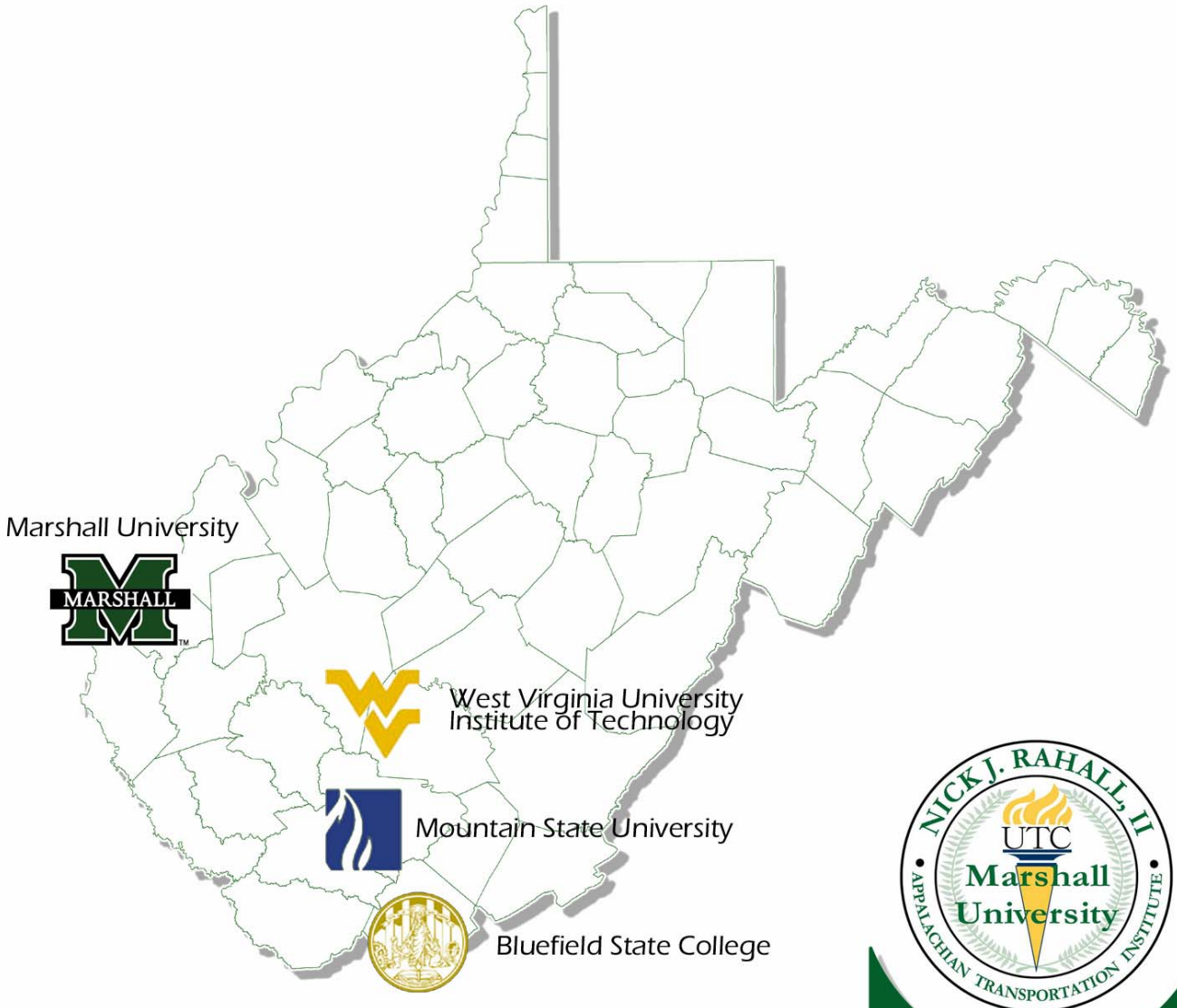
TTP 00-12 Deployment Plan for the WV High Technology Corridor



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16. Abstract

This *Growth Assessment and Recommendations* describes a revolutionary method to create technology-ready communities. Through a comprehensive approach to technology integration, we outline a structure for fostering high technology led economic growth in southern West Virginia. To outline this approach we provide background information on issues of high technology led economic growth in this chapter. This is followed by a chapter that provides a full model of economic growth, including a discussion of clustering, trade, human capital, private capital and public capital as well as a review of research findings that compare each of these factors relative contribution to growth. This chapter is followed by a review of successes and failures in other high technology corridor projects. We end with a menu of policy and program recommendations for the region.

