85971	MASSACHU	0.94995	OHIO	0.96521	OHIO	1.05649	OHIO	1.10276
OHIO	0.81213	OHIO	0.83703	MASSACHU	0.85641	MASSACHU	0.85389	PENNSYLV	0.77229	MASSACHU	0.85747	OHIO	0.8541	MASSACHU	0.89397	MASSACHU	1.01	PENNSYLV	1.0349
PENNSYLV	0.69307	PENNSYLV	0.75589	PENNSYLV	0.81182	PENNSYLV	0.82424	OHIO	0.77225	PENNSYLV	0.77691	PENNSYLV	0.77871	PENNSYLV	0.79288	PENNSYLV	0.88896	MASSACHU	0.98112
MICHIGAN	0.60559	MICHIGAN	0.55534	MICHIGAN	0.54839	MICHIGAN	0.60247	MICHIGAN	0.56768	MICHIGAN	0.56964	MICHIGAN	0.62596	MICHIGAN	0.63571	MICHIGAN	0.64885	MICHIGAN	0.70108
FLORIDA	0.05063	FLORIDA	0.1148	FLORIDA	0.13232	FLORIDA	0.12335	FLORIDA	0.13037	FLORIDA	0.15951	FLORIDA	0.16045	FLORIDA	0.14954	FLORIDA	0.23921	FLORIDA	0.26556
NORTH CA	0.04093	WISCONSI	0.04638	WISCONSI	0.06995	NORTH CA	0.09025	INDIANA	0.06416	VIRGINIA	0.0659	VIRGINIA	0.10002	VIRGINIA	0.14652	VIRGINIA	0.20023	VIRGINIA	0.2306
INDIANA	0.02832	INDIANA	0.04109	NORTH CA	0.05954	INDIANA	0.06912	NORTH CA	0.06	INDIANA	0.04951	INDIANA	0.06696	NEW JERS	0.09265	INDIANA	0.13849	INDIANA	0.18901
WISCONSI	0.02589	NORTH CA	0.01929	INDIANA	0.04871	WISCONSI	0.04491	VIRGINIA	0.00924	NORTH CA	0.02208	NORTH CA	0.05597	INDIANA	0.08857	NEW JERS	0.12441	NEW JERS	0.16591
VIRGINIA	-0.08995	VIRGINIA	-0.0426	VIRGINIA	-0.04609	VIRGINIA	-0.01762	WISCONSI	-0.00295	NEW JERS	-0.00802	NEW JERS	0.04408	NORTH CA	0.03413	NORTH CA	0.11846	NORTH CA	0.15268
MINNESOT	-0.13471	NEW JERS	-0.08247	NEW JERS	-0.09081	NEW JERS	-0.07383	NEW JERS	-0.0334	WISCONSI	-0.01416	WISCONSI	-0.0378	WISCONSI	-0.0235	WISCONSI	0.06425	WISCONSI	0.0647
NEW JERS	-0.14023	MINNESOT	-0.10424	MINNESOT	-0.11952	MINNESOT	-0.0934	MINNESOT	-0.08799	MINNESOT	-0.10279	COLORADO	-0.06289	COLORADO	-0.06992	ARIZONA	-0.03798	ARIZONA	-0.02827
WASHINGT	-0.14185	GEORGIA	-0.11347	GEORGIA	-0.12359	COLORADO	-0.10014	GEORGIA	-0.13532	COLORADO	-0.12078	ARIZONA	-0.09028	ARIZONA	-0.10207	MINNESOT	-0.08566	GEORGIA	-0.06741
GEORGIA	-0.15601	COLORADO	-0.12236	COLORADO	-0.13516	GEORGIA	-0.1391	COLORADO	-0.14281	ARIZONA	-0.14443	MINNESOT	-0.10581	MISSOURI	-0.13892	GEORGIA	-0.10292	MINNESOT	-0.0914
COLORADO	-0.16818	WASHINGT	-0.1628	MISSOURI	-0.19804	MISSOURI	-0.17775	ARIZONA	-0.15742	GEORGIA	-0.17135	MISSOURI	-0.15073	GEORGIA	-0.15572	COLORADO	-0.10692	MISSOURI	-0.11486
MISSOURI	-0.16967	MISSOURI	-0.19378	WASHINGT	-0.20897	ARIZONA	-0.19835	MISSOURI	-0.19878	MISSOURI	-0.19372	GEORGIA	-0.15101	MINNESOT	-0.1615	MISSOURI	-0.10902	COLORADO	-0.12996
CONNECTI	-0.21854	CONNECTI	-0.22163	CONNECTI	-0.23105	KANSAS	-0.20067	OKLAHOMA	-0.22464	IOWA	-0.22587	IOWA	-0.19933	WASHINGT	-0.22689	WASHINGT	-0.16601	WASHINGT	-0.16907
IOWA	-0.27989	KANSAS	-0.26771	KANSAS	-0.2416	WASHINGT	-0.20302	LOUISIAN	-0.25498	WASHINGT	-0.23358	WASHINGT	-0.2129	IOWA	-0.22709	IOWA	-0.18687	CONNECTI	-0.1996
KANSAS	-0.29378	IOWA	-0.2742	IOWA	-0.24189	OKLAHOMA	-0.21011	IOWA	-0.27003	LOUISIAN	-0.2484	CONNECTI	-0.21373	CONNECTI	-0.2404	CONNECTI	-0.19441	IOWA	-0.21535
TENNESSE	-0.29437	OKLAHOMA	-0.29309	ARIZONA	-0.26689	CONNECTI	-0.23601	CONNECTI	-0.27479	CONNECTI	-0.25398	LOUISIAN	-0.24732	LOUISIAN	-0.24539	LOUISIAN	-0.25153	LOUISIAN	-0.27992
ARIZONA	-0.31403	TENNESSE	-0.30818	OKLAHOMA	-0.28585	IOWA	-0.2371	KANSAS	-0.27641	OKLAHOMA	-0.28818	OKLAHOMA	-0.26572	OKLAHOMA	-0.27639	OKLAHOMA	-0.30139	KANSAS	-0.2899
OKLAHOMA	-0.32496	ARIZONA	-0.33382	LOUISIAN	-0.31638	LOUISIAN	-0.2798	WASHINGT	-0.27679	TENNESSE	-0.33512	TENNESSE	-0.33778	KANSAS	-0.35573	KANSAS	-0.31617	OKLAHOMA	-0.317
LOUISIAN	-0.37884	LOUISIAN	-0.34885	TENNESSE	-0.31885	TENNESSE	-0.33292	TENNESSE	-0.32701	KANSAS	-0.33648	KANSAS	-0.34186	TENNESSE	-0.35821	TENNESSE	-0.35033	TENNESSE	-0.31746
OREGON	-0.45442	NEBRASKA	-0.43359	NEBRASKA	-0.43863	NEBRASKA	-0.42351	SOUTH CA	-0.45904	SOUTH CA	-0.45965	SOUTH CA	-0.42036	SOUTH CA	-0.44269	KENTUCKY	-0.42248	ALABAMA	-0.39181
ALABAMA	-0.47045	OREGON	-0.44487	OREGON	-0.46264	OREGON	-0.44767	KENTUCKY	-0.48125	ALABAMA	-0.46072	ALABAMA	-0.45072	ALABAMA	-0.48676	SOUTH CA	-0.43861	SOUTH CA	-0.39655
NEBRASKA	-0.47993	KENTUCKY	-0.4827	KENTUCKY	-0.49094	MISSISSI	-0.4559	ALABAMA	-0.4908	OREGON	-0.47882	OREGON	-0.48737	KENTUCKY	-0.49055	ALABAMA	-0.44405	KENTUCKY	-0.41429
KENTUCKY	-0.49698	ALABAMA	-0.49984	ALABAMA	-0.49615	KENTUCKY	-0.46072	OREGON	-0.49514	KENTUCKY	-0.49002	KENTUCKY	-0.49892	OREGON	-0.56882	OREGON	-0.51647	MISSISSI	-0.54623
SOUTH CA	-0.53043	SOUTH CA	-0.52128	SOUTH CA	-0.50806	SOUTH CA	-0.46626	MISSISSI	-0.50924	MISSISSI	-0.53292	MISSISSI	-0.50614	MISSISSI	-0.57816	MISSISSI	-0.55292	OREGON	-0.55228
UTAH	-0.54129	MISSISSI	-0.55514	UTAH	-0.52405	ALABAMA	-0.47826	UTAH	-0.51623	UTAH	-0.56056	NEBRASKA	-0.56013	MONTANA	-0.58875	UTAH	-0.56426	ALASKA	-0.55926
MISSISSI	-0.56839	UTAH	-0.5589	MISSISSI	-0.53576	UTAH	-0.51316	NEBRASKA	-0.53909	NEBRASKA	-0.56924	MONTANA	-0.57416	WEST VIR	-0.61462	NEBRASKA	-0.56515	MONTANA	-0.57506
ARKANSAS	-0.58821	WEST VIR	-0.60853	ARKANSAS	-0.5902	MONTANA	-0.55423	MONTANA	-0.56316	MONTANA	-0.57451	UTAH	-0.57445	NEBRASKA	-0.61893	MONTANA	-0.58858	NEBRASKA	-0.58436
WEST VIR	-0.60831	ARKANSAS	-0.61346	MONTANA	-0.60184	WEST VIR	-0.57292	WEST VIR	-0.5838	WEST VIR	-0.58388	WEST VIR	-0.58043	UTAH	-0.62354	MAINE	-0.58945	MAINE	-0.60981
MAINE	-0.64489	IDAHO	-0.63785	WEST VIR	-0.60343	ARKANSAS	-0.60759	SOUTH DA	-0.62999	MAINE	-0.64394	IDAHO	-0.62762	SOUTH DA	-0.63015	WEST VIR	-0.63566	ARKANSAS	-0.62868
IDAHO	-0.64908	SOUTH DA	-0.65202	WYOMING	-0.63648	ALASKA	-0.6127	ARKANSAS	-0.63254	ARKANSAS	-0.65028	MAINE	-0.62773	MAINE	-0.63023	IDAHO	-0.63967	WEST VIR	-0.63348
SOUTH DA	-0.64965	MONTANA	-0.65351	SOUTH DA	-0.63733	SOUTH DA	-0.63397	MAINE	-0.63748	ALASKA	-0.65068	ARKANSAS	-0.63498	IDAHO	-0.63832	ARKANSAS	-0.64732	UTAH	-0.64002
MONTANA	-0.6648	MAINE	-0.65835	MAINE	-0.63889	MARYLAND	-0.63485	NEW HAMP	-0.6815	DELAWARE	-0.6529	WYOMING	-0.66059	ARKANSAS	-0.6629	DELAWARE	-0.65635	IDAHO	-0.65177
NEVADA	-0.68289	WYOMING	-0.66787	NEVADA	-0.65711	MAINE	-0.63916	ALASKA	-0.68625	SOUTH DA	-0.65657	DELAWARE	-0.66204	WYOMING	-0.66442	SOUTH DA	-0.6713	NEVADA	-0.65978
NEW HAMP	-0.69865	HAWAII	-0.67679	IDAHO	-0.66986	WYOMING	-0.65925	NEVADA	-0.68639	NEVADA	-0.68005	ALASKA	-0.6648	DELAWARE	-0.66804	NEVADA	-0.68321	SOUTH DA	-0.66189
MARYLAND	-0.70444	NEVADA	-0.69687	HAWAII	-0.68339	NEVADA	-0.66213	DELAWARE	-0.68898	IDAHO	-0.68494	SOUTH DA	-0.66654	NORTH DA	-0.69018	WYOMING	-0.69011	DELAWARE	-0.6648
WYOMING	-0.71061	NEW HAMP	-0.69777	NEW HAMP	-0.68384	IDAHO	-0.67422	HAWAII	-0.72934	NEW HAMP	-0.69874	HAWAII	-0.67684	ALASKA	-0.69619	HAWAII	-0.70545	WYOMING	-0.69199
DELAWARE	-0.73314	DELAWARE	-0.73692	MARYLAND	-0.6919	NEW HAMP	-0.6779	IDAHO	-0.73184	HAWAII	-0.7132	NEVADA	-0.68494	NEVADA	-0.69751	NEW HAMP	-0.70687	NEW HAMP	-0.69811
HAWAII	-0.74542	NORTH DA	-0.76487	DELAWARE	-0.69247	HAWAII	-0.70058	WYOMING	-0.73287	WYOMING	-0.74486	NEW HAMP	-0.70768	HAWAII	-0.71463	ALASKA	-0.7078	RHODE IS	-0.70545
NORTH DA	-0.75708	MARYLAND	-0.78981	NORTH DA	-0.73168	DELAWARE	-0.70516	NORTH DA	-0.76414	NORTH DA	-0.74743	NORTH DA	-0.72611	NEW HAMP	-0.71851	NEW MEXI	-0.70907	NEW MEXI	-0.74286
VERMONT	-0.76662	RHODE IS	-0.79581	ALASKA	-0.76305	NORTH DA	-0.73595	RHODE IS	-0.77632	RHODE IS	-0.77372	RHODE IS	-0.79173	NEW MEXI	-0.75244	NORTH DA	-0.77489	NORTH DA	-0.78576
RHODE IS	-0.78661	VERMONT	-0.80806	RHODE IS	-0.78078	RHODE IS	-0.77472	MARYLAND	-0.78644	NEW MEXI	-0.78951	MARYLAND	-0.79381	RHODE IS	-0.75467	RHODE IS	-0.77954	HAWAII	-0.78736
NEW MEXI	-0.7945	NEW MEXI	-0.80883	VERMONT	-0.7975	VERMONT	-0.77737	NEW MEXI	-0.80533	MARYLAND	-0.79942	NEW MEXI	-0.85657	MARYLAND	-0.86597	MARYLAND	-0.8324	MARYLAND	-0.83315
ALASKA	-1.08685	ALASKA	-0.88291	NEW MEXI	-0.85748	NEW MEXI	-0.7895	VERMONT	-0.8187	VERMONT	-0.82068	VERMONT	-0.85693	VERMONT	-0.9324	VERMONT	-0.96922	VERMONT	-0.88483