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Nick J. Rahall, II
High Technology
Corridors Program

PART 1: I-64, BECKLEY, WV TO WHITE SULPHUR SPRINGS, WV

GROWTH ASSESSMENT AND RECOMMENDATIONS

SEPTEMBER 2003

CENTER FOR BUSINESS AND ECONOMIC RESEARCH

MARSHALL UNIVERSITY

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The opinions expressed in this document are solely those of the investigators, and do not reflect the opinion of Marshall University, any of its affiliated organizations, its Governing bodies or project sponsors.

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1. INTRODUCTION

This *Growth Assessment and Recommendations* describes a revolutionary method to create technology-ready communities. Through a comprehensive approach to technology integration, we outline a structure for fostering high technology led economic growth in southern West Virginia. To outline this approach we provide background information on issues of high technology led economic growth in this chapter. This is followed by a chapter that provides a full model of economic growth, including a discussion of clustering, trade, human capital, private capital and public capital as well as a review of research findings that compare each of these factors relative contribution to growth. This chapter is followed by a review of successes and failures in other high technology corridor projects. We end with a menu of policy and program recommendations for the region.

Background

The rapid application of new telecommunications technologies over the past two decades holds the promise for improved prosperity in rural regions. The hope is that widespread Internet access will spread economic activity more broadly, permitting rural regions to enjoy the technology related economic growth of urban areas. This has led to a number of efforts to spawn economic development by fostering high technology firm growth. These efforts include state and local policies and programs by economic development agencies to secure access to specific technologies such as broadband telecommunications service.[1]

For many communities that have undertaken these planning and policy efforts it is too soon to gauge the success of their endeavors. However, for most rural regions the results have been disappointing. The reason so many technology-led development efforts have not realized significant benefits is complex, as we shall later explain. The examples

[1] At the Federal level, legislation to promote rural broadband access has been introduced in the Senate (S. 905) with a House of Representatives companion bill (HR-768). The Federal Communications Commission has also undertaken a regulatory review that will focus on efforts to extend broadband communications to rural regions.

of limited success provide important policy lessons, which strongly suggest that an innovative approach to securing and exploiting technology change for local economic development is needed. However, one issue makes a re-evaluation of commonly applied methods imperative – the recent recession and collapse of high technology investment. For this reason alone it is necessary that any new regional efforts to acquire high technology be carefully undertaken and integrated with a broader view of the growth applications of high technology.

Most planning efforts that eye technology-led economic growth focus heavily on two areas. The first of these is the structure of specific policies that foster high technology companies. Examples of these policies include tax incentives that promote telecommunications investment and spending on research and development. The second is in the regional acquisition of a specific technology, such as broadband access.

The efficacy of specific state and local incentives to develop high technology firms cannot yet be fully evaluated. While there is much evidence to suspect that results of tax incentives and R&D subsidies yield little results at the state level, it is too early to rule out entirely these policies.[2] Happily, for our purposes, that determination is of limited importance. Since the tax structure of West Virginia places considerable limits on local option taxes, there are unlikely to be circumstances where direct incentives at the local level will be possible.[3]

Local efforts to secure a specific technology – most commonly broadband telecommunications access - have yielded the most disappointing results. This should not be surprising for three reasons. First, broadband access is a costly investment for firms and is not an easy undertaking, particularly in the current low investment environment for high technology telecommunications firms. Second, the recent recession has severely limited the ability of states to aid in the funding of such investments. The

[2] For a treatment of many of these issues see Fox, William F. and Matthew Murray *The Effects of Local Government Public Policies on the Location of Business Activities* in Industry Location and Public Policy, Herzog and Schlottman, eds. 1991.

[3] The recent passage of *Tax Increment Financing* expands this option by providing for local use for approved purposes incremental property tax collections on improved structures. This, along with constrained rate local bonds and county share severance taxes are among the few instruments available. None of these are likely of sufficient magnitude to permit extensive telecommunications infrastructure investment.

effects of this recession occurred in West Virginia in late 2002 and 2003 and are forecast to continue at least into late 2004. Finally, investment in communications technology is primarily a private sector activity. Even the most informed public sector planners would find integrating an essentially private sector activity into public sector plans difficult.