State Human Capacity for Innovation by Year: 1990-1999

	1990		1991		1992		1993		1994
Rank	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
CALIFORN	4.75444	CALIFORN	4.85152	CALIFORN	5.06776	CALIFORN	5.32716	CALIFORN	5.37833
NEW YORK	2.91459	NEW YORK	3.06073	NEW YORK	3.23615	NEW YORK	3.27885	NEW YORK	3.18035
TEXAS	1.76938	TEXAS	1.9228	TEXAS	2.08073	TEXAS	2.15742	TEXAS	2.13583
ILLINOIS	1.58452	ILLINOIS	1.69547	ILLINOIS	1.7047	ILLINOIS	1.67636	ILLINOIS	1.69004
OHIO	1.1459	OHIO	1.3148	OHIO	1.38894	OHIO	1.40838	MASSACHU	1.51758
MASSACHU	1.13784	MASSACHU	1.27121	MASSACHU	1.34292	MASSACHU	1.40037	OHIO	1.48767
PENNSYLV	1.06626	PENNSYLV	1.19236	PENNSYLV	1.22242	PENNSYLV	1.23917	PENNSYLV	1.27232
MICHIGAN	0.76732	MICHIGAN	0.83509	MICHIGAN	0.91961	MICHIGAN	0.9144	MICHIGAN	0.92358
FLORIDA	0.31086	FLORIDA	0.35376	FLORIDA	0.43644	FLORIDA	0.53149	FLORIDA	0.7096
VIRGINIA	0.2688	INDIANA	0.29629	INDIANA	0.34082	VIRGINIA	0.39289	VIRGINIA	0.39441
INDIANA	0.25321	VIRGINIA	0.27815	VIRGINIA	0.30988	GEORGIA	0.35521	GEORGIA	0.39044
NORTH CA	0.19257	NORTH CA	0.23347	NORTH CA	0.29656	INDIANA	0.32109	INDIANA	0.34529
NEW JERS	0.16015	NEW JERS	0.18566	GEORGIA	0.24553	NORTH CA	0.28937	NORTH CA	0.29835
WISCONSI	0.13021	WISCONSI	0.18022	NEW JERS	0.22597	NEW JERS	0.20855	WISCONSI	0.22685
GEORGIA	0.04087	GEORGIA	0.13185	WISCONSI	0.1791	WISCONSI	0.17152	NEW JERS	0.16795
ARIZONA	-0.01223	ARIZONA	0.05611	ARIZONA	0.04257	ARIZONA	0.10629	MINNESOT	0.04038
MINNESOT	-0.01461	MINNESOT	0.01627	COLORADO	0.02281	COLORADO	0.09944	ARIZONA	0.03474
COLORADO	-0.03193	COLORADO	-0.00348	MINNESOT	-0.00254	MINNESOT	0.07313	MISSOURI	0.01755
MISSOURI	-0.09206	WASHINGT	-0.06745	MISSOURI	-0.01998	MISSOURI	-0.02008	COLORADO	0.01674
CONNECTI	-0.09944	MISSOURI	-0.07531	CONNECTI	-0.08786	WASHINGT	-0.08313	WASHINGT	-0.05279
WASHINGT	-0.13047	CONNECTI	-0.11382	WASHINGT	-0.10296	LOUISIAN	-0.08409	CONNECTI	-0.07517
IOWA	-0.19018	IOWA	-0.15124	LOUISIAN	-0.13163	IOWA	-0.10408	LOUISIAN	-0.08142
LOUISIAN	-0.20578	LOUISIAN	-0.18589	IOWA	-0.14899	CONNECTI	-0.11099	TENNESSE	-0.11762
OKLAHOMA	-0.22603	OKLAHOMA	-0.22122	KANSAS	-0.20711	TENNESSE	-0.17791	IOWA	-0.13425
KANSAS	-0.26865	KANSAS	-0.24661	OKLAHOMA	-0.21846	KANSAS	-0.21047	KANSAS	-0.13503
TENNESSE	-0.30845	TENNESSE	-0.27989	TENNESSE	-0.22716	OKLAHOMA	-0.21831	OKLAHOMA	-0.22557
SOUTH CA	-0.36404	ALABAMA	-0.30979	SOUTH CA	-0.29827	OREGON	-0.28289	OREGON	-0.22889
ALABAMA	-0.37627	SOUTH CA	-0.3265	ALABAMA	-0.31003	ALABAMA	-0.30406	ALABAMA	-0.27532
KENTUCKY	-0.43222	KENTUCKY	-0.3903	KENTUCKY	-0.36572	SOUTH CA	-0.32494	KENTUCKY	-0.31397
OREGON	-0.4542	OREGON	-0.39414	OREGON	-0.38024	KENTUCKY	-0.32893	SOUTH CA	-0.32425
NEBRASKA	-0.52801	MISSISSI	-0.50546	NEBRASKA	-0.48586	MISSISSI	-0.47868	NEBRASKA	-0.43844
MISSISSI	-0.53362	NEBRASKA	-0.51858	MISSISSI	-0.49845	NEBRASKA	-0.4813	UTAH	-0.45229
MONTANA	-0.59068	MAINE	-0.5779	RHODE IS	-0.55036	ARKANSAS	-0.51024	MISSISSI	-0.46181
ARKANSAS	-0.59295	MONTANA	-0.57862	MAINE	-0.56446	MARYLAND	-0.54477	RHODE IS	-0.48244
MAINE	-0.5966	WEST VIR	-0.59432	WEST VIR	-0.57591	UTAH	-0.54611	IDAHO	-0.52824
IDAHO	-0.60722	NORTH DA	-0.59567	ARKANSAS	-0.57779	MONTANA	-0.56041	NEW MEXI	-0.52903
WEST VIR	-0.64287	ARKANSAS	-0.60649	MARYLAND	-0.58484	MAINE	-0.56351	ARKANSAS	-0.53972
SOUTH DA	-0.64878	NEVADA	-0.60834	NEVADA	-0.58521	RHODE IS	-0.56722	MAINE	-0.55201
DELAWARE	-0.65114	SOUTH DA	-0.62107	IDAHO	-0.59129	IDAHO	-0.57509	MONTANA	-0.5707
UTAH	-0.6544	RHODE IS	-0.62625	UTAH	-0.59749	NEVADA	-0.58735	NORTH DA	-0.57071
RHODE IS	-0.67196	DELAWARE	-0.63004	MONTANA	-0.60865	SOUTH DA	-0.59987	WEST VIR	-0.58736
NEW MEXI	-0.68842	IDAHO	-0.6341	NORTH DA	-0.61257	NORTH DA	-0.6087	MARYLAND	-0.60692
WYOMING	-0.68976	WYOMING	-0.66041	SOUTH DA	-0.61935	NEW MEXI	-0.61459	SOUTH DA	-0.61501
HAWAII	-0.69712	MARYLAND	-0.66937	WYOMING	-0.65981	DELAWARE	-0.62887	NEVADA	-0.62496
NEW HAMP	-0.69926	UTAH	-0.67595	DELAWARE	-0.66119	HAWAII	-0.65372	WYOMING	-0.63005
NEVADA	-0.70633	NEW MEXI	-0.67749	NEW MEXI	-0.67682	WEST VIR	-0.6723	HAWAII	-0.63117
MARYLAND	-0.71368	ALASKA	-0.69496	HAWAII	-0.7027	WYOMING	-0.69964	DELAWARE	-0.65581
ALASKA	-0.74624	NEW HAMP	-0.69655	ALASKA	-0.70962	NEW HAMP	-0.72175	NEW HAMP	-0.69433
VERMONT	-0.83283	HAWAII	-0.70716	NEW HAMP	-0.74474	VERMONT	-0.85501	VERMONT	-0.75357
NORTH DA	-0.8793	VERMONT	-0.87876	VERMONT	-0.82079	ALASKA	-0.97684	ALASKA	-0.76516

	1995		1996		1997		1998		1999
Rank	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
CALIFORN	5.33582	CALIFORN	5.2423	CALIFORN	5.37833	CALIFORN	5.42272	CALIFORN	5.57271
NEW YORK	3.04754	NEW YORK	3.1119	NEW YORK	3.10556	NEW YORK	3.15061	NEW YORK	3.10189
TEXAS	2.09846	TEXAS	2.00832	TEXAS	1.98952	TEXAS	1.97627	TEXAS	2.05791
ILLINOIS	1.69483	ILLINOIS	1.6654	ILLINOIS	1.59558	ILLINOIS	1.64699	ILLINOIS	1.64132
MASSACHU	1.51659	MASSACHU	1.59096	MASSACHU	1.54069	MASSACHU	1.53808	MASSACHU	1.46586
OHIO	1.44067	OHIO	1.4151	OHIO	1.33051	PENNSYLV	1.28931	OHIO	1.26006
PENNSYLV	1.2909	PENNSYLV	1.28208	PENNSYLV	1.30417	OHIO	1.2619	PENNSYLV	1.24885
MICHIGAN	0.88834	MICHIGAN	0.92202	MICHIGAN	0.90263	MICHIGAN	0.91143	MICHIGAN	0.91344
FLORIDA	0.69808	FLORIDA	0.76466	FLORIDA	0.76642	FLORIDA	0.79503	FLORIDA	0.89548
VIRGINIA	0.42977	VIRGINIA	0.40214	VIRGINIA	0.4521	VIRGINIA	0.45484	VIRGINIA	0.49647
GEORGIA	0.36693	NORTH CA	0.35748	NORTH CA	0.39822	NORTH CA	0.37349	NORTH CA	0.39842
INDIANA	0.35217	INDIANA	0.35463	GEORGIA	0.35889	GEORGIA	0.36063	INDIANA	0.34748
NORTH CA	0.29522	GEORGIA	0.32322	INDIANA	0.30724	INDIANA	0.3275	GEORGIA	0.34532
WISCONSI	0.18664	NEW JERS	0.22949	NEW JERS	0.22521	NEW JERS	0.23741	NEW JERS	0.27596
NEW JERS	0.17673	WISCONSI	0.19057	WISCONSI	0.16212	WISCONSI	0.16159	WISCONSI	0.16857
COLORADO	0.07605	ARIZONA	0.04566	ARIZONA	0.0567	MINNESOT	0.11205	MINNESOT	0.1525
MINNESOT	0.00515	MINNESOT	0.04006	MINNESOT	0.03004	ARIZONA	0.07771	ARIZONA	0.06628
ARIZONA	0.001	MISSOURI	0.02158	MISSOURI	0.01171	MISSOURI	-0.01784	MISSOURI	-0.01559
MISSOURI	-0.00467	COLORADO	0.01483	KANSAS	-0.00435	KANSAS	-0.02868	COLORADO	-0.03743
CONNECTI	-0.03314	KANSAS	-0.05344	COLORADO	-0.04114	COLORADO	-0.04306	TENNESSE	-0.08261
LOUISIAN	-0.04729	LOUISIAN	-0.05379	TENNESSE	-0.06761	TENNESSE	-0.08481	KANSAS	-0.10292
WASHINGT	-0.05188	CONNECTI	-0.06066	LOUISIAN	-0.09503	LOUISIAN	-0.08868	WASHINGT	-0.10705
TENNESSE	-0.11729	WASHINGT	-0.08822	WASHINGT	-0.10438	WASHINGT	-0.09994	LOUISIAN	-0.13816
KANSAS	-0.12344	TENNESSE	-0.09655	CONNECTI	-0.11936	CONNECTI	-0.1091	CONNECTI	-0.1537
IOWA	-0.13146	IOWA	-0.14906	IOWA	-0.1955	IOWA	-0.1923	KENTUCKY	-0.21486
OKLAHOMA	-0.18795	OKLAHOMA	-0.22868	ALABAMA	-0.22515	KENTUCKY	-0.20855	IOWA	-0.2432
KENTUCKY	-0.27329	ALABAMA	-0.2497	OKLAHOMA	-0.28838	ALABAMA	-0.26947	ALABAMA	-0.26038
ALABAMA	-0.27455	KENTUCKY	-0.29329	KENTUCKY	-0.29948	SOUTH CA	-0.29456	OKLAHOMA	-0.27039
OREGON	-0.31505	OREGON	-0.34023	UTAH	-0.32223	OKLAHOMA	-0.31342	SOUTH CA	-0.27293
SOUTH CA	-0.37884	UTAH	-0.34081	SOUTH CA	-0.33682	UTAH	-0.36647	NEBRASKA	-0.27801
UTAH	-0.41033	SOUTH CA	-0.37815	MARYLAND	-0.39018	OREGON	-0.40092	OREGON	-0.38029
NEBRASKA	-0.42773	NEBRASKA	-0.41807	OREGON	-0.39735	MARYLAND	-0.41428	MARYLAND	-0.39287
MISSISSI	-0.45609	MARYLAND	-0.48156	NEBRASKA	-0.45173	NEBRASKA	-0.42088	UTAH	-0.39671
WEST VIR	-0.52344	WYOMING	-0.52096	MISSISSI	-0.4655	NORTH DA	-0.45308	WEST VIR	-0.45991
ARKANSAS	-0.52648	WEST VIR	-0.52851	WYOMING	-0.47528	MISSISSI	-0.45719	WYOMING	-0.51753
IDAHO	-0.54402	MISSISSI	-0.52886	NORTH DA	-0.48179	WEST VIR	-0.46321	RHODE IS	-0.53276
MAINE	-0.55139	ARKANSAS	-0.52958	NEW MEXI	-0.53148	RHODE IS	-0.46379	MAINE	-0.53504
MONTANA	-0.57717	MONTANA	-0.55169	WEST VIR	-0.53213	ARKANSAS	-0.50203	MISSISSI	-0.53597
WYOMING	-0.58233	IDAHO	-0.55641	ARKANSAS	-0.53852	IDAHO	-0.54521	SOUTH DA	-0.53793
NEVADA	-0.58968	MAINE	-0.57284	NEVADA	-0.5425	WYOMING	-0.55235	NORTH DA	-0.54304
NEW MEXI	-0.59293	NEVADA	-0.58243	IDAHO	-0.5633	NEVADA	-0.55343	ARKANSAS	-0.56309
NORTH DA	-0.60453	SOUTH DA	-0.58951	MAINE	-0.59105	MAINE	-0.56823	IDAHO	-0.56536
RHODE IS	-0.60973	DELAWARE	-0.59388	SOUTH DA	-0.59867	SOUTH DA	-0.57015	MONTANA	-0.59986
SOUTH DA	-0.61752	NORTH DA	-0.59883	MONTANA	-0.60609	MONTANA	-0.5883	NEW MEXI	-0.61223
HAWAII	-0.63798	NEW MEXI	-0.60223	RHODE IS	-0.62706	NEW MEXI	-0.59559	NEVADA	-0.62264
MARYLAND	-0.63946	RHODE IS	-0.62767	DELAWARE	-0.63973	DELAWARE	-0.61985	DELAWARE	-0.66807
VERMONT	-0.68274	ALASKA	-0.69695	NEW HAMP	-0.66803	NEW HAMP	-0.65103	NEW HAMP	-0.70995
DELAWARE	-0.69233	NEW HAMP	-0.71024	ALASKA	-0.68203	VERMONT	-0.68916	VERMONT	-0.72023
NEW HAMP	-0.70542	VERMONT	-0.72919	VERMONT	-0.7259	HAWAII	-0.76236	ALASKA	-0.75438
ALASKA	-0.73597	HAWAII	-0.74229	HAWAII	-0.7823	ALASKA	-0.76681	HAWAII	-0.8302