The difficulty in predicting private sector technology needs is especially true for technologies that have changed rapidly and are likely to continue to develop at a rate that is difficult to foresee. Even today, as regions and firms push for fiber-optic based broadband access, better, less costly and more easily deployed technologies have been developed. It is a near certainty that the technology that will most excite rural access advocates in 2008 is not currently known to many.

The limitations of tax incentives and subsidies combined with the difficulty government suffers in predicting the correct path of private sector investment strongly suggest that communities implement a new and innovative approach to technology led regional growth. The goal here is for planning and policy to lay the groundwork for regional economic growth, not to direct its path. If performed correctly, planning and policy for high technology growth will focus on the use of technology by the entire community. This would create, in essence, a community high technology corridor. With regions effectively prepared to integrate new technologies as they become available, it is no longer necessary for economic developers to choose the right technology. Instead, this difficult and important choice will be made within the marketplace as new technologies become available.

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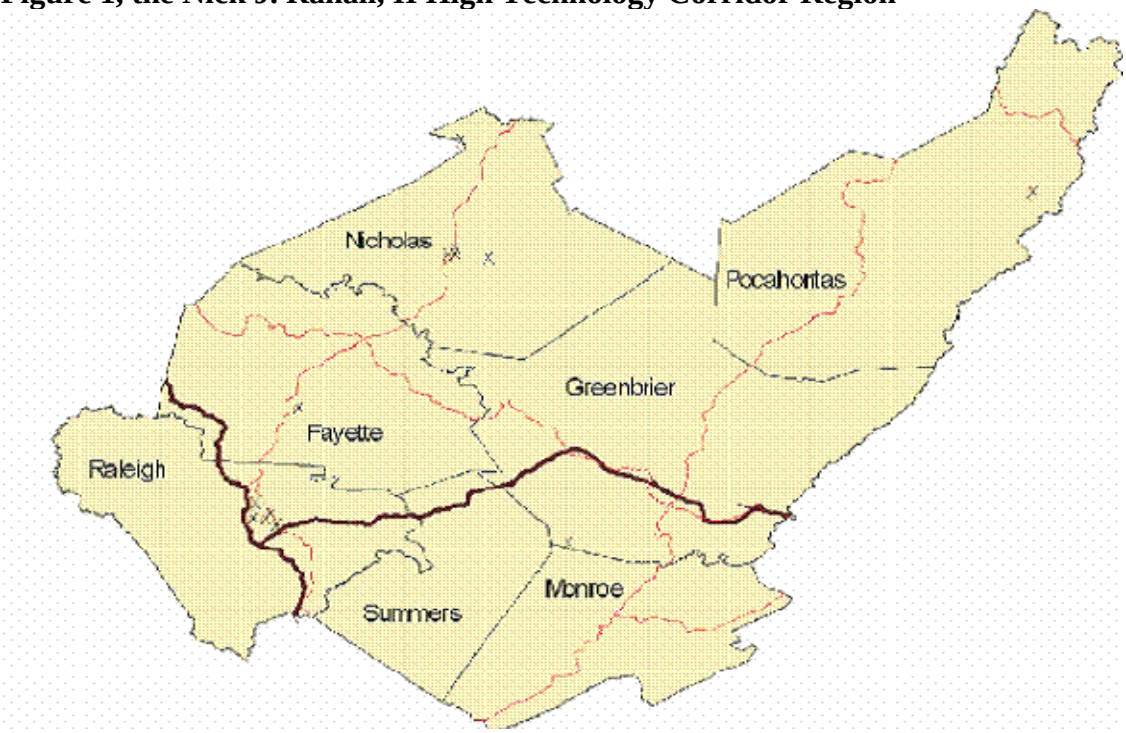
In the past, many of the important facets of technology led growth have been insufficiently treated in many economic development reports available to the public. Indeed, a common thread of most other studies and reports dealing with technology led regional growth assumed a conclusive causal link between high technology investment and economic growth. This has led too often to what is colloquially known as the "Field of Dreams" approach to economic development. In this approach investment in specific structures or technologies are undertaken with the belief that "if you build it, they will

come." Economists who study economic growth do not widely share the hopefulness of this approach. Indeed, there is wide consensus that a much fuller set of regional economic factors must coalesce to create effective high technology led growth. We explain these in much detail in later sections.