State Federal Financial Capacity for Innovation by Year: 1980-1989

	1980		1981		1982		1983		1984		1985		1986		1987		1988		1989
Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
MARYLAND	3.13063	MARYLAND	4.11089	MARYLAND	3.3637	MARYLAND	3.29019	MARYLAND	3.23107	MARYLAND	3.47687	MARYLAND	3.75991	MARYLAND	4.16925	MARYLAND	4.41667	MARYLAND	4.38567
MASSACHU	2.22257	MASSACHU	2.20773	MASSACHU	2.18825	MASSACHU	2.4871	MASSACHU	2.61209	MASSACHU	2.83636	MASSACHU	2.86279	MASSACHU	3.02048	MASSACHU	3.00895	MASSACHU	3.35838
ALASKA	1.73538	UTAH	0.78515	NEW MEXI	0.86514	NEW MEXI	0.81655	NEW MEXI	1.0268	CONNECTI	1.0192	NEW MEXI	1.359	CONNECTI	1.22193	VERMONT	1.24986	UTAH	1.39078
RHODE IS	0.753	ALASKA	0.70841	RHODE IS	0.76207	CONNECTI	0.77319	CONNECTI	0.86102	RHODE IS	0.94818	UTAH	1.01967	UTAH	1.08146	CONNECTI	1.18667	CONNECTI	1.22869
HAWAII	0.71439	RHODE IS	0.69786	UTAH	0.70098	RHODE IS	0.76132	RHODE IS	0.78684	UTAH	0.93486	RHODE IS	1.01681	VERMONT	0.96878	RHODE IS	1.13343	VERMONT	1.08643
UTAH	0.6496	CONNECTI	0.62652	CONNECTI	0.67171	UTAH	0.61613	UTAH	0.70144	NEW MEXI	0.90648	CONNECTI	0.90395	RHODE IS	0.91303	UTAH	0.97428	RHODE IS	0.97164
CONNECTI	0.63032	NEW MEXI	0.52262	WASHINGT	0.22999	WASHINGT	0.32786	VERMONT	0.50916	VERMONT	0.6135	VERMONT	0.80357	NEW MEXI	0.71563	COLORADO	0.65238	NEW MEXI	0.86906
NEW MEXI	0.60049	WASHINGT	0.27819	VERMONT	0.20573	HAWAII	0.1833	WASHINGT	0.49544	WASHINGT	0.52889	WASHINGT	0.44425	WASHINGT	0.51326	WASHINGT	0.59951	COLORADO	0.702
COLORADO	0.43526	COLORADO	0.26949	COLORADO	0.1767	VERMONT	0.1689	COLORADO	0.18404	HAWAII	0.39806	COLORADO	0.22588	COLORADO	0.46177	NEW MEXI	0.53742	HAWAII	0.69823
WASHINGT	0.4188	VERMONT	0.22345	HAWAII	0.17252	COLORADO	0.08509	HAWAII	0.15652	COLORADO	0.27905	NEW YORK	0.22451	HAWAII	0.45359	HAWAII	0.42852	WASHINGT	0.68253
VERMONT	0.31457	HAWAII	0.21461	ALASKA	0.04427	NEW YORK	-0.08042	OREGON	0.08703	NEW YORK	0.21712	NEW HAMP	0.19948	NORTH CA	0.31513	NORTH CA	0.39625	NORTH CA	0.57449
NEW HAMP	-0.04438	WISCONSI	-0.11648	OREGON	-0.15359	OREGON	-0.1411	WYOMING	0.02761	NEW HAMP	0.1089	HAWAII	0.1881	NEW HAMP	0.3013	NEW YORK	0.33179	NEW YORK	0.39391
WISCONSI	-0.04661	NEW HAMP	-0.13182	NEW HAMP	-0.19472	NEW HAMP	-0.14514	NEW YORK	0.01615	WYOMING	0.10583	NORTH CA	0.137	OREGON	0.26317	NEW HAMP	0.32617	NEW HAMP	0.28745
OREGON	-0.0803	OREGON	-0.19717	WISCONSI	-0.23953	WISCONSI	-0.1484	WISCONSI	-0.06569	WISCONSI	0.09729	WISCONSI	0.10984	NEW YORK	0.26145	OREGON	0.25435	OREGON	0.27114
NORTH CA	-0.15968	NORTH CA	-0.20112	NEW YORK	-0.24244	NORTH CA	-0.18336	NEW HAMP	-0.08271	NORTH CA	0.08656	OREGON	0.05843	WISCONSI	0.16884	PENNSYLV	0.22588	WISCONSI	0.26348
NEW YORK	-0.20273	NEW YORK	-0.2249	NORTH CA	-0.24937	PENNSYLV	-0.30651	NORTH CA	-0.13095	OREGON	0.03187	PENNSYLV	-0.00903	PENNSYLV	0.09999	WISCONSI	0.14141	PENNSYLV	0.20389
DELAWARE	-0.25571	NORTH DA	-0.30045	MINNESOT	-0.39057	WYOMING	-0.31981	NORTH DA	-0.22427	PENNSYLV	-0.12236	CALIFORN	-0.17607	ALABAMA	-0.06829	ALABAMA	-0.02358	IOWA	0.04698
MINNESOT	-0.27687	ARIZONA	-0.32294	MISSOURI	-0.39509	MISSOURI	-0.38838	PENNSYLV	-0.30437	CALIFORN	-0.23798	ALASKA	-0.20399	CALIFORN	-0.08152	TENNESSE	-0.09529	ALABAMA	0.03433
MISSOURI	-0.31417	DELAWARE	-0.33378	ARIZONA	-0.41567	DELAWARE	-0.38946	MISSOURI	-0.34834	MISSOURI	-0.2394	MISSOURI	-0.25612	MINNESOT	-0.12166	ALASKA	-0.11644	MISSOURI	-0.04404
NORTH DA	-0.31437	MISSOURI	-0.36816	DELAWARE	-0.45004	NORTH DA	-0.434	IOWA	-0.3631	NORTH DA	-0.28611	ALABAMA	-0.26652	ALASKA	-0.12352	MINNESOT	-0.12527	MINNESOT	-0.05501
ARIZONA	-0.33784	PENNSYLV	-0.38747	PENNSYLV	-0.46743	ARIZONA	-0.45026	IDAHO	-0.37056	MINNESOT	-0.29255	MINNESOT	-0.29745	MISSOURI	-0.15039	MISSOURI	-0.12876	TENNESSE	-0.11854
PENNSYLV	-0.38291	MINNESOT	-0.41047	NORTH DA	-0.52077	IOWA	-0.45651	ALASKA	-0.40174	ALABAMA	-0.34494	DELAWARE	-0.31632	TENNESSE	-0.20627	IOWA	-0.15397	CALIFORN	-0.13787
IOWA	-0.42732	TENNESSE	-0.4838	IOWA	-0.53347	TENNESSE	-0.49208	DELAWARE	-0.41926	IOWA	-0.35765	IOWA	-0.32496	IOWA	-0.207	GEORGIA	-0.1954	GEORGIA	-0.16782
TEXAS	-0.48356	WYOMING	-0.4851	ALABAMA	-0.55588	MINNESOT	-0.49434	ALABAMA	-0.43853	ALASKA	-0.35808	TENNESSE	-0.34932	GEORGIA	-0.27158	CALIFORN	-0.24432	DELAWARE	-0.17407
TENNESSE	-0.49804	IOWA	-0.49559	TENNESSE	-0.56514	GEORGIA	-0.50228	CALIFORN	-0.47067	DELAWARE	-0.39319	GEORGIA	-0.35553	DELAWARE	-0.36775	NORTH DA	-0.24658	NORTH DA	-0.21795
ALABAMA	-0.5054	ALABAMA	-0.50788	GEORGIA	-0.56649	ALABAMA	-0.51466	MINNESOT	-0.47487	GEORGIA	-0.40804	NORTH DA	-0.42816	NEBRASKA	-0.37157	DELAWARE	-0.24794	ALASKA	-0.24147
WYOMING	-0.52664	TEXAS	-0.54699	WYOMING	-0.58843	ALASKA	-0.5724	GEORGIA	-0.48431	TENNESSE	-0.40872	ARIZONA	-0.48446	ARIZONA	-0.37751	TEXAS	-0.31813	WYOMING	-0.28065
KANSAS	-0.55605	INDIANA	-0.58627	TEXAS	-0.59628	CALIFORN	-0.60141	TENNESSE	-0.52012	ARIZONA	-0.43958	TEXAS	-0.51844	NORTH DA	-0.44978	WYOMING	-0.40553	ARIZONA	-0.34343
VIRGINIA	-0.57411	VIRGINIA	-0.6387	INDIANA	-0.61999	TEXAS	-0.6408	ARIZONA	-0.53781	NEBRASKA	-0.50049	NEBRASKA	-0.55922	WYOMING	-0.46379	ARIZONA	-0.42174	MICHIGAN	-0.38476
CALIFORN	-0.57545	GEORGIA	-0.6412	VIRGINIA	-0.65561	INDIANA	-0.65322	NEBRASKA	-0.60974	TEXAS	-0.50937	VIRGINIA	-0.57336	TEXAS	-0.4686	MICHIGAN	-0.47603	TEXAS	-0.38709
MONTANA	-0.58051	MONTANA	-0.65182	MONTANA	-0.69997	VIRGINIA	-0.65634	VIRGINIA	-0.65077	VIRGINIA	-0.53508	INDIANA	-0.57979	VIRGINIA	-0.49002	VIRGINIA	-0.48646	VIRGINIA	-0.38754
INDIANA	-0.61322	NEVADA	-0.70156	ILLINOIS	-0.7052	ILLINOIS	-0.68267	INDIANA	-0.65424	INDIANA	-0.55982	WYOMING	-0.60843	INDIANA	-0.52096	NEBRASKA	-0.49342	LOUISIAN	-0.41483
GEORGIA	-0.62597	KANSAS	-0.70756	CALIFORN	-0.71396	NEW JERS	-0.77111	TEXAS	-0.66156	ILLINOIS	-0.58857	ILLINOIS	-0.6169	ILLINOIS	-0.52293	INDIANA	-0.5367	NEBRASKA	-0.46956
ILLINOIS	-0.6934	ILLINOIS	-0.70918	NEW JERS	-0.75071	NEVADA	-0.7724	ILLINOIS	-0.6806	NEW JERS	-0.67388	NEVADA	-0.66322	NEVADA	-0.53953	MISSISSI	-0.56694	INDIANA	-0.47091
NEW JERS	-0.6957	CALIFORN	-0.72044	IDAHO	-0.77429	IDAHO	-0.79337	NEW JERS	-0.73063	NEVADA	-0.67646	MICHIGAN	-0.67156	MICHIGAN	-0.55489	ILLINOIS	-0.57757	NEVADA	-0.54812
NEVADA	-0.74775	NEW JERS	-0.72351	NEVADA	-0.78832	MONTANA	-0.84675	NEVADA	-0.73557	MICHIGAN	-0.6815	NEW JERS	-0.70888	MISSISSI	-0.61405	NEVADA	-0.58783	ILLINOIS	-0.56174
SOUTH CA	-0.77044	SOUTH CA	-0.79466	SOUTH CA	-0.82091	MICHIGAN	-0.85645	MICHIGAN	-0.75528	KANSAS	-0.75907	KANSAS	-0.72727	NEW JERS	-0.65668	NEW JERS	-0.66248	MISSISSI	-0.56572
LOUISIAN	-0.8223	LOUISIAN	-0.84797	KANSAS	-0.83436	KANSAS	-0.86114	MONTANA	-0.83294	IDAHO	-0.76142	OHIO	-0.74282	KANSAS	-0.67627	KANSAS	-0.66621	NEW JERS	-0.6462
WEST VIR	-0.84234	IDAHO	-0.85022	WEST VIR	-0.84961	SOUTH CA	-0.87218	KANSAS	-0.84066	MISSISSI	-0.78394	MONTANA	-0.79184	MONTANA	-0.71267	OHIO	-0.69444	FLORIDA	-0.66385
MICHIGAN	-0.84458	WEST VIR	-0.8541	MICHIGAN	-0.85039	LOUISIAN	-0.87996	OHIO	-0.84842	LOUISIAN	-0.80413	SOUTH DA	-0.81105	OHIO	-0.72743	FLORIDA	-0.70635	OHIO	-0.67282
SOUTH DA	-0.84627	MICHIGAN	-0.86458	LOUISIAN	-0.86871	MAINE	-0.91783	MAINE	-0.85846	SOUTH CA	-0.8092	MISSISSI	-0.81641	LOUISIAN	-0.74911	LOUISIAN	-0.71532	KANSAS	-0.67523
NEBRASKA	-0.8532	SOUTH DA	-0.88136	MISSISSI	-0.88234	SOUTH DA	-0.92527	LOUISIAN	-0.86415	OHIO	-0.81952	LOUISIAN	-0.83774	FLORIDA	-0.79271	MONTANA	-0.71854	MONTANA	-0.71462
IDAHO	-0.85732	MISSISSI	-0.88409	FLORIDA	-0.90199	ARKANSAS	-0.93615	MISSISSI	-0.88436	SOUTH DA	-0.83171	FLORIDA	-0.8575	SOUTH DA	-0.83948	IDAHO	-0.79519	IDAHO	-0.73271
MISSISSI	-0.86876	FLORIDA	-0.89773	SOUTH DA	-0.90838	OHIO	-0.95408	SOUTH CA	-0.90596	MONTANA	-0.83907	SOUTH CA	-0.86799	SOUTH CA	-0.8472	SOUTH DA	-0.81529	SOUTH DA	-0.74688
FLORIDA	-0.881	OHIO	-0.91162	KENTUCKY	-0.90911	FLORIDA	-0.95424	SOUTH DA	-0.90785	ARKANSAS	-0.86185	KENTUCKY	-0.87677	IDAHO	-0.86186	SOUTH CA	-0.83303	WEST VIR	-0.80775
OHIO	-0.8831	MAINE	-0.93263	OHIO	-0.9464	KENTUCKY	-0.95521	WEST VIR	-0.9185	MAINE	-0.87806	ARKANSAS	-0.90449	KENTUCKY	-0.86685	WEST VIR	-0.83798	ARKANSAS	-0.83195
OKLAHOMA	-0.90439	KENTUCKY	-0.93277	MAINE	-0.953	WEST VIR	-0.9692	ARKANSAS	-0.93383	FLORIDA	-0.8806	MAINE	-0.93024	ARKANSAS	-0.87436	ARKANSAS	-0.84606	KENTUCKY	-0.84885
KENTUCKY	-0.92268	NEBRASKA	-0.94792	ARKANSAS	-0.95302	NEBRASKA	-1.02655	KENTUCKY	-0.94907	KENTUCKY	-0.90185	IDAHO	-0.93869	MAINE	-0.91518	KENTUCKY	-0.8982	SOUTH CA	-0.86802
MAINE	-0.97491	ARKANSAS	-0.95864	NEBRASKA	-0.97513	MISSISSI	-1.02807	FLORIDA	-0.96631	WEST VIR	-0.94332	WEST VIR	-0.95012	WEST VIR	-0.91795	MAINE	-0.99041	MAINE	-0.91328
ARKANSAS	-1.04645	OKLAHOMA	-1.11055	OKLAHOMA	-1.0692	OKLAHOMA	-1.19329	OKLAHOMA	-1.15989	OKLAHOMA	-1.04399	OKLAHOMA	-1.07549	OKLAHOMA	-1.0303	OKLAHOMA	-1.09195	OKLAHOMA	-1.01734