To potentially aid in economic growth, regions must ask two specific questions about technology-led economic development. First, if high technology is a *necessary* condition for economic growth, what are the sufficient conditions? And second, what mechanisms can be brought to bear that facilitate investment in the appropriate types of technology for the region?

Given these questions and the mixed outcomes of other efforts a revolutionary approach to technology led economic development is needed. It is within this climate that the *Rahall Appalachian Transportation Institute* at *Marshall University*, the *4C Economic Development Authority* and the *Greenbrier Valley Economic Development Corporation* have resourced this *Growth Assessment Analysis and Recommendations* for the *Nick J. Rahall, II High Technology Corridors Program.* The region covered by this document is illustrated in the following figure.

Figure 1, the Nick J. Rahall, II High Technology Corridor Region



This document will outline a technology-transfer project designed to aid in technology related economic growth in a seven county region along I-64 from Beckley to White Sulphur Springs, West Virginia.

High Technology Historically Considered

The Internet has inescapably altered the lives of most Americans. Within a decade of the first commercial access to the Internet a majority of Americans experienced the wonder of this technology. The awe that accompanied this technology is not new. Steam power, internal combustion engines, electricity and early telephony all provided the same hope for technology led growth. Indeed, West Virginia has been able to absorb and profit from each of these technologies. It is fitting that the lessons learned from the adoption of these technologies also inform the process of absorbing high technology and its associated infrastructure.

The Internet and other high technology is a ubiquitous part of living and doing business. As previously mentioned, these technologies offer the tantalizing possibility for regional economic growth. This makes the acquisition and application of technological improvements an important policy option for regions concerned about economic growth. The process of using high technology is a private sector activity, but one that the public sector may be able to influence through efficacious application of policies that reduce the cost of high technology for individuals and firms. The *Rahall Appalachian Transportation Institute* is a clear example of federally sponsored research, education and technology transfer funding that reduces the private cost of infrastructure investment. It is useful to view the acquisition and extension of high technology services in this infrastructure framework since many similarities exist.

Among the many historical lessons learned from the integration of highways, rail, electricity and telephony is that while the presence of some technologies may be necessary they are not typically sufficient to foster economic development. Other factors that permit communities to integrate these technologies effectively must coexist for economic growth to result.

Among the many historical lessons learned from the integration of highways, rail, electricity and telephony is that while the presence of some technologies may be necessary they are not typically sufficient to foster economic development. Other factors that permit communities to integrate these technologies effectively must coexist for economic growth to result.

Another critical lesson is in understanding the role of government in infrastructure acquisition. Many types of infrastructure require direct government provisioning since they meet the criterion of a public good. Highways and roads are clear examples. Yet other types of infrastructure require government to provide some ongoing indirect subsidization. Regional air service is a prime example. Others require only early aid and support such as in the creation of local water and sewer cooperatives by local communities. Technology and infrastructure require regulation alone. Regulation, in this context, is almost wholly focused on preventing unwanted pricing and access outcomes inherent in natural monopolies. It is critical to note that regional monopolies in telephony, electricity distribution and other network intensive utilities are a natural outcome of high fixed costs relative to demand. Regulation in these industries developed in response to natural monopolies, not the other way around. This suggests that for regions where high fixed costs relative to demand persist, regulatory change may not generate competition.

There have been considerable efforts to ameliorate the access outcomes of natural monopolies through payments to rural providers. The High Cost Program, E-Rates and the Rural Health Access Program are examples of federal efforts in this area. In 2000 alone West Virginia received roughly $83 million in funding for these programs. This translates into roughly $46 per resident in the State.[4]

The type of high technology access associated with the Internet is subject to some types of telecommunications regulations. It is perhaps best to view the network technologies associated with the Internet as having characteristics similar to telephony in terms of government involvement. For our purposes it is important to note that early telephony was not only heavily regulated, but enjoyed considerable efforts at extending

[4] See Michael Oden and Sharon Strover, *Links to the Future, The Role of Information and Telecommunications Technology in Appalachian Economic Development*, Appalachian Regional Commission, June 2002.

service. This service was not extended to higher end uses such as long distance and business services. Indeed, the case is quite the contrary. High end service consumers typically subsidized universal access. This history suggests a real need for rural communities to revolutionize their approach to absorbing high technology.