State Federal Financial Capacity for Innovation by Year: 1990-1999

	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999
Rank	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
MARYLAND	4.48009	MARYLAND	4.49945	MARYLAND	4.64373	MARYLAND	4.5826	MARYLAND	5.16523	MARYLAND	4.85851	MARYLAND	4.83255	MARYLAND	4.56326	MARYLAND	4.80278	MARYLAND	5.53073
MASSACHU	3.30475	MASSACHU	3.45047	MASSACHU	3.62649	MASSACHU	3.72414	MASSACHU	3.63833	MASSACHU	3.58884	MASSACHU	3.28728	MASSACHU	3.43029	MASSACHU	3.8714	MASSACHU	4.28366
UTAH	1.61958	UTAH	1.65972	UTAH	1.51944	NEW MEXI	1.25774	CONNECTI	1.28064	CONNECTI	1.21398	CONNECTI	1.30059	CONNECTI	1.40115	COLORADO	1.80763	COLORADO	2.03029
VERMONT	1.13473	VERMONT	1.4159	CONNECTI	1.23551	CONNECTI	1.21537	COLORADO	1.1716	UTAH	1.19777	COLORADO	1.11894	COLORADO	1.33035	CONNECTI	1.47607	CONNECTI	1.78764
CONNECTI	1.08275	CONNECTI	1.10862	COLORADO	1.10281	UTAH	1.20917	UTAH	1.14977	COLORADO	1.15464	NORTH CA	1.02854	RHODE IS	1.05808	NORTH CA	1.11478	NEW HAMP	1.32805
RHODE IS	0.90659	NEW MEXI	0.94799	VERMONT	1.09493	VERMONT	1.14654	VERMONT	1.06686	NORTH CA	1.06773	WASHINGT	0.97639	WASHINGT	0.97617	WASHINGT	1.04318	WASHINGT	1.32723
COLORADO	0.84551	COLORADO	0.89877	NEW MEXI	1.04069	ALASKA	1.06928	NORTH CA	1.02254	NEW MEXI	1.01692	NEW HAMP	0.88901	PENNSYLV	0.91345	UTAH	1.02673	PENNSYLV	1.29157
NEW MEXI	0.73918	RHODE IS	0.88003	NEW HAMP	1.01304	NEW HAMP	0.97574	NEW MEXI	1.01037	WASHINGT	0.99012	VERMONT	0.87227	NORTH CA	0.91298	PENNSYLV	1.01474	VERMONT	1.27484
WASHINGT	0.72653	WASHINGT	0.82371	WASHINGT	0.89817	COLORADO	0.90809	WASHINGT	0.96545	RHODE IS	0.98554	RHODE IS	0.86037	UTAH	0.8906	VERMONT	0.93219	HAWAII	1.25604
NEW HAMP	0.64549	NEW HAMP	0.77896	NORTH CA	0.83909	WASHINGT	0.86163	NEW HAMP	0.76518	VERMONT	0.89918	UTAH	0.84279	NEW HAMP	0.82445	HAWAII	0.81583	NORTH CA	1.243
NORTH CA	0.56013	NORTH CA	0.67963	RHODE IS	0.80908	NORTH CA	0.83892	PENNSYLV	0.72027	NEW HAMP	0.749	PENNSYLV	0.77901	VERMONT	0.8009	NEW HAMP	0.79893	UTAH	1.22138
HAWAII	0.55767	PENNSYLV	0.53782	PENNSYLV	0.61256	RHODE IS	0.71674	ALASKA	0.71769	PENNSYLV	0.73399	NEW MEXI	0.73736	HAWAII	0.76402	NEW MEXI	0.76623	ALASKA	0.99315
ALASKA	0.39442	HAWAII	0.50068	HAWAII	0.50121	PENNSYLV	0.67149	RHODE IS	0.71612	OREGON	0.47454	HAWAII	0.71068	NEW MEXI	0.57156	RHODE IS	0.75729	RHODE IS	0.93152
NORTH DA	0.35095	OREGON	0.34838	WISCONSI	0.40619	HAWAII	0.4523	HAWAII	0.56105	HAWAII	0.42163	WISCONSI	0.35215	OREGON	0.56883	OREGON	0.69038	MISSOURI	0.75719
PENNSYLV	0.31528	WISCONSI	0.31582	NEW YORK	0.37106	WISCONSI	0.39957	WISCONSI	0.4878	WISCONSI	0.3924	ALABAMA	0.34231	ALABAMA	0.49456	ALABAMA	0.56599	NEW MEXI	0.71572
NEW YORK	0.29872	NEW YORK	0.27907	OREGON	0.29667	OREGON	0.26713	IOWA	0.37025	ALABAMA	0.37484	OREGON	0.30883	ALASKA	0.48184	MISSOURI	0.50486	OREGON	0.71312
WISCONSI	0.25879	ALASKA	0.19078	ALASKA	0.28517	NEW YORK	0.24162	NEW YORK	0.32181	NEW YORK	0.29143	MISSOURI	0.30536	MISSOURI	0.37005	ALASKA	0.42171	ALABAMA	0.63459
OREGON	0.16965	IOWA	0.18807	IOWA	0.26438	IOWA	0.22822	OREGON	0.28112	IOWA	0.28834	IOWA	0.24259	NEW YORK	0.30324	IOWA	0.36097	NEW YORK	0.6257
ALABAMA	0.05613	ALABAMA	0.17703	ALABAMA	0.23003	ALABAMA	0.21265	DELAWARE	0.2477	DELAWARE	0.27232	DELAWARE	0.24183	IOWA	0.30117	NEW YORK	0.34992	IOWA	0.62504
MISSOURI	0.03483	MISSOURI	0.1057	DELAWARE	0.18269	DELAWARE	0.11215	ALABAMA	0.23895	MISSOURI	0.25406	NORTH DA	0.19961	WISCONSI	0.26797	WISCONSI	0.29348	MONTANA	0.59156
IOWA	0.02643	MINNESOT	0.07556	MISSOURI	0.17196	MISSOURI	0.11083	MISSOURI	0.14971	ALASKA	0.24055	NEW YORK	0.1389	MINNESOT	0.26527	DELAWARE	0.20112	DELAWARE	0.4088
TENNESSE	-0.04069	TENNESSE	0.0144	MINNESOT	0.10185	MINNESOT	-0.00436	MINNESOT	0.10777	MINNESOT	0.22136	MINNESOT	0.11113	DELAWARE	0.08155	MONTANA	0.16858	WISCONSI	0.3559
MINNESOT	-0.11695	DELAWARE	-0.15197	TENNESSE	0.05583	TENNESSE	-0.01029	TENNESSE	-0.0005	NORTH DA	0.02372	ALASKA	0.10234	MONTANA	0.04725	MINNESOT	0.06466	MINNESOT	0.17413
DELAWARE	-0.15645	CALIFORN	-0.19485	CALIFORN	-0.10995	WYOMING	-0.04245	ARIZONA	-0.02329	TENNESSE	-0.01907	CALIFORN	-0.01291	TENNESSE	-0.03682	CALIFORN	0.03048	CALIFORN	0.153
CALIFORN	-0.18267	GEORGIA	-0.26656	NORTH DA	-0.16224	VIRGINIA	-0.17955	VIRGINIA	-0.13895	ARIZONA	-0.0532	TENNESSE	-0.09848	MICHIGAN	-0.10644	TENNESSE	-0.05983	TENNESSE	0.02418
ARIZONA	-0.28188	VIRGINIA	-0.2703	ARIZONA	-0.21747	NORTH DA	-0.20027	MICHIGAN	-0.15582	MICHIGAN	-0.13501	MICHIGAN	-0.15899	CALIFORN	-0.12127	MICHIGAN	-0.09232	MICHIGAN	0.02383
GEORGIA	-0.31165	NORTH DA	-0.2713	VIRGINIA	-0.24449	MICHIGAN	-0.23266	CALIFORN	-0.22506	VIRGINIA	-0.14089	TEXAS	-0.2331	TEXAS	-0.16212	TEXAS	-0.09579	TEXAS	-0.02757
VIRGINIA	-0.32995	ARIZONA	-0.29407	TEXAS	-0.25533	ARIZONA	-0.26716	MONTANA	-0.2295	CALIFORN	-0.17511	VIRGINIA	-0.23841	VIRGINIA	-0.21883	VIRGINIA	-0.17763	NORTH DA	-0.05118
NEVADA	-0.34749	WYOMING	-0.3156	MICHIGAN	-0.26674	MONTANA	-0.28345	NORTH DA	-0.3004	MONTANA	-0.28958	MONTANA	-0.24379	NORTH DA	-0.25341	GEORGIA	-0.29417	MISSISSI	-0.08233
TEXAS	-0.36056	MICHIGAN	-0.33295	GEORGIA	-0.2684	TEXAS	-0.30877	TEXAS	-0.34269	GEORGIA	-0.32814	GEORGIA	-0.31697	NEBRASKA	-0.34122	ARIZONA	-0.31314	ILLINOIS	-0.10327
WYOMING	-0.38335	NEBRASKA	-0.34635	WYOMING	-0.32128	WEST VIR	-0.31781	GEORGIA	-0.38341	TEXAS	-0.37549	ARIZONA	-0.32261	ILLINOIS	-0.34477	ILLINOIS	-0.34628	ARIZONA	-0.15243
MICHIGAN	-0.40241	LOUISIAN	-0.39761	INDIANA	-0.37512	CALIFORN	-0.3338	LOUISIAN	-0.40415	NEBRASKA	-0.41641	NEBRASKA	-0.37669	LOUISIAN	-0.38642	MISSISSI	-0.36035	VIRGINIA	-0.19902
INDIANA	-0.51193	TEXAS	-0.39928	MONTANA	-0.37857	GEORGIA	-0.34198	INDIANA	-0.4073	NEW JERS	-0.42532	SOUTH CA	-0.39782	INDIANA	-0.38773	NORTH DA	-0.38056	GEORGIA	-0.20328
MISSISSI	-0.55214	INDIANA	-0.46274	NEBRASKA	-0.42501	INDIANA	-0.39227	NEW JERS	-0.41328	INDIANA	-0.42891	LOUISIAN	-0.41696	ARIZONA	-0.39791	NEBRASKA	-0.39312	LOUISIAN	-0.29646
NEBRASKA	-0.55933	WEST VIR	-0.47079	LOUISIAN	-0.45031	MISSISSI	-0.44223	ILLINOIS	-0.42051	ILLINOIS	-0.44333	ILLINOIS	-0.4388	GEORGIA	-0.39848	KANSAS	-0.40376	KANSAS	-0.3012
ILLINOIS	-0.59009	MISSISSI	-0.50178	MISSISSI	-0.48811	NEBRASKA	-0.45598	NEBRASKA	-0.45074	SOUTH CA	-0.46256	INDIANA	-0.49455	SOUTH CA	-0.41725	LOUISIAN	-0.40713	OHIO	-0.38624
MONTANA	-0.6047	MONTANA	-0.50199	KANSAS	-0.53406	NEW JERS	-0.47687	NEVADA	-0.48693	LOUISIAN	-0.47229	MISSISSI	-0.49826	NEW JERS	-0.4542	NEW JERS	-0.44327	NEW JERS	-0.4562
NEW JERS	-0.61332	NEVADA	-0.53243	WEST VIR	-0.53544	ILLINOIS	-0.49236	WYOMING	-0.497	MISSISSI	-0.48939	NEW JERS	-0.52886	MISSISSI	-0.52212	SOUTH CA	-0.45206	INDIANA	-0.46614
WEST VIR	-0.61817	NEW JERS	-0.59205	NEVADA	-0.56334	KANSAS	-0.50838	MISSISSI	-0.49708	KANSAS	-0.52829	KANSAS	-0.57325	KANSAS	-0.58585	WYOMING	-0.45418	ARKANSAS	-0.50212
OHIO	-0.62756	KANSAS	-0.60639	ILLINOIS	-0.56418	NEVADA	-0.54471	SOUTH CA	-0.53802	OHIO	-0.58862	WYOMING	-0.59309	OHIO	-0.58905	INDIANA	-0.48331	NEVADA	-0.50229
KANSAS	-0.6541	OHIO	-0.6122	NEW JERS	-0.57263	LOUISIAN	-0.56236	WEST VIR	-0.58706	WYOMING	-0.6031	OHIO	-0.61911	SOUTH DA	-0.59405	OHIO	-0.57257	SOUTH CA	-0.55159
LOUISIAN	-0.69082	ILLINOIS	-0.61977	FLORIDA	-0.60183	OHIO	-0.6119	KANSAS	-0.60556	NEVADA	-0.61175	WEST VIR	-0.65343	ARKANSAS	-0.66305	OKLAHOMA	-0.63943	NEBRASKA	-0.61379
FLORIDA	-0.70411	FLORIDA	-0.62375	OHIO	-0.6246	FLORIDA	-0.62428	ARKANSAS	-0.6468	ARKANSAS	-0.67389	NEVADA	-0.66778	WYOMING	-0.67284	ARKANSAS	-0.64254	WYOMING	-0.63503
SOUTH DA	-0.79306	IDAHO	-0.68352	SOUTH CA	-0.68503	SOUTH DA	-0.67295	SOUTH DA	-0.64917	SOUTH DA	-0.67569	ARKANSAS	-0.66853	KENTUCKY	-0.69757	NEVADA	-0.66264	IDAHO	-0.67581
IDAHO	-0.80757	SOUTH CA	-0.75842	KENTUCKY	-0.7319	IDAHO	-0.67711	OHIO	-0.66189	IDAHO	-0.72523	KENTUCKY	-0.70412	FLORIDA	-0.71775	FLORIDA	-0.69054	FLORIDA	-0.69132
ARKANSAS	-0.81776	ARKANSAS	-0.76354	IDAHO	-0.73528	SOUTH CA	-0.70359	IDAHO	-0.66363	KENTUCKY	-0.72726	SOUTH DA	-0.7322	OKLAHOMA	-0.7195	IDAHO	-0.73201	KENTUCKY	-0.7003
KENTUCKY	-0.8335	SOUTH DA	-0.78058	ARKANSAS	-0.73741	ARKANSAS	-0.71997	FLORIDA	-0.67363	WEST VIR	-0.73752	FLORIDA	-0.75132	IDAHO	-0.75867	SOUTH DA	-0.75907	OKLAHOMA	-0.70037
SOUTH CA	-0.86019	KENTUCKY	-0.81179	SOUTH DA	-0.7605	KENTUCKY	-0.72459	KENTUCKY	-0.70009	FLORIDA	-0.74833	IDAHO	-0.82238	NEVADA	-0.77291	MAINE	-0.81373	SOUTH DA	-0.72099
MAINE	-0.91392	MAINE	-0.94818	OKLAHOMA	-0.85848	OKLAHOMA	-0.87408	OKLAHOMA	-0.86848	MAINE	-0.84627	OKLAHOMA	-0.85625	MAINE	-0.82588	KENTUCKY	-0.81613	WEST VIR	-0.82367
OKLAHOMA	-1.06197	OKLAHOMA	-1.04167	MAINE	-0.95446	MAINE	-0.8829	MAINE	-0.86985	OKLAHOMA	-0.89765	MAINE	-0.92822	WEST VIR	-0.83394	WEST VIR	-0.85876	MAINE	-0.84783