From this brief review of the history of technology infrastructure it is clear that the adoption of broadband service or other types of high end internet access and related network connections has many of the same characteristics of telephony. This is perhaps why telephone companies play such a crucial role in Internet access. An important lesson is that while government may play important roles in developing access, it is the private sector that most influences the deployment of high technology infrastructure. Normally, a wholly private sector activity would not warrant public sector involvement. It is in the potential for economic growth that accompanies the technology that interests local communities. With this in mind, it is government's role to convene planning, research and other resources. To better understand the regional attraction of technology infrastructure we describe the phenomenon known as economic clustering, and outline the basic features that contribute to clusters of technology.

Technology Clustering

Firms that employ high technology are everywhere, even in the most rural areas of the world. Firms that produce high technology related items are almost as common as those that use them in production. The presence of high technology producers or recent growth of employment does not suggest increased future growth in this sector. Something much less visible must be at work to lead to expansion in the regions' high technology based firms and the economic growth that may accompany such expansion. Economists have identified two phenomena that lead to high rates of economic growth; regional comparative advantage and agglomeration or clustering.

Regional comparative advantage in production occurs when a region enjoys greater productivity due to some characteristic of one or more inputs to production. For example the presence of high quality coal in West Virginia has directly led to the clustering of rail transportation services and electricity generation in the region. For high

technology research, development and production, human capital is undoubtedly the key factor in regional comparative advantage.

The second explanation for regional patterns of industrial location is agglomeration. This is also known as *clustering* in popular literature. Agglomeration economies occur in regions where the productivity for one type of good or service is affected by the production of another good or service. Examples of these are where firms share resources such as transportation services or training of employees. This phenomenon is one factor that drives the regional clustering of economic activity.

There are other forces that serve to pull economic activity inward in greater proximity and forces that drive it apart – we will call these centripetal and centrifugal forces. The centripetal forces that pull firms and populations together are the cost reducing aspects of sharing production costs (e.g. transport, training) as well as the benefits of shared spillovers of technology. The centrifugal forces that push firms apart include the cost of land and other input costs in a region.

Amenities also foster individual migration to and from cities, resulting in a change in patterns of economic activity across regions. These amenities include virtually every aspect of cities and rural areas (e.g. quiet rural evenings or Broadway plays). There is a clear policy role in enhancing and marketing local amenities, as they play a role in clustering economic activity. The broad suite of environmental amenities in the region suggest this as an important policy option

The proximity of the region to Washington, D.C. and the suite of amenities enjoyed by the region suggest opportunities for high technology growth. However, these opportunities are dependent on underlying economic factors that drive clustering.

It is best to view the current spatial distribution of firms as an equilibrium result of past economic forces – including policy decisions. However, the equilibrium is not static over time. Forces that alter the costs of doing business in one area can result in firms responding in a way that may result in differing spatial distributions of economic activity.

Two factors emerge to suggest that the equilibrium is shifting towards the possibility of increased levels of high technology employment within the region. The

first, and perhaps most obvious is the increase in land costs and congestion in the Washington, D.C. metropolitan area. This undoubtedly motivates some producers to locate elsewhere. Second, the increased concerns regarding terrorism will likely induce firms and workers to distribute themselves more evenly rather than concentrate in urban areas. The proximity of the region to Washington, D.C. and the suite of amenities enjoyed by the region suggest opportunities for high technology growth. However, these opportunities are dependent on underlying economic factors that drive clustering.

The following chapter dedicates considerable effort to describing how productivity differentials occur in regions, and how these are translated into comparative advantage. The role of public policy is explicitly outlined throughout the text, as are specific regional examples. The goal here is to provide a clear assessment of regional strengths and challenges and to focus on policy efforts to create technology ready communities.

CHAPTER 2. HIGH TECHNOLOGY AND ECONOMIC GROWTH

As we mentioned in the outset, technology is ubiquitous for individuals and firms. Technology is important for generating regional comparative advantage and clustering or agglomeration. In order to understand these phenomenon it is important to frame the basic structure of economic growth within a region and then describe how that growth is occurring within the region we are concerned with.

The most effective method for achieving the development of a regional economy is through pure economic growth. Economic growth is typically defined as the increase in real per capita income, and is not merely an increase in the size of a regional economy. This definition is important because the sole cause of economic growth in the economy is through increased efficiency in the production of goods and services. This increased efficiency is typically referred to as an increase in the productivity of one of the factors of production: human capital, public capital and private capital. Technology is important insofar as it affects the productivity of one or more of these factors of production.

The only important omission with this definition of economic growth is that it typically does not measure individual utility. By this we mean that this measure of economic growth does not count environmental and social amenities that also matter to individuals. As long as we recognize this omission it is unlikely we will recommend any wrong-headed policies. The chief fear in this area is that policies that result in unsustainable extraction of natural resources to improve short run incomes (at the expense of the long-run) will occur. Before we describe growth we outline what factors matter most in explaining inter-state differences in growth and per capital income.

Economists describe growth in formal models where the factors of production in regions combine to produce goods and services. While microeconomists spend considerable effort modeling the direct functional relationship between inputs in individual firms and industries, macroeconomists focus on aggregate or regional measures of the three key factors of production: human capital, public capital and private capital. Both fields use a basic production function method for describing the mathematical relationship between factors of production. In practice the productivity impacts can be either supply side or demand side. For technical reasons it is appropriate

to model them as wholly supply side (as we do here) as long as we deal with the long run. For our purposes, the long run is a decade or longer.

Since it is not practical to directly model each firm's production relationships in an aggregate model, macroeconomic representations of the economy appear stylized and unrealistic. Fortunately, despite this drawback, they perform very well as a tool for analyzing, describing and predicting growth. What follows is a stylized description of a growth model that highlights the key issues that face the region.

A Simple Growth Model

Consider a closed economy (without trade) where three factors of production coalesce to produce goods and services. As we have mentioned, the three factors are human capital, private capital and public capital. Together these three factors of production act as an umbrella for all other important factors such as entrepreneurial talent, natural resources, et cetera. Since these three major areas are those that respond to direct policy intervention, we use them as the primary descriptors of growth. This is expressed as **Y** = *f*(**H, K, G**), which reads as: output is a function of human capital, private capital and public capital.[5] Here, technology is a key factor in influencing the productivity of each of the factors of production. However technology, at the margin, is not the dominant factor in generating growth and income differentials between states. The reason for this is that technology diffuses quickly between regions in the United States and so cannot explain persistent growth differences or divergent trends.[6] To better understand the prime causative features of growth and income differences across states we will discuss each of the factors of production and describe their relative contributions to growth.

[5] This is a stylized model of an augmented Solow Growth model. The augmented portion treats human capital as an external input to production. The description of this growth model is sufficiently general to include endogenous growth models of the 1980's and 1990's.

[6] Despite what many high technology study proponents hope, high speed telecommunications access cannot explain growth or income differences between regions. The differences existed prior to, and will persist for some places long after, broadband access becomes universally available.

Public Capital

There is clearly a great deal of policy discussion regarding public capital investments. Public capital is typically defined as roads, water system, sewage and other physical inputs to production. It is often useful to think of legal systems, services from government and other factors as part of public capital. In either definition it is the flow of services that generate productivity gains. As mentioned earlier the impact may be supply side (as in lower transportation costs for intermediate goods) or demand side (easier access for more visitors to the region).[7]

While a great deal of policy discussion is paid to differences in public capital between States, in fact, there is no more homogeneous region than the U.S. Even in areas where stark policy or physical infrastructure differences appear, these appear to contribute minimally to overall growth and income differentials across states. However, this does not mean that public capital is unimportant. However, the preponderance of research suggests that differences in public capital play no major role in regional growth and income differences. Even within studies that find public capital disparities contributing to regional growth and income differences, the overall impact is quite small.[8] This often runs counter to the observation that more affluent regions typically enjoy more public capital in the form of interstate highways, airports, telecom networks, et cetera. This is the clearest example of the confusion regarding endogeny or direction of causation in public policy. Simply, most infrastructure investment results from regional growth, not the other way around.

These research findings are not to be interpreted as an indictment of public capital investments. On the contrary, individual investments in infrastructure should continue to be individually evaluated, as is the current practice. Additionally, most infrastructure investments are not primarily designed to induce economic growth, but instead to ameliorate congestion, improve public safety and provide key public services. Further, given the limited set of growth policies, public capital may provide among the largest

[7] Duality theory provides a set of technical tools to treat cost and production functions as interchangeable given a very tractable and realistic set of assumptions regarding economic performance in the long run. We implicitly use these methods here. For a fuller example of this method, see Burton, Hicks and Kent, *Coal Production Forecasts and Economic Impact Simulations,* 2000.