State/Local Financial Capacity for Innovation by Year: 1980-1989

	1980		1981		1982		1983		1984		1985		1986		1987		1988		1989
Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
ALASKA	1.57435	ALASKA	1.8796	ALASKA	2.23514	ALASKA	2.43599	ALASKA	2.5424	ALASKA	2.13329	ALASKA	2.01796	ALASKA	2.13608	ALASKA	2.18141	ALASKA	2.75146
NEBRASKA	0.33144	NEBRASKA	0.5371	NEBRASKA	0.61427	NEBRASKA	0.69217	OKLAHOMA	0.31929	DELAWARE	0.40371	IOWA	0.65371	ARIZONA	0.88764	ARIZONA	1.07812	IOWA	1.1904
DELAWARE	-0.09012	OKLAHOMA	0.02231	WYOMING	0.17266	OKLAHOMA	0.31906	ARIZONA	0.25075	IOWA	0.40286	ARIZONA	0.64557	DELAWARE	0.87481	IOWA	1.0732	ARIZONA	1.11228
IOWA	-0.19964	WYOMING	0.02067	IOWA	-0.02787	WYOMING	0.19689	DELAWARE	0.21216	ARIZONA	0.34382	DELAWARE	0.64231	IOWA	0.82053	DELAWARE	0.76578	DELAWARE	0.86825
WYOMING	-0.20174	DELAWARE	-0.09469	OKLAHOMA	-0.06478	DELAWARE	0.03799	MINNESOT	0.01441	OKLAHOMA	0.24656	WYOMING	0.49844	NEW MEXI	0.45578	OKLAHOMA	0.62934	NEBRASKA	0.65497
MICHIGAN	-0.33977	IOWA	-0.12011	DELAWARE	-0.07369	IOWA	0.03444	WYOMING	-0.01375	WYOMING	0.00479	OKLAHOMA	0.25436	OKLAHOMA	0.449	WYOMING	0.52998	WYOMING	0.47053
COLORADO	-0.36173	COLORADO	-0.26303	MINNESOT	-0.26506	MINNESOT	-0.07889	COLORADO	-0.03692	MINNESOT	-0.0282	NEBRASKA	0.22422	WYOMING	0.42702	NEBRASKA	0.49277	OKLAHOMA	0.45024
GEORGIA	-0.37811	MICHIGAN	-0.29452	GEORGIA	-0.27681	COLORADO	-0.0947	IOWA	-0.04701	COLORADO	-0.03685	KANSAS	0.2129	KANSAS	0.331	NEW MEXI	0.40447	NEW MEXI	0.42469
MINNESOT	-0.39682	MINNESOT	-0.30291	COLORADO	-0.31747	KANSAS	-0.20077	KANSAS	-0.07122	KANSAS	-0.0573	MINNESOT	0.09616	NORTH DA	0.22883	NORTH DA	0.39721	KANSAS	0.41733
CALIFORN	-0.49146	GEORGIA	-0.32502	ARIZONA	-0.34462	ARIZONA	-0.20243	NEBRASKA	-0.15903	NEBRASKA	-0.10024	GEORGIA	0.01611	GEORGIA	0.20905	KANSAS	0.30597	GEORGIA	0.37965
ARIZONA	-0.49344	CALIFORN	-0.3791	MICHIGAN	-0.39468	MISSISSI	-0.23568	TEXAS	-0.2792	VERMONT	-0.14444	MICHIGAN	-0.04168	MICHIGAN	0.19615	GEORGIA	0.24835	UTAH	0.37267
OKLAHOMA	-0.54966	ARIZONA	-0.50643	NORTH DA	-0.47192	GEORGIA	-0.24143	MICHIGAN	-0.29972	MICHIGAN	-0.22908	COLORADO	-0.08423	NEBRASKA	0.17479	VERMONT	0.23091	VERMONT	0.35437
SOUTH DA	-0.60897	IDAHO	-0.51256	CALIFORN	-0.47474	UTAH	-0.29286	UTAH	-0.31107	MONTANA	-0.27196	NORTH DA	-0.08586	MINNESOT	0.14592	UTAH	0.21433	NORTH DA	0.34726
UTAH	-0.62592	VERMONT	-0.59341	SOUTH DA	-0.52541	MONTANA	-0.29936	MONTANA	-0.31839	TEXAS	-0.28503	VERMONT	-0.11132	WISCONSI	0.07723	MICHIGAN	0.20774	MINNESOT	0.32803
KANSAS	-0.68727	NORTH DA	-0.65173	VERMONT	-0.54458	MICHIGAN	-0.3337	GEORGIA	-0.33591	NORTH DA	-0.31221	TEXAS	-0.15922	VERMONT	0.06293	MINNESOT	0.14761	MICHIGAN	0.32653
WISCONSI	-0.69496	KANSAS	-0.65182	UTAH	-0.56024	VERMONT	-0.36335	VERMONT	-0.40109	WISCONSI	-0.31293	MONTANA	-0.16596	MONTANA	0.06032	ILLINOIS	0.14504	ILLINOIS	0.30452
NORTH DA	-0.71837	UTAH	-0.66081	KANSAS	-0.56097	TEXAS	-0.39556	WISCONSI	-0.42409	VIRGINIA	-0.32655	WASHINGT	-0.16669	TEXAS	0.01197	MONTANA	0.13416	SOUTH CA	0.2397
VERMONT	-0.74897	SOUTH DA	-0.67102	OREGON	-0.58364	CALIFORN	-0.44848	VIRGINIA	-0.45419	GEORGIA	-0.33829	ILLINOIS	-0.21489	ILLINOIS	0.00369	WISCONSI	0.10402	VIRGINIA	0.23262
OREGON	-0.77079	WISCONSI	-0.67939	WISCONSI	-0.59205	WISCONSI	-0.479	NORTH DA	-0.47513	UTAH	-0.35986	VIRGINIA	-0.2221	SOUTH CA	-0.00319	VIRGINIA	0.04262	MONTANA	0.22142
ARKANSAS	-0.78828	TEXAS	-0.68119	TEXAS	-0.6268	NORTH DA	-0.49232	CALIFORN	-0.49689	ILLINOIS	-0.39525	WISCONSI	-0.23384	UTAH	-0.03164	SOUTH CA	-0.04564	TEXAS	0.18171
MISSISSI	-0.79782	OREGON	-0.69442	VIRGINIA	-0.67467	VIRGINIA	-0.5624	ILLINOIS	-0.52273	LOUISIAN	-0.42035	SOUTH CA	-0.26179	VIRGINIA	-0.03967	TEXAS	-0.06629	CONNECTI	0.16708
VIRGINIA	-0.86726	VIRGINIA	-0.7249	MISSISSI	-0.72871	OREGON	-0.58044	LOUISIAN	-0.60297	OREGON	-0.50057	UTAH	-0.26888	COLORADO	-0.1021	LOUISIAN	-0.07406	WISCONSI	0.07827
TEXAS	-0.87782	MISSISSI	-0.77958	MONTANA	-0.7558	SOUTH DA	-0.62915	SOUTH CA	-0.63417	WASHINGT	-0.50626	CONNECTI	-0.30569	OREGON	-0.12694	CONNECTI	-0.09174	OREGON	-0.00079
ILLINOIS	-0.89427	NEW MEXI	-0.79798	LOUISIAN	-0.79483	ILLINOIS	-0.69255	INDIANA	-0.66459	CALIFORN	-0.51837	LOUISIAN	-0.31909	WASHINGT	-0.15351	MISSOURI	-0.09223	COLORADO	-0.05603
LOUISIAN	-0.93427	LOUISIAN	-0.83862	NEVADA	-0.80829	LOUISIAN	-0.73723	OREGON	-0.6851	SOUTH CA	-0.5778	OREGON	-0.32974	LOUISIAN	-0.20105	COLORADO	-0.12607	MISSOURI	-0.06486
MONTANA	-0.94089	ILLINOIS	-0.87509	ILLINOIS	-0.83642	SOUTH CA	-0.76718	MISSOURI	-0.75005	CONNECTI	-0.60747	MISSOURI	-0.42155	CONNECTI	-0.21894	CALIFORN	-0.12936	CALIFORN	-0.10397
MAINE	-0.94466	MAINE	-0.91335	MAINE	-0.89497	OHIO	-0.77795	MISSISSI	-0.77311	INDIANA	-0.6457	CALIFORN	-0.44609	MISSOURI	-0.2585	OREGON	-0.18925	WASHINGT	-0.13598
WASHINGT	-0.94707	HAWAII	-0.92715	OHIO	-0.91005	NEVADA	-0.81391	NORTH CA	-0.79472	MISSOURI	-0.67211	INDIANA	-0.57321	CALIFORN	-0.29053	WASHINGT	-0.2358	LOUISIAN	-0.14854
OHIO	-0.97694	MONTANA	-0.92913	NEW MEXI	-0.92501	INDIANA	-0.82666	SOUTH DA	-0.83278	OHIO	-0.69485	ALABAMA	-0.59851	INDIANA	-0.40286	INDIANA	-0.36021	ALABAMA	-0.18537
NEW MEXI	-1.011	OHIO	-0.93	WASHINGT	-0.92704	MISSOURI	-0.86154	CONNECTI	-0.83685	NORTH CA	-0.76231	IDAHO	-0.61574	ALABAMA	-0.44745	ALABAMA	-0.36838	MASSACHU	-0.19253
INDIANA	-1.02156	NEW HAMP	-0.9503	CONNECTI	-0.95138	MAINE	-0.8741	OHIO	-0.85153	MISSISSI	-0.76577	OHIO	-0.67239	OHIO	-0.52196	MASSACHU	-0.39125	NEW JERS	-0.20625
CONNECTI	-1.0564	WASHINGT	-0.96499	INDIANA	-0.97309	WASHINGT	-0.89835	HAWAII	-0.86487	NEW MEXI	-0.78253	NORTH CA	-0.67295	NEVADA	-0.5605	KENTUCKY	-0.39316	INDIANA	-0.25704
IDAHO	-1.06951	INDIANA	-0.96854	SOUTH CA	-0.98845	NEW HAMP	-0.9193	WASHINGT	-0.87086	NEW HAMP	-0.85004	KENTUCKY	-0.68949	KENTUCKY	-0.56195	OHIO	-0.40234	IDAHO	-0.26551
ALABAMA	-1.07832	CONNECTI	-0.97627	NEW HAMP	-1.00996	CONNECTI	-0.97292	FLORIDA	-0.88934	ALABAMA	-0.85113	MISSISSI	-0.69528	PENNSYLV	-0.59207	NEW JERS	-0.41858	PENNSYLV	-0.26814
KENTUCKY	-1.09011	MISSOURI	-1.06089	IDAHO	-1.01987	NORTH CA	-0.97671	ALABAMA	-0.92485	MAINE	-0.86621	PENNSYLV	-0.70308	MISSISSI	-0.59374	NORTH CA	-0.42186	OHIO	-0.27581
NORTH CA	-1.10752	SOUTH CA	-1.0758	MISSOURI	-1.0237	FLORIDA	-1.00167	MAINE	-0.93656	FLORIDA	-0.89591	MAINE	-0.70978	NORTH CA	-0.61606	IDAHO	-0.50888	NORTH CA	-0.34722
MISSOURI	-1.11383	KENTUCKY	-1.0866	HAWAII	-1.03359	KENTUCKY	-1.00251	KENTUCKY	-0.93919	KENTUCKY	-0.90103	NEVADA	-0.72383	NEW JERS	-0.61628	PENNSYLV	-0.51212	MARYLAND	-0.40349
FLORIDA	-1.15586	NORTH CA	-1.08773	ARKANSAS	-1.04195	IDAHO	-1.00412	NEW HAMP	-0.97695	PENNSYLV	-0.91429	MASSACHU	-0.76312	IDAHO	-0.62804	MAINE	-0.54572	KENTUCKY	-0.4065
NEVADA	-1.16337	FLORIDA	-1.10516	NORTH CA	-1.06002	HAWAII	-1.01136	PENNSYLV	-1.00293	MASSACHU	-0.96434	NEW MEXI	-0.80741	MASSACHU	-0.63243	NEW HAMP	-0.55505	RHODE IS	-0.47722
SOUTH CA	-1.16938	ALABAMA	-1.1392	KENTUCKY	-1.07005	ALABAMA	-1.02614	NEVADA	-1.07405	IDAHO	-0.96529	HAWAII	-0.8094	NEW HAMP	-0.66152	NEVADA	-0.61077	NEW HAMP	-0.49014
HAWAII	-1.20044	NEVADA	-1.16688	ALABAMA	-1.08376	PENNSYLV	-1.10137	TENNESSE	-1.10528	NEVADA	-0.97096	NEW JERS	-0.82199	MAINE	-0.70749	NEW YORK	-0.64357	MAINE	-0.49963
NEW HAMP	-1.21501	ARKANSAS	-1.19015	FLORIDA	-1.10785	NEW MEXI	-1.11519	NEW MEXI	-1.11881	TENNESSE	-1.03388	FLORIDA	-0.8466	NEW YORK	-0.71393	MISSISSI	-0.68543	NEVADA	-0.5211
NEW YORK	-1.23885	PENNSYLV	-1.27784	PENNSYLV	-1.15922	ARKANSAS	-1.1468	MASSACHU	-1.12837	HAWAII	-1.04229	NEW HAMP	-0.84945	FLORIDA	-0.7624	RHODE IS	-0.70918	MISSISSI	-0.5499
TENNESSE	-1.25988	TENNESSE	-1.3121	TENNESSE	-1.2479	TENNESSE	-1.16959	ARKANSAS	-1.13007	ARKANSAS	-1.11582	ARKANSAS	-0.9501	RHODE IS	-0.84408	HAWAII	-0.73152	HAWAII	-0.56481
PENNSYLV	-1.2801	NEW YORK	-1.3183	NEW YORK	-1.26057	NEW JERS	-1.2139	NEW YORK	-1.16725	NEW JERS	-1.11988	NEW YORK	-0.9791	HAWAII	-0.85204	TENNESSE	-0.82279	NEW YORK	-0.56633
MASSACHU	-1.44437	MASSACHU	-1.3959	NEW JERS	-1.31791	WEST VIR	-1.26371	NEW JERS	-1.18309	RHODE IS	-1.13287	TENNESSE	-1.00739	ARKANSAS	-0.86306	MARYLAND	-0.83628	WEST VIR	-0.65787
NEW JERS	-1.46775	NEW JERS	-1.41155	MASSACHU	-1.35824	NEW YORK	-1.33302	IDAHO	-1.18493	NEW YORK	-1.13649	RHODE IS	-1.01488	TENNESSE	-0.9158	FLORIDA	-0.84478	FLORIDA	-0.71541
WEST VIR	-1.57526	WEST VIR	-1.59712	WEST VIR	-1.59569	MASSACHU	-1.33641	WEST VIR	-1.31081	SOUTH DA	-1.15368	SOUTH DA	-1.0834	MARYLAND	-0.94232	ARKANSAS	-0.86231	ARKANSAS	-0.73413
RHODE IS	-1.70736	RHODE IS	-1.67686	RHODE IS	-1.68795	RHODE IS	-1.65356	RHODE IS	-1.44468	WEST VIR	-1.26372	WEST VIR	-1.16981	SOUTH DA	-0.95223	SOUTH DA	-0.98389	TENNESSE	-0.84273
MARYLAND	-2.3073	MARYLAND	-2.82748	MARYLAND	-2.27014	MARYLAND	-2.04083	MARYLAND	-1.55398	MARYLAND	-1.29075	MARYLAND	-1.35057	WEST VIR	-1.03758	WEST VIR	-0.99564	SOUTH DA	-0.96965

State/Local Financial Capacity for Innovation by Year: 1990-1999

	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999
Rank	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
ALASKA	2.40893	ALASKA	2.54937	ALASKA	2.45365	NORTH DA	2.29688	NORTH DA	2.23519	NORTH DA	2.14617	ALASKA	2.80318	ALASKA	2.88131	ALASKA	2.64629	ALASKA	3.82111
IOWA	1.32114	NORTH DA	2.42616	NORTH DA	2.34051	IOWA	1.61614	ALASKA	1.9012	ALASKA	2.12851	NORTH DA	2.26417	WYOMING	2.38517	NORTH DA	2.60218	NEBRASKA	3.57112
ARIZONA	1.28315	IOWA	1.46554	IOWA	1.48746	ARIZONA	1.23243	IOWA	1.56963	WYOMING	1.99318	WYOMING	1.93353	NORTH DA	2.31788	WYOMING	2.07033	NORTH DA	2.48612
NEBRASKA	1.16014	ARIZONA	1.41356	NEBRASKA	1.40728	ALASKA	1.21144	WYOMING	1.54207	NEBRASKA	1.73247	IOWA	1.75758	IOWA	1.79758	IOWA	2.01233	WYOMING	2.24234
DELAWARE	0.95172	NEBRASKA	1.24475	ARIZONA	1.26611	NEBRASKA	1.19606	NEBRASKA	1.43761	IOWA	1.58155	NEBRASKA	1.67114	DELAWARE	1.761	NEBRASKA	1.88378	IOWA	2.10905
NEW MEXI	0.78293	NEW MEXI	1.10371	DELAWARE	1.11086	DELAWARE	1.13528	GEORGIA	1.40787	GEORGIA	1.49088	GEORGIA	1.34165	GEORGIA	1.64166	DELAWARE	1.59537	GEORGIA	1.6021
OKLAHOMA	0.68963	DELAWARE	1.09478	WYOMING	1.06455	GEORGIA	1.02964	NEW MEXI	1.33676	NEW MEXI	1.41349	NEW MEXI	1.22378	NEBRASKA	1.59422	NEW MEXI	1.54258	DELAWARE	1.57776
GEORGIA	0.61383	OKLAHOMA	0.90131	NEW MEXI	0.9266	NEW MEXI	0.80807	DELAWARE	1.17401	DELAWARE	1.25069	DELAWARE	1.2132	NEW MEXI	1.55777	GEORGIA	1.47793	WISCONSI	1.47784
KANSAS	0.56386	GEORGIA	0.86291	GEORGIA	0.91902	MICHIGAN	0.76184	KANSAS	0.96136	KANSAS	1.12265	MONTANA	1.18946	KANSAS	1.37344	KANSAS	1.39478	NEW MEXI	1.44285
WYOMING	0.50724	KANSAS	0.82835	OKLAHOMA	0.87577	WYOMING	0.71616	ARIZONA	0.87655	VERMONT	1.03513	KANSAS	1.16795	UTAH	1.14705	UTAH	1.30184	KANSAS	1.42873
MINNESOT	0.47979	ILLINOIS	0.65288	KANSAS	0.7671	KANSAS	0.70642	COLORADO	0.80505	MONTANA	1.01998	VERMONT	1.04598	VERMONT	1.07589	VERMONT	1.26116	VERMONT	1.41555
MICHIGAN	0.47131	CONNECTI	0.62394	MICHIGAN	0.73108	CONNECTI	0.7046	OKLAHOMA	0.74557	ARIZONA	0.88226	ARIZONA	1.03168	MICHIGAN	0.9909	MICHIGAN	1.15001	UTAH	1.39233
CONNECTI	0.46186	MICHIGAN	0.60543	CONNECTI	0.67198	OKLAHOMA	0.6667	MICHIGAN	0.69764	OKLAHOMA	0.88224	MICHIGAN	0.95275	ARIZONA	0.92445	ARIZONA	1.09269	LOUISIAN	1.29782
ILLINOIS	0.45824	MINNESOT	0.55168	UTAH	0.62417	MINNESOT	0.55863	WISCONSI	0.67877	MICHIGAN	0.85045	OKLAHOMA	0.78667	MONTANA	0.91839	KENTUCKY	1.04821	NORTH CA	1.2514
SOUTH CA	0.39656	WYOMING	0.4982	SOUTH CA	0.52058	COLORADO	0.51888	MONTANA	0.63797	CONNECTI	0.82012	CONNECTI	0.78176	LOUISIAN	0.88696	LOUISIAN	0.98196	MICHIGAN	1.22382
VERMONT	0.39082	TEXAS	0.48879	ILLINOIS	0.50625	TEXAS	0.41644	VERMONT	0.6263	COLORADO	0.80407	MASSACHU	0.75895	WISCONSI	0.73953	WISCONSI	0.93492	KENTUCKY	1.17614
VIRGINIA	0.29683	SOUTH CA	0.46593	MINNESOT	0.4709	VIRGINIA	0.37528	IDAHO	0.5942	WISCONSI	0.68883	WISCONSI	0.70309	CALIFORN	0.72901	CALIFORN	0.8815	OKLAHOMA	1.13817
TEXAS	0.26422	UTAH	0.38305	VERMONT	0.44624	OREGON	0.37104	CONNECTI	0.59351	LOUISIAN	0.65009	COLORADO	0.66189	CONNECTI	0.68069	ALABAMA	0.81895	ARIZONA	1.11055
UTAH	0.25608	WISCONSI	0.33318	COLORADO	0.44067	SOUTH CA	0.36708	OREGON	0.59035	OREGON	0.5827	UTAH	0.62271	MASSACHU	0.67877	MONTANA	0.79849	SOUTH CA	1.08742
MONTANA	0.2385	VERMONT	0.30792	MONTANA	0.36769	ILLINOIS	0.35354	MINNESOT	0.49349	ALABAMA	0.55005	OREGON	0.56482	ALABAMA	0.66828	COLORADO	0.78241	CALIFORN	1.04612
WISCONSI	0.22385	MONTANA	0.30769	WISCONSI	0.34408	MONTANA	0.34268	UTAH	0.48377	WASHINGT	0.49834	ALABAMA	0.52284	OHIO	0.5594	INDIANA	0.78077	INDIANA	1.04133
NORTH DA	0.16369	VIRGINIA	0.20285	TEXAS	0.33815	VERMONT	0.3226	SOUTH CA	0.47142	ILLINOIS	0.49577	ILLINOIS	0.50926	NORTH CA	0.54537	ILLINOIS	0.7767	COLORADO	0.96673
LOUISIAN	0.12922	COLORADO	0.18213	VIRGINIA	0.31936	LOUISIAN	0.29183	ALABAMA	0.46667	UTAH	0.49264	INDIANA	0.50514	ILLINOIS	0.50975	SOUTH CA	0.74284	MONTANA	0.91564
COLORADO	0.059	ALABAMA	0.13734	OREGON	0.2056	UTAH	0.28326	ILLINOIS	0.45748	SOUTH CA	0.47719	OHIO	0.48891	INDIANA	0.48239	MINNESOT	0.66656	ALABAMA	0.8028
ALABAMA	0.02984	WASHINGT	0.10558	LOUISIAN	0.19251	WISCONSI	0.27093	TEXAS	0.44629	MASSACHU	0.44255	LOUISIAN	0.47178	WASHINGT	0.45657	CONNECTI	0.62328	MINNESOT	0.77594
OREGON	-0.02708	NEW JERS	0.04987	NEW JERS	0.17589	WASHINGT	0.25406	VIRGINIA	0.43619	VIRGINIA	0.43554	WASHINGT	0.38127	SOUTH CA	0.44802	NORTH CA	0.61842	ILLINOIS	0.76075
CALIFORN	-0.04614	MASSACHU	0.02757	WASHINGT	0.1714	MASSACHU	0.21274	RHODE IS	0.39107	INDIANA	0.42802	IDAHO	0.32594	OKLAHOMA	0.43594	RHODE IS	0.61105	OHIO	0.73547
WASHINGT	-0.0536	OREGON	0.02565	MASSACHU	0.16146	CALIFORN	0.14072	OHIO	0.28897	MINNESOT	0.41416	MINNESOT	0.32386	COLORADO	0.40587	VIRGINIA	0.57495	CONNECTI	0.68097
MISSOURI	-0.07449	INDIANA	0.00366	RHODE IS	0.14937	OHIO	0.13211	MASSACHU	0.2826	TEXAS	0.39707	RHODE IS	0.30829	MINNESOT	0.38798	OKLAHOMA	0.57112	VIRGINIA	0.64374
NEW JERS	-0.07514	IDAHO	0.00122	INDIANA	0.06024	NEW JERS	0.13199	INDIANA	0.27045	RHODE IS	0.37701	VIRGINIA	0.29687	VIRGINIA	0.36755	OREGON	0.54207	WASHINGT	0.62797
INDIANA	-0.13719	LOUISIAN	-0.03206	CALIFORN	0.0599	RHODE IS	0.08972	LOUISIAN	0.26816	MISSOURI	0.25966	CALIFORN	0.28005	KENTUCKY	0.30393	OHIO	0.52614	OREGON	0.60462
MASSACHU	-0.16317	RHODE IS	-0.04668	NEVADA	0.05976	MISSOURI	0.05883	WASHINGT	0.24259	OHIO	0.20273	NEW JERS	0.25696	MISSOURI	0.29011	WASHINGT	0.49934	RHODE IS	0.58736
PENNSYLV	-0.24348	MISSOURI	-0.05975	OHIO	0.0571	ALABAMA	0.03728	MISSOURI	0.20966	KENTUCKY	0.18651	KENTUCKY	0.24981	OREGON	0.28566	NEW JERS	0.43716	NEW JERS	0.5868
OHIO	-0.2438	NORTH CA	-0.06877	NORTH CA	0.05694	IDAHO	0.01843	CALIFORN	0.17118	NEW JERS	0.18299	MISSOURI	0.2028	RHODE IS	0.27172	MISSOURI	0.30154	MISSOURI	0.48622
IDAHO	-0.25112	OHIO	-0.07745	ALABAMA	0.00334	INDIANA	0.01478	NEW JERS	0.12972	CALIFORN	0.14598	NORTH CA	0.14468	IDAHO	0.24638	HAWAII	0.28864	HAWAII	0.39976
NORTH CA	-0.33454	CALIFORN	-0.09883	IDAHO	-0.00506	NORTH CA	-0.02082	NEW HAMP	-0.00143	IDAHO	0.14062	SOUTH CA	0.14316	NEW JERS	0.23807	IDAHO	0.27345	TEXAS	0.3934
KENTUCKY	-0.34516	NEVADA	-0.1629	MISSOURI	-0.0726	NEVADA	-0.05316	MISSISSI	-0.02118	NORTH CA	0.08069	TEXAS	0.12336	TEXAS	0.16543	NEW YORK	0.27156	MISSISSI	0.35396
MAINE	-0.38223	HAWAII	-0.24548	KENTUCKY	-0.2138	KENTUCKY	-0.08751	KENTUCKY	-0.0595	NEW YORK	-0.08283	NEW YORK	0.04875	MISSISSI	0.08962	MISSISSI	0.24625	IDAHO	0.2533
NEW HAMP	-0.4255	MARYLAND	-0.24722	PENNSYLV	-0.23699	NEW HAMP	-0.24441	NORTH CA	-0.0746	MISSISSI	-0.1233	NEVADA	-0.05522	MARYLAND	0.05712	NEW HAMP	0.19922	NEW YORK	0.21923
RHODE IS	-0.43655	KENTUCKY	-0.27968	NEW HAMP	-0.26087	MAINE	-0.28395	MAINE	-0.14817	PENNSYLV	-0.12875	PENNSYLV	-0.08594	NEVADA	0.05388	TEXAS	0.147	NEW HAMP	0.2117
MISSISSI	-0.46658	PENNSYLV	-0.29432	NEW YORK	-0.31163	MISSISSI	-0.30029	NEW YORK	-0.20631	NEW HAMP	-0.14765	MARYLAND	-0.11437	NEW YORK	0.05313	WEST VIR	0.14003	WEST VIR	0.16589
NEW YORK	-0.50671	NEW HAMP	-0.29966	MAINE	-0.34302	NEW YORK	-0.3288	NEVADA	-0.26321	NEVADA	-0.16198	MISSISSI	-0.176	PENNSYLV	0.00945	MASSACHU	0.10802	MASSACHU	0.14015
HAWAII	-0.53201	MAINE	-0.31069	HAWAII	-0.34493	PENNSYLV	-0.32957	PENNSYLV	-0.27055	MARYLAND	-0.23046	HAWAII	-0.18786	HAWAII	0.00753	PENNSYLV	0.10192	PENNSYLV	0.12236
MARYLAND	-0.58585	NEW YORK	-0.32311	MISSISSI	-0.39559	MARYLAND	-0.36577	HAWAII	-0.45912	MAINE	-0.26879	MAINE	-0.20505	NEW HAMP	-0.06117	MARYLAND	0.05491	MAINE	0.11273
WEST VIR	-0.69659	MISSISSI	-0.45096	MARYLAND	-0.40484	ARKANSAS	-0.38546	ARKANSAS	-0.50766	FLORIDA	-0.33939	NEW HAMP	-0.21423	WEST VIR	-0.18509	ARKANSAS	-0.05479	SOUTH DA	-0.07294
ARKANSAS	-0.7013	WEST VIR	-0.55212	ARKANSAS	-0.55102	HAWAII	-0.42057	TENNESSE	-0.54603	ARKANSAS	-0.37232	ARKANSAS	-0.32708	ARKANSAS	-0.23202	MAINE	-0.11824	MARYLAND	-0.18326
NEVADA	-0.70502	ARKANSAS	-0.66657	SOUTH DA	-0.6139	WEST VIR	-0.64635	WEST VIR	-0.55384	WEST VIR	-0.4588	TENNESSE	-0.36005	MAINE	-0.2353	NEVADA	-0.11997	ARKANSAS	-0.2313
FLORIDA	-0.71901	SOUTH DA	-0.74062	WEST VIR	-0.61939	SOUTH DA	-0.65485	FLORIDA	-0.61586	TENNESSE	-0.47327	SOUTH DA	-0.36636	FLORIDA	-0.3838	SOUTH DA	-0.26463	NEVADA	-0.2478
TENNESSE	-0.82384	TENNESSE	-0.77156	TENNESSE	-0.77766	FLORIDA	-0.76674	SOUTH DA	-0.75645	HAWAII	-0.50403	WEST VIR	-0.41345	SOUTH DA	-0.40767	TENNESSE	-0.35123	FLORIDA	-0.25841
SOUTH DA	-0.91265	FLORIDA	-0.77887	FLORIDA	-0.86782	TENNESSE	-0.7902	MARYLAND	-0.94424	SOUTH DA	-0.61048	FLORIDA	-0.47418	TENNESSE	-0.43878	FLORIDA	-0.37192	TENNESSE	-0.27739

State Commercialization Capacity:

State Commercialization Capacity Rank and Score: 1983-1992

	1983		1984		1985		1986		1987		1988		1989		1990		1991		1992
Rank	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
CALIFORN	-0.03035	CALIFORN	1.12946	CALIFORN	1.68891	CALIFORN	2.92789	CALIFORN	2.68443	CALIFORN	3.58038	CALIFORN	3.4253	CALIFORN	3.99998	CALIFORN	3.66849	CALIFORN	3.93683
MAINE	-0.12687	MAINE	0.801	MAINE	0.84776	MAINE	1.54296	MAINE	1.32055	MAINE	2.08844	MAINE	2.16726	MAINE	2.4136	MAINE	2.27081	MAINE	2.82182
VERMONT	-0.32494	VERMONT	-0.06705	VERMONT	0.20492	VERMONT	0.33951	MARYLAND	0.2245	MARYLAND	0.70931	VERMONT	0.47106	NORTH DA	0.5107	VERMONT	0.54956	NORTH DA	0.53783
MARYLAND	-0.37282	OHIO	-0.13095	MARYLAND	-0.02	MARYLAND	0.16558	VERMONT	0.18283	VERMONT	0.38601	MARYLAND	0.37662	MARYLAND	0.35278	MARYLAND	0.42199	VERMONT	0.39728
WASHINGT	-0.37656	MARYLAND	-0.15102	PENNSYLV	-0.04473	NORTH DA	0.16044	NORTH DA	0.08091	PENNSYLV	0.23933	NORTH DA	0.28559	VERMONT	0.32098	NORTH DA	0.28054	MARYLAND	0.37496
OHIO	-0.38509	PENNSYLV	-0.16964	NORTH DA	-0.11834	PENNSYLV	0.11716	PENNSYLV	0.06667	NORTH DA	0.20517	PENNSYLV	0.15329	CONNECTI	0.26688	COLORADO	0.1861	CONNECTI	0.27819
PENNSYLV	-0.39473	WASHINGT	-0.17214	WASHINGT	-0.12713	COLORADO	0.07119	TEXAS	-0.08423	NEW MEXI	0.07499	TEXAS	0.12263	PENNSYLV	0.16002	PENNSYLV	0.17012	OHIO	0.14705
NORTH DA	-0.39793	NORTH DA	-0.23202	OHIO	-0.1735	TEXAS	0.02058	COLORADO	-0.11848	COLORADO	0.05037	COLORADO	0.02357	TEXAS	0.08752	TEXAS	0.16986	NEW MEXI	0.13092
TEXAS	-0.40269	COLORADO	-0.29435	COLORADO	-0.17796	CONNECTI	-0.03293	WASHINGT	-0.14031	FLORIDA	0.00376	OHIO	0.01718	NEW MEXI	0.05688	NEW MEXI	0.05378	NEW YORK	0.12249
CONNECTI	-0.41503	ALASKA	-0.29724	NEW YORK	-0.22546	OHIO	-0.04297	CONNECTI	-0.14746	WASHINGT	-0.00885	NEW MEXI	-0.00434	FLORIDA	0.03891	CONNECTI	-0.02444	PENNSYLV	0.075
COLORADO	-0.41693	MICHIGAN	-0.30218	CONNECTI	-0.22813	NEW YORK	-0.06023	OHIO	-0.15926	CONNECTI	-0.04421	CONNECTI	-0.03955	COLORADO	0.01205	OHIO	-0.06519	MICHIGAN	0.03428
NEBRASKA	-0.42319	INDIANA	-0.32002	TEXAS	-0.24559	WASHINGT	-0.08559	NEW YORK	-0.20177	NEW YORK	-0.08867	NEW YORK	-0.07838	WASHINGT	-0.037	INDIANA	-0.13433	TEXAS	0.02146
INDIANA	-0.42388	NEBRASKA	-0.32727	NEW MEXI	-0.29792	FLORIDA	-0.1018	FLORIDA	-0.22176	TEXAS	-0.10293	FLORIDA	-0.07974	OHIO	-0.07338	NEW YORK	-0.14507	COLORADO	-0.02945
ALASKA	-0.42421	NEW MEXI	-0.33699	IOWA	-0.32114	NEW MEXI	-0.20222	NEW MEXI	-0.22621	UTAH	-0.1538	WASHINGT	-0.12537	NEW YORK	-0.13202	ALASKA	-0.14764	WASHINGT	-0.05487
NEW MEXI	-0.42517	TEXAS	-0.33816	INDIANA	-0.32918	UTAH	-0.2301	INDIANA	-0.24569	OHIO	-0.16665	INDIANA	-0.1911	INDIANA	-0.13566	FLORIDA	-0.15925	INDIANA	-0.05876
UTAH	-0.42749	CONNECTI	-0.33974	MICHIGAN	-0.3363	MICHIGAN	-0.23828	TENNESSE	-0.25454	ALASKA	-0.17654	TENNESSE	-0.20839	TENNESSE	-0.1433	ARKANSAS	-0.18158	FLORIDA	-0.06804
MICHIGAN	-0.42919	OREGON	-0.34258	MINNESOT	-0.33678	MINNESOT	-0.25802	MICHIGAN	-0.26345	INDIANA	-0.1788	MICHIGAN	-0.2088	MINNESOT	-0.14572	OREGON	-0.18799	ALASKA	-0.10289
TENNESSE	-0.43488	UTAH	-0.34817	UTAH	-0.34538	ALASKA	-0.26308	UTAH	-0.26554	TENNESSE	-0.20137	UTAH	-0.21243	UTAH	-0.22431	MINNESOT	-0.20452	UTAH	-0.14487
FLORIDA	-0.43706	ARKANSAS	-0.36148	ALASKA	-0.34796	NEW JERS	-0.26419	ALASKA	-0.30186	MICHIGAN	-0.22491	NEW JERS	-0.23597	NEBRASKA	-0.22779	WASHINGT	-0.22375	OREGON	-0.18592
NEW YORK	-0.43927	FLORIDA	-0.36868	NEBRASKA	-0.35332	INDIANA	-0.30062	NEBRASKA	-0.31774	ARKANSAS	-0.25954	ARKANSAS	-0.26538	ALASKA	-0.23639	MICHIGAN	-0.23142	NEW JERS	-0.20289
NEW JERS	-0.44018	TENNESSE	-0.37458	NEW JERS	-0.35603	OREGON	-0.31243	MINNESOT	-0.32779	OREGON	-0.26944	MINNESOT	-0.2838	MICHIGAN	-0.2539	UTAH	-0.25726	NEBRASKA	-0.22544
ARKANSAS	-0.4411	NEW JERS	-0.37873	OKLAHOMA	-0.37313	TENNESSE	-0.31933	NEW JERS	-0.33697	NEW JERS	-0.27046	ALASKA	-0.30258	OREGON	-0.25965	NEBRASKA	-0.28033	MINNESOT	-0.2264
OREGON	-0.44397	MINNESOT	-0.38459	TENNESSE	-0.3733	NEBRASKA	-0.32816	OREGON	-0.35288	MINNESOT	-0.27398	NEBRASKA	-0.32001	ARKANSAS	-0.30958	TENNESSE	-0.29331	ARKANSAS	-0.27654
DELAWARE	-0.44657	GEORGIA	-0.38713	OREGON	-0.37412	ARKANSAS	-0.35441	ARKANSAS	-0.37401	GEORGIA	-0.34206	OREGON	-0.32418	NEW JERS	-0.32951	NEW JERS	-0.30312	WEST VIR	-0.27705
MASSACHU	-0.44707	NEW YORK	-0.38931	FLORIDA	-0.38226	IOWA	-0.35754	GEORGIA	-0.3853	NEBRASKA	-0.3531	GEORGIA	-0.3675	GEORGIA	-0.3628	WEST VIR	-0.32854	GEORGIA	-0.27915
MINNESOT	-0.4473	IOWA	-0.40628	GEORGIA	-0.39854	GEORGIA	-0.37467	WEST VIR	-0.41337	IOWA	-0.37725	DELAWARE	-0.37204	WEST VIR	-0.36347	NORTH CA	-0.35683	TENNESSE	-0.302
IOWA	-0.44807	WEST VIR	-0.40788	ARKANSAS	-0.39904	MASSACHU	-0.39096	NORTH CA	-0.41529	HAWAII	-0.38713	WEST VIR	-0.38801	MISSISSI	-0.37804	MISSISSI	-0.358	HAWAII	-0.31494
WEST VIR	-0.45006	DELAWARE	-0.42316	DELAWARE	-0.40739	MISSISSI	-0.39849	OKLAHOMA	-0.41703	OKLAHOMA	-0.40263	MISSISSI	-0.39893	IOWA	-0.38368	GEORGIA	-0.36821	NORTH CA	-0.37296
GEORGIA	-0.45064	MISSISSI	-0.43156	LOUISIAN	-0.41425	DELAWARE	-0.41383	SOUTH CA	-0.42046	MISSISSI	-0.40635	OKLAHOMA	-0.40067	VIRGINIA	-0.40022	IDAHO	-0.37627	RHODE IS	-0.39469
RHODE IS	-0.45221	NEW HAMP	-0.43254	NORTH CA	-0.41477	OKLAHOMA	-0.41788	IOWA	-0.4212	LOUISIAN	-0.41189	MONTANA	-0.40396	NORTH CA	-0.40376	HAWAII	-0.38871	MISSISSI	-0.39783
OKLAHOMA	-0.45476	HAWAII	-0.43305	KANSAS	-0.42306	RHODE IS	-0.42449	MISSISSI	-0.42318	KENTUCKY	-0.41487	IOWA	-0.40422	RHODE IS	-0.40908	VIRGINIA	-0.39748	IOWA	-0.40182
KANSAS	-0.45512	MASSACHU	-0.43752	MASSACHU	-0.43171	WEST VIR	-0.42562	LOUISIAN	-0.42511	NORTH CA	-0.41616	MASSACHU	-0.40629	LOUISIAN	-0.41224	IOWA	-0.39802	NEW HAMP	-0.40865
MISSISSI	-0.45521	RHODE IS	-0.43797	VIRGINIA	-0.43498	KANSAS	-0.43685	MASSACHU	-0.42926	MASSACHU	-0.4217	ARIZONA	-0.41613	MASSACHU	-0.41519	RHODE IS	-0.40595	OKLAHOMA	-0.41421
NEW HAMP	-0.45534	ILLINOIS	-0.43805	MONTANA	-0.437	MONTANA	-0.44003	RHODE IS	-0.43145	NEW HAMP	-0.4286	HAWAII	-0.42033	OKLAHOMA	-0.41669	LOUISIAN	-0.41911	IDAHO	-0.41843
NORTH CA	-0.45628	ARIZONA	-0.44035	MISSISSI	-0.43791	VIRGINIA	-0.44333	VIRGINIA	-0.43784	IDAHO	-0.43104	IDAHO	-0.42137	IDAHO	-0.42341	DELAWARE	-0.42159	DELAWARE	-0.42757
MISSOURI	-0.45647	MISSOURI	-0.44835	RHODE IS	-0.44063	LOUISIAN	-0.44377	MONTANA	-0.44198	WEST VIR	-0.43226	NORTH CA	-0.42439	ARIZONA	-0.4297	OKLAHOMA	-0.42234	MASSACHU	-0.43119
HAWAII	-0.45697	OKLAHOMA	-0.44915	ILLINOIS	-0.44598	NORTH CA	-0.44463	HAWAII	-0.44624	VIRGINIA	-0.43297	LOUISIAN	-0.43212	HAWAII	-0.44156	NEW HAMP	-0.42514	MISSOURI	-0.43453
LOUISIAN	-0.45705	LOUISIAN	-0.45322	HAWAII	-0.44713	ARIZONA	-0.44952	DELAWARE	-0.44627	RHODE IS	-0.43535	KANSAS	-0.43222	MONTANA	-0.44358	MASSACHU	-0.4301	ARIZONA	-0.43835
ARIZONA	-0.45764	IDAHO	-0.4539	WEST VIR	-0.44771	MISSOURI	-0.45015	KANSAS	-0.44744	ARIZONA	-0.43723	NEVADA	-0.43823	NEW HAMP	-0.44829	KANSAS	-0.43185	KANSAS	-0.43895
KENTUCKY	-0.45805	NORTH CA	-0.45417	NEW HAMP	-0.4514	ILLINOIS	-0.45233	MISSOURI	-0.44954	DELAWARE	-0.43971	KENTUCKY	-0.43914	DELAWARE	-0.44843	MONTANA	-0.44062	ALABAMA	-0.44244
ILLINOIS	-0.45845	VIRGINIA	-0.45571	SOUTH CA	-0.45343	HAWAII	-0.45377	IDAHO	-0.45057	ILLINOIS	-0.44736	VIRGINIA	-0.44154	KENTUCKY	-0.45013	WISCONSI	-0.44215	LOUISIAN	-0.44313
ALABAMA	-0.46057	SOUTH CA	-0.45614	MISSOURI	-0.45613	IDAHO	-0.45596	NEW HAMP	-0.45378	MISSOURI	-0.4487	ILLINOIS	-0.44676	KANSAS	-0.45073	ILLINOIS	-0.44836	KENTUCKY	-0.4438
NEVADA	-0.46057	KANSAS	-0.45618	KENTUCKY	-0.45819	KENTUCKY	-0.45604	KENTUCKY	-0.4569	MONTANA	-0.44903	NEW HAMP	-0.44681	ILLINOIS	-0.4534	MISSOURI	-0.44891	MONTANA	-0.44902
SOUTH CA	-0.46057	KENTUCKY	-0.45711	WISCONSI	-0.4582	WISCONSI	-0.45639	WISCONSI	-0.45823	NEVADA	-0.44949	RHODE IS	-0.45212	WISCONSI	-0.45455	KENTUCKY	-0.45087	ILLINOIS	-0.45083
SOUTH DA	-0.46057	MONTANA	-0.45816	ARIZONA	-0.45827	SOUTH CA	-0.45659	ILLINOIS	-0.45826	KANSAS	-0.4495	MISSOURI	-0.45242	SOUTH CA	-0.45564	WYOMING	-0.45222	VIRGINIA	-0.45111
MONTANA	-0.46057	SOUTH DA	-0.4583	WYOMING	-0.46057	SOUTH DA	-0.45824	WYOMING	-0.4583	SOUTH DA	-0.45011	SOUTH CA	-0.45356	NEVADA	-0.45658	ARIZONA	-0.45464	NEVADA	-0.45315
WYOMING	-0.46057	WYOMING	-0.46057	IDAHO	-0.46057	NEW HAMP	-0.45827	NEVADA	-0.45833	SOUTH CA	-0.45204	WISCONSI	-0.45442	MISSOURI	-0.45713	SOUTH CA	-0.45859	SOUTH DA	-0.45862
WISCONSI	-0.46058	NEVADA	-0.46057	NEVADA	-0.46057	WYOMING	-0.46057	SOUTH DA	-0.45833	ALABAMA	-0.45446	SOUTH DA	-0.45805	ALABAMA	-0.45769	ALABAMA	-0.46057	WISCONSI	-0.45866
IDAHO	-0.46059	WISCONSI	-0.46058	SOUTH DA	-0.46057	NEVADA	-0.46057	ARIZONA	-0.45834	WISCONSI	-0.45618	WYOMING	-0.45844	WYOMING	-0.45859	NEVADA	-0.46057	WYOMING	-0.45924
VIRGINIA	-0.46065	ALABAMA	-0.46058	ALABAMA	-0.46058	ALABAMA	-0.46058	ALABAMA	-0.46059	WYOMING	-0.46057	ALABAMA	-0.45844	SOUTH DA	-0.46057	SOUTH DA	-0.46057	SOUTH CA	-0.46057