[8] See "Human Capital and Endogenous Growth: Hard Times for West Virginia", Michael Hicks, *Appalachian Studies Association,* March 2003.

immediate contributions to regional economic growth. The only cautionary tale to be absorbed from the research on public capital and economic growth is that expectations regarding the impact of public capital should not interfere with the furtherance of effective policies in other growth enhancing areas. Quite literally, public infrastructure is only part of the equation.

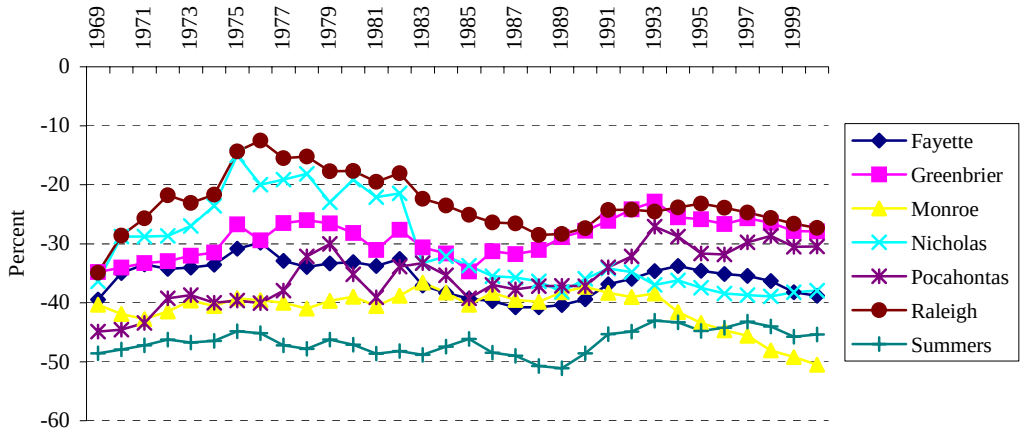
Private Capital

Economists define capital as the physical inputs to production that are financed through the financial markets. Without a doubt, few markets work as effectively as those that service private capital in the United States. While access to capital in rural regions remains a focus of considerable concern, there is limited evidence that market failure generates regional variation in the access to capital. Instead, state and local taxes that distort investment spending tend to offer the most potential to explain regional growth and income variations. West Virginia is among the few states that heavily tax investment in physical capital through the *Business Franchise Tax*. This is likely the prime source of real (not market driven) disparities in private capital investment in the State. Further, while there is considerable concern regarding a paucity of local lending and venture capital in the region, much of this outcome is the result of optimal market behavior. Simply, the inability to obtain loans and venture capital investment in rural areas may be that the perceived rate of return is insufficient to warrant this investment.

Access to private capital and levels of private investment generated by low access play a modestly larger role than public capital disparities in explaining growth. Together, public and private capital disparities explain, at most, a quarter of the total growth and income differences between states, perhaps less than five percent. Another 25 percent of growth and income differences remain, as yet, unexplained by economists. By this we mean that there is not strong research concurrence on how much factors such as regional endowments in natural resources, culture and weather explain growth and income differences. The remainder of growth and income differences in states, ranging between 50 and 80 percent, are attributable to human capital disparities. These disparities are large. The following figure illustrates the per capita income gap between the counties in the region and the nation as a whole, presented in percentage terms. These data are

startling, but even closer examination of the underlying components will reveal an even less happy story. A much greater divergence between the region and nation as a whole would occur if it were not for an increasing share of transfer payments in the region.

Figure 2, U.S. and Region Per Capita Income Differences



Human Capital

Levels of regional education, health, training and other factors describing direct labor productivity potential define human capital. This broad description is primarily employed in an international setting where health care access and other factors influence productivity. But in even the poorest and most ill-served regions of the U.S. health care is, on an international scale, quite available. As evidence of this, major measures of health care differences reveal very small interstate differences when compared to international differences. For example, in the state with the worst health care outcomes average life expectancy remains much higher than the average working life. In contrast, many parts of Asia and sub-Saharan Africa suffer life expectancy of less than 50 years. The real source of productivity differences in U.S. is due to variation in educational achievement across regions. This should not be surprising, since the poorest regions typically suffer educational achievement disparities that are proportionately much larger than income differences. For example, the