State Commercialization Capacity Rank and Score: 1993-2002

	1993		1994		1995		1996		1997		1998		1999		2000		2001		2002
Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
CALIFORN	4.20978	CALIFORN	4.93372	CALIFORN	6.67235	CALIFORN	6.67054	CALIFORN	7.9249	CALIFORN	7.05895	CALIFORN	6.49157	CALIFORN	6.30631	CALIFORN	7.55212	CALIFORN	8.78662
MAINE	3.5108	MAINE	2.51898	MAINE	4.48098	MAINE	4.5576	MAINE	5.04889	MAINE	4.81658	MAINE	5.10708	MAINE	4.77841	MAINE	4.90703	MAINE	6.20022
NORTH DA	0.75204	VERMONT	0.78415	VERMONT	1.45501	VERMONT	1.43203	VERMONT	1.84694	VERMONT	1.55321	COLORADO	1.65108	VERMONT	1.41594	VERMONT	1.82161	VERMONT	2.31531
MARYLAND	0.69788	MARYLAND	0.67494	NORTH DA	1.32112	NORTH DA	1.0179	MARYLAND	1.18416	MARYLAND	1.18523	VERMONT	1.62192	COLORADO	1.25734	MARYLAND	1.27292	MARYLAND	1.86774
VERMONT	0.69202	NORTH DA	0.49199	MARYLAND	0.98323	MARYLAND	0.77	NORTH DA	1.13579	COLORADO	1.10827	MARYLAND	1.29728	MARYLAND	1.1991	COLORADO	1.26069	COLORADO	1.85724
COLORADO	0.54813	COLORADO	0.43406	OHIO	0.85277	COLORADO	0.66058	COLORADO	1.03256	OHIO	1.07811	NORTH DA	1.14175	OHIO	0.93662	OHIO	1.08806	NORTH DA	1.50421
PENNSYLV	0.3883	NEW MEXI	0.29282	PENNSYLV	0.76806	TEXAS	0.64946	PENNSYLV	0.93655	TEXAS	0.86168	OHIO	1.00075	NORTH DA	0.87732	NORTH DA	0.83916	OHIO	1.49624
CONNECTI	0.35651	CONNECTI	0.27977	COLORADO	0.7473	OHIO	0.56962	TEXAS	0.78186	PENNSYLV	0.84647	TEXAS	0.82762	TEXAS	0.79658	TEXAS	0.83702	PENNSYLV	1.22535
NEW MEXI	0.32585	TEXAS	0.23304	CONNECTI	0.70539	CONNECTI	0.52273	OHIO	0.75604	NORTH DA	0.80543	PENNSYLV	0.78187	PENNSYLV	0.5556	PENNSYLV	0.80735	TEXAS	1.20693
TEXAS	0.31136	PENNSYLV	0.1146	TEXAS	0.66693	NEW MEXI	0.45524	NEW MEXI	0.62712	MICHIGAN	0.59939	NEW MEXI	0.65712	NEW MEXI	0.48785	NEW MEXI	0.54096	NEW MEXI	0.97563
OHIO	0.14829	OHIO	0.05261	NEW MEXI	0.6489	PENNSYLV	0.39326	CONNECTI	0.57489	NEW MEXI	0.4941	WASHINGT	0.4785	FLORIDA	0.33678	WASHINGT	0.41401	WASHINGT	0.87622
FLORIDA	0.08125	WASHINGT	0.04983	WASHINGT	0.41713	WASHINGT	0.25289	ALASKA	0.45155	WASHINGT	0.4909	FLORIDA	0.30202	ALASKA	0.32043	FLORIDA	0.30424	ARKANSAS	0.59556
NEW YORK	0.03703	MICHIGAN	-0.0739	FLORIDA	0.19678	ALASKA	0.20735	FLORIDA	0.44258	CONNECTI	0.37329	NEW YORK	0.26474	WASHINGT	0.20403	ARKANSAS	0.24985	ALASKA	0.47419
WASHINGT	0.0194	OREGON	-0.08079	MICHIGAN	0.18151	MINNESOT	0.18521	MICHIGAN	0.36151	ARKANSAS	0.17458	ARKANSAS	0.25679	ARKANSAS	0.19324	MICHIGAN	0.24552	FLORIDA	0.45704
UTAH	-0.04964	ALASKA	-0.08336	NEW YORK	0.18046	FLORIDA	0.15719	WASHINGT	0.34046	ALASKA	0.15842	CONNECTI	0.18005	NEW YORK	0.12275	NEW YORK	0.14537	MINNESOT	0.3633
INDIANA	-0.11013	FLORIDA	-0.12464	ALASKA	0.16934	NEW YORK	0.15344	ARKANSAS	0.23695	FLORIDA	0.12012	OREGON	0.09625	INDIANA	0.10172	CONNECTI	0.13523	MICHIGAN	0.29673
ARKANSAS	-0.12741	NEW YORK	-0.14446	MINNESOT	0.07712	MICHIGAN	0.12003	NEW JERS	0.14499	NEW YORK	0.09387	NEBRASKA	0.09419	CONNECTI	0.09507	INDIANA	0.12642	CONNECTI	0.26334
MICHIGAN	-0.18996	ARKANSAS	-0.14522	OREGON	-0.01649	ARKANSAS	0.02773	NEW YORK	0.14218	OREGON	0.04513	MICHIGAN	0.07093	MICHIGAN	0.06186	MINNESOT	0.01589	NEBRASKA	0.23132
ALASKA	-0.19356	TENNESSE	-0.15922	NEW JERS	-0.05569	OREGON	0.02006	OREGON	0.13346	INDIANA	0.01851	INDIANA	0.06655	MINNESOT	-0.00909	NEBRASKA	0.00739	NEW YORK	0.19874
MINNESOT	-0.19816	NEW JERS	-0.16905	INDIANA	-0.07894	NEW JERS	0.01149	MINNESOT	0.12131	NEBRASKA	-0.00713	ALASKA	0.0291	NEW JERS	-0.01986	ALASKA	0.00726	NEW JERS	0.13722
NEW JERS	-0.19907	NEBRASKA	-0.16924	NEBRASKA	-0.098	INDIANA	-0.07029	NEBRASKA	0.04539	MINNESOT	-0.0781	MINNESOT	0.01161	OREGON	-0.08797	OREGON	-0.01146	OREGON	0.11193
NEBRASKA	-0.24036	MINNESOT	-0.18193	ARKANSAS	-0.10776	TENNESSE	-0.10456	INDIANA	0.0083	GEORGIA	-0.11719	NEW JERS	-0.00647	NEBRASKA	-0.09977	NEW JERS	-0.04927	INDIANA	0.07153
OREGON	-0.25839	INDIANA	-0.23483	UTAH	-0.13885	UTAH	-0.17275	GEORGIA	-0.08572	NEW JERS	-0.12727	GEORGIA	-0.03923	GEORGIA	-0.12398	GEORGIA	-0.06493	UTAH	0.02717
TENNESSE	-0.25841	UTAH	-0.27292	WEST VIR	-0.1618	NEBRASKA	-0.17544	UTAH	-0.10145	TENNESSE	-0.1659	UTAH	-0.07332	TENNESSE	-0.14935	WEST VIR	-0.10876	WEST VIR	0.00569
MASSACHU	-0.34771	WEST VIR	-0.3076	TENNESSE	-0.19765	WEST VIR	-0.1984	WEST VIR	-0.10848	UTAH	-0.17103	WEST VIR	-0.11932	WEST VIR	-0.16384	TENNESSE	-0.12548	GEORGIA	-0.03148
GEORGIA	-0.35187	GEORGIA	-0.33863	GEORGIA	-0.21745	IOWA	-0.31582	TENNESSE	-0.17658	MISSISSI	-0.24543	IOWA	-0.21168	UTAH	-0.19304	UTAH	-0.13884	TENNESSE	-0.14338
WEST VIR	-0.35955	IOWA	-0.37955	KANSAS	-0.27663	HAWAII	-0.31973	IOWA	-0.21606	WEST VIR	-0.2501	TENNESSE	-0.24825	MONTANA	-0.27035	MONTANA	-0.21668	IOWA	-0.19579
RHODE IS	-0.38019	HAWAII	-0.38329	IOWA	-0.28977	VIRGINIA	-0.3366	DELAWARE	-0.30982	KANSAS	-0.31083	DELAWARE	-0.26475	MISSISSI	-0.2985	IOWA	-0.29911	DELAWARE	-0.23033
IOWA	-0.38229	MONTANA	-0.38642	VIRGINIA	-0.3558	GEORGIA	-0.34775	KENTUCKY	-0.32672	IOWA	-0.35568	MISSISSI	-0.27686	HAWAII	-0.31795	SOUTH CA	-0.31451	NORTH CA	-0.23095
MISSISSI	-0.38453	MISSISSI	-0.39554	MASSACHU	-0.36329	KENTUCKY	-0.37125	MISSISSI	-0.33964	OKLAHOMA	-0.35588	HAWAII	-0.33347	IOWA	-0.32069	RHODE IS	-0.33922	SOUTH CA	-0.23388
NEW HAMP	-0.39195	RHODE IS	-0.39668	HAWAII	-0.37667	LOUISIAN	-0.38222	RHODE IS	-0.34912	VIRGINIA	-0.35721	OKLAHOMA	-0.33761	DELAWARE	-0.33117	WISCONSI	-0.34341	MISSISSI	-0.24573
DELAWARE	-0.39633	DELAWARE	-0.40067	MISSISSI	-0.38183	RHODE IS	-0.38608	OKLAHOMA	-0.37157	MONTANA	-0.36562	KENTUCKY	-0.34052	SOUTH CA	-0.33257	DELAWARE	-0.34355	MONTANA	-0.24802
VIRGINIA	-0.40119	VIRGINIA	-0.40354	OKLAHOMA	-0.38374	MASSACHU	-0.40235	HAWAII	-0.37843	HAWAII	-0.37794	IDAHO	-0.36063	VIRGINIA	-0.3421	NORTH CA	-0.34657	IDAHO	-0.27884
LOUISIAN	-0.40338	MASSACHU	-0.40554	DELAWARE	-0.38938	MONTANA	-0.40574	NORTH CA	-0.38267	NORTH CA	-0.37985	VIRGINIA	-0.36189	MISSOURI	-0.34538	KANSAS	-0.3485	OKLAHOMA	-0.28969
OKLAHOMA	-0.40613	LOUISIAN	-0.41315	MONTANA	-0.39374	OKLAHOMA	-0.40728	KANSAS	-0.38453	LOUISIAN	-0.40266	RHODE IS	-0.36544	RHODE IS	-0.34714	MASSACHU	-0.35372	RHODE IS	-0.2934
KANSAS	-0.40876	KANSAS	-0.42371	RHODE IS	-0.40348	SOUTH CA	-0.40965	WYOMING	-0.38868	SOUTH CA	-0.41854	KANSAS	-0.36731	KANSAS	-0.37091	OKLAHOMA	-0.35609	KANSAS	-0.30264
NORTH CA	-0.41158	OKLAHOMA	-0.43062	ILLINOIS	-0.40426	NORTH CA	-0.41258	VIRGINIA	-0.39695	NEW HAMP	-0.42154	SOUTH DA	-0.38872	MASSACHU	-0.37656	HAWAII	-0.35835	KENTUCKY	-0.32212
HAWAII	-0.41244	ARIZONA	-0.43541	KENTUCKY	-0.40879	MISSOURI	-0.4218	MASSACHU	-0.40935	MASSACHU	-0.42218	MONTANA	-0.39161	NEW HAMP	-0.38028	KENTUCKY	-0.3618	ILLINOIS	-0.3279
KENTUCKY	-0.41686	ILLINOIS	-0.43918	NEW HAMP	-0.41564	DELAWARE	-0.42182	NEW HAMP	-0.41302	DELAWARE	-0.42644	WISCONSI	-0.40541	NEVADA	-0.38147	MISSISSI	-0.36861	HAWAII	-0.35297
MONTANA	-0.43029	KENTUCKY	-0.43945	NORTH CA	-0.41745	KANSAS	-0.42696	SOUTH CA	-0.41534	KENTUCKY	-0.42779	SOUTH CA	-0.40613	KENTUCKY	-0.38394	VIRGINIA	-0.3748	MISSOURI	-0.3593
NEVADA	-0.43587	NORTH CA	-0.44047	LOUISIAN	-0.43175	SOUTH DA	-0.42797	IDAHO	-0.41689	ARIZONA	-0.43091	MASSACHU	-0.41088	OKLAHOMA	-0.38804	LOUISIAN	-0.37794	LOUISIAN	-0.36041
ILLINOIS	-0.45005	IDAHO	-0.45154	MISSOURI	-0.43242	NEVADA	-0.43163	WISCONSI	-0.41917	SOUTH DA	-0.43165	ILLINOIS	-0.41473	ARIZONA	-0.39318	NEW HAMP	-0.38618	WYOMING	-0.36243
IDAHO	-0.45107	SOUTH CA	-0.45199	NEVADA	-0.43509	ALABAMA	-0.43349	MISSOURI	-0.42417	WYOMING	-0.43573	NORTH CA	-0.41779	LOUISIAN	-0.39926	IDAHO	-0.39443	MASSACHU	-0.37704
ARIZONA	-0.4512	MISSOURI	-0.45234	SOUTH CA	-0.44634	MISSISSI	-0.43427	LOUISIAN	-0.4286	IDAHO	-0.43819	ARIZONA	-0.41788	WISCONSI	-0.40447	WYOMING	-0.39919	VIRGINIA	-0.38909
MISSOURI	-0.45122	NEVADA	-0.45411	SOUTH DA	-0.44839	IDAHO	-0.44404	ILLINOIS	-0.42936	RHODE IS	-0.43836	NEW HAMP	-0.42077	WYOMING	-0.4065	ILLINOIS	-0.40494	SOUTH DA	-0.39356
WYOMING	-0.46057	NEW HAMP	-0.4555	ALABAMA	-0.44966	ILLINOIS	-0.44443	SOUTH DA	-0.43477	ILLINOIS	-0.44134	MISSOURI	-0.43054	NORTH CA	-0.40783	NEVADA	-0.41422	ARIZONA	-0.39893
SOUTH DA	-0.46057	SOUTH DA	-0.45873	IDAHO	-0.45267	WYOMING	-0.44718	NEVADA	-0.43829	WISCONSI	-0.44457	WYOMING	-0.4344	IDAHO	-0.4296	ARIZONA	-0.43344	NEW HAMP	-0.40267
SOUTH CA	-0.46058	WYOMING	-0.46057	ARIZONA	-0.45816	WISCONSI	-0.45111	MONTANA	-0.44907	NEVADA	-0.45029	LOUISIAN	-0.43704	ILLINOIS	-0.43081	ALABAMA	-0.43755	NEVADA	-0.41826
WISCONSI	-0.4606	WISCONSI	-0.46058	WYOMING	-0.45841	ARIZONA	-0.45557	ARIZONA	-0.44963	ALABAMA	-0.4517	NEVADA	-0.44517	SOUTH DA	-0.43886	SOUTH DA	-0.43762	WISCONSI	-0.42056
ALABAMA	-0.46063	ALABAMA	-0.4606	WISCONSI	-0.46058	NEW HAMP	-0.45635	ALABAMA	-0.45533	MISSOURI	-0.45703	ALABAMA	-0.45861	ALABAMA	-0.44038	MISSOURI	-0.43947	ALABAMA	-0.45798

Appendix B

Results of Fixed Effects Analysis

Results of Fixed-Effects Analysis

			Independent Variables							
Model	**Dependent Variable**	**Overall R-sq**	*SLFINCAP*	*FEDFINCAP*	*HUMANCAP*	*RFOSEFEP*	*RFRDPPP*	*SLARDPP*	*PISR*	*COMMCAP*
1	PISR	0.833	-218.6***	383.9***	2700.8***	-3.3	18.3*	-0.97	n/a	n/a
2	PISR t+1	0.822	-244.7***	393.5***	3098.1***	-8.9	24.7**	0.51	n/a	n/a
3	PISR t+2	0.813	-279.2***	429.1***	3476.9***	-8.8	30.9**	1.9	n/a	n/a
4	PISR t+3	0.812	-316.4***	418.6***	3793.5***	-8.2	37.8***	3.1	n/a	n/a
5	PISR t+4	0.815	-375.9***	442.7***	4130.8***	-0.96	41.0***	2.8	n/a	n/a
6	PISR t+5	0.82	-430.6***	430.7***	4326.2***	.11	47.8***	5.0	n/a	n/a
7	COMMCAP	0.38	n/a	n/a	n/a	n/a	n/a	n/a	.000398***	n/a
8	COMMCAP t+1	0.36	n/a	n/a	n/a	n/a	n/a	n/a	.000417***	n/a
9	COMMCAP t+2	0.34	n/a	n/a	n/a	n/a	n/a	n/a	.000447***	n/a
10	COMMCAP t+3	0.33	n/a	n/a	n/a	n/a	n/a	n/a	.000514***	n/a
11	COMMCAP t+4	0.32	n/a	n/a	n/a	n/a	n/a	n/a	.00058***	n/a
12	COMMCAP t+5	0.31	n/a	n/a	n/a	n/a	n/a	n/a	.000738***	n/a
13	REALGSP	0.87	n/a	n/a	n/a	n/a	n/a	n/a	47,200,000***	8,970,000,000***
14	REALGSP t+1	0.87	n/a	n/a	n/a	n/a	n/a	n/a	49,200,000***	9,930,000,000***
15	REALGSP t+2	0.88	n/a	n/a	n/a	n/a	n/a	n/a	51,700,000***	11,300,000,000***
16	REALGSP t+3	0.89	n/a	n/a	n/a	n/a	n/a	n/a	57,800,000***	11,600,000,000***
17	REALGSP t+4	0.91	n/a	n/a	n/a	n/a	n/a	n/a	83,600,000***	2,690,000,000
18	REALGSP t+5	0.91	n/a	n/a	n/a	n/a	n/a	n/a	89,200,000***	1,640,000,000
		* = p<.05; ** = p<.01; *** = p<.001								

Appendix C:

Results with Population Density as a Control Variable

As indicated in Chapter Six, the following tables represent the output of a series of six supplemental models that investigate the relationship of innovation capacity to innovation outcomes when state population density is included as a control variable.

To summarize, these models are all statistically significant, with R-sq values ranging from 0.86 in the same year equation to 0.83 in the equation that includes a five-year lag. The variables RFRDPPP and RFOSEFE are not statistically significant in either iteration of the model. State & Local Financial Capacity for Innovation is statistically significant in each model, with coefficients ranging from 67.8 to 92.6 in the first three iterations, and then declining again to 73.4 with the five-year lag. Federal Financial Capacity is not statistically significant in the same-year model or the one-year lag model, but is significant in the remaining iterations. The coefficients for Federal Financial Capacity steadily increase from 36.4 to 60.8. Human Capacity for Innovation is statistically significant with a steadily increasing coefficient ranging from 1341.9 to 1784.7. State/Local-Funded Academic Research & Development is not statistically significant in the same-year model but is in those iterations that follow, with coefficients increasing from 3.8 to 7.5.

These trends are virtually the same in trend and magnitude as the results obtained in the original cross sectional analysis using panel corrected standard errors, with the exception of the fact that State/Local-Funded Academic Research & Development is now significant in all but the first iteration. The addition of the Density measure, then, has not dramatically altered the initial findings. The Density measure is statistically significant (p<.001) in all iterations, and its coefficient gradually decreases from 0.87 to 0.62. So, if population density is higher by four persons per square mile, a state will generate approximately three additional patents in the same year.

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Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =      1000
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        20
Autocorrelation:  no autocorrelation                           avg =        20
                                                               max =        20
Estimated covariances      =      1275          R-squared          =    0.8557
Estimated autocorrelations =         0          Wald chi2(7)       =   2836.60
Estimated coefficients     =         8          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
        pisr |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    slfincap |   67.76237   21.73191     3.12   0.002     25.16862    110.3561
    fedfinca |    14.1389   12.80964     1.10   0.270    -10.96754    39.24533
    humancap |   1341.872   81.26906    16.51   0.000     1182.588    1501.157
    rfosefep |   6.781993   11.65521     0.58   0.561    -16.06179    29.62578
     rfrdppp |  -4.098111   7.705869    -0.53   0.595    -19.20134    11.00512
     slardpp |   2.344162   1.480651     1.58   0.113    -.5578602    5.246184
     density |    .870989   .0785743    11.08   0.000     .7169862    1.024992
       _cons |   835.5437   40.03863    20.87   0.000     757.0694     914.018
------------------------------------------------------------------------------
```

```
Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:   fips                          Number of obs      =      1000
Time variable:    year                          Number of groups   =        50
Panels:           correlated (balanced)         Obs per group: min =        20
Autocorrelation:  no autocorrelation                           avg =        20
                                                               max =        20
Estimated covariances      =      1275          R-squared          =    0.8415
Estimated autocorrelations =         0          Wald chi2(7)       =   2844.56
Estimated coefficients     =         8          Prob > chi2        =    0.0000

------------------------------------------------------------------------------
             |           Panel-corrected
       PISR1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    slfincap |   81.78408   23.63449     3.46   0.001     35.46134    128.1068
    fedfinca |   23.74454   13.12284     1.81   0.070    -1.975756    49.46484
    humancap |   1433.313   93.54853    15.32   0.000     1249.962    1616.665
    rfosefep |   2.760712   12.56495     0.22   0.826    -21.86614    27.38756
     rfrdppp |   .0321574   8.355377     0.00   0.997    -16.34408    16.40839
     slardpp |   3.798015   1.681331     2.26   0.024     .5026665    7.093364
     density |   .8303488   .0865888     9.59   0.000     .6606379     1.00006
       _cons |   876.1483   43.57991    20.10   0.000     790.7332    961.5633
------------------------------------------------------------------------------
```

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	1000
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	20
Autocorrelation:	no autocorrelation	avg =	20
		max =	20
Estimated covariances =	1275	R-squared =	0.8302
Estimated autocorrelations =	0	Wald chi2(7) =	3411.81
Estimated coefficients =	8	Prob > chi2 =	0.0000

PISR2	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
slfincap	92.63378	25.03656	3.70	0.000	43.56303	141.7045
fedfinca	36.40587	14.01981	2.60	0.009	8.927547	63.8842
humancap	1529.832	104.5783	14.63	0.000	1324.862	1734.802
rfosefep	2.475472	13.38691	0.18	0.853	-23.76239	28.71334
rfrdppp	4.476081	8.948444	0.50	0.617	-13.06255	22.01471
slardpp	5.368088	1.847548	2.91	0.004	1.74696	8.989217
density	.7764167	.0933163	8.32	0.000	.59352	.9593134
_cons	917.9078	46.21076	19.86	0.000	827.3364	1008.479

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	1000
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	20
Autocorrelation:	no autocorrelation	avg =	20
		max =	20
Estimated covariances =	1275	R-squared =	0.8274
Estimated autocorrelations =	0	Wald chi2(7) =	3332.94
Estimated coefficients =	8	Prob > chi2 =	0.0000

PISR3	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
slfincap	90.34379	24.91623	3.63	0.000	41.50888	139.1787
fedfinca	44.94732	14.80117	3.04	0.002	15.93756	73.95709
humancap	1628.931	109.6488	14.86	0.000	1414.023	1843.838
rfosefep	3.262269	13.99111	0.23	0.816	-24.1598	30.68434
rfrdppp	9.564822	9.45642	1.01	0.312	-8.969421	28.09906
slardpp	6.433695	1.90686	3.37	0.001	2.696318	10.17107
density	.7205538	.1017968	7.08	0.000	.5210358	.9200718
_cons	967.5912	46.1831	20.95	0.000	877.074	1058.108

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	1000
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	20
Autocorrelation:	no autocorrelation	avg =	20
		max =	20
Estimated covariances =	1275	R-squared =	0.8284
Estimated autocorrelations =	0	Wald chi2(7) =	3741.99
Estimated coefficients =	8	Prob > chi2 =	0.0000

PISR4	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
slfincap	81.72526	23.05013	3.55	0.000	36.54785	126.9027
fedfinca	58.04189	15.63647	3.71	0.000	27.39497	88.68881
humancap	1733.202	111.4593	15.55	0.000	1514.746	1951.658
rfosefep	8.110216	14.38804	0.56	0.573	-20.08983	36.31026
rfrdppp	12.21462	9.874764	1.24	0.216	-7.139563	31.5688
slardpp	7.020015	1.909937	3.68	0.000	3.276608	10.76342
density	.6446936	.1123771	5.74	0.000	.4244384	.8649487
_cons	1027.706	44.4203	23.14	0.000	940.6436	1114.768

Linear regression, correlated panels corrected standard errors (PCSEs)

Group variable:	fips	Number of obs =	950
Time variable:	year	Number of groups =	50
Panels:	correlated (balanced)	Obs per group: min =	19
Autocorrelation:	no autocorrelation	avg =	19
		max =	19
Estimated covariances =	1275	R-squared =	0.8334
Estimated autocorrelations =	0	Wald chi2(7) =	4002.48
Estimated coefficients =	8	Prob > chi2 =	0.0000

PISR5	Coef.	Panel-corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
slfincap	73.37262	22.11906	3.32	0.001	30.02006	116.7252
fedfinca	60.7757	15.87701	3.83	0.000	29.65732	91.89408
humancap	1784.722	111.3034	16.03	0.000	1566.571	2002.873
rfosefep	3.507714	14.88919	0.24	0.814	-25.67455	32.68998
rfrdppp	15.39531	9.838386	1.56	0.118	-3.887568	34.6782
slardpp	7.452974	1.954524	3.81	0.000	3.622178	11.28377
density	.6165004	.1147603	5.37	0.000	.3915744	.8414264
_cons	1067.767	44.76557	23.85	0.000	980.0277	1155.506

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Per Capita Personal Income,
State FIPS Codes,
Population Estimates:
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Number of Science & Engineering Graduate Students (SEGS),
Number of Full-Time S&E Graduate Students (SEGSFT),
Number of S&E Postdoctorates (NSEPD):
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Federally Financed Academic R&D Expenditures (FOARD),
State/Local Government Financed Academic R&D Expenditures (SLARD),
Industry Financed Academic R&D Expenditures (IARD),
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Federal Obligations for Science & Engineering Facilities & Equipment (FOSEFE),
Federal Obligations for Fellowships, Traineeships, and Training Grants (FOFTT),
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U.S. Geological Survey. http://www.usgs.gov/state/.

Business Cycle Data (not utilized in analysis):
National Bureau of Economic Research. http://www.nber.org/cycles/.

Vita

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EDUCATION

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AWARDS and HONORS

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- Leadership East Kentucky Class of 2003.

EXPERIENCE

University of Alabama at Birmingham: Assistant Professor of Government and Public Service; August 2005—.

University of Kentucky: Research Assistant, Martin School of Public Policy and Administration; August 2003 – August 2005.

Morehead State University (KY): Research and Development Coordinator, Institute for Regional Analysis and Public Policy; July 2002 – August 2003.

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U.S. Department of Housing and Urban Development, Office of University Partnerships:

On-Site Technical Assistance Provider: Community Outreach Partnership Centers (COPC) Program. May, 2005.

Grant Review Panel Leader, Community Outreach Partnership Centers (COPC) Program. August, 2004.

Grant Review Panel Leader, Community Outreach Partnership Centers (COPC) Program. August, 2003.

Grant Reviewer, Community Development Work Study Program. June, 2003.

Grant Reviewer, Community Development Work Study Program. March, 2002.

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Grant Reviewer, Community Technology Centers Program. August, 2002.

University of Kentucky Small Business Development Center:

Instructor, "Tilling the Soil of Opportunity." January-March, 2004; January-March, 2003

PEER REVIEWED JOURNAL ARTICLES

Hall, Jeremy L. "Understanding State Economic Development Policy in the New Economy: A Theoretical Foundation and Empirical Examination of State Innovation in the U.S." (Public Administration Review, forthcoming)

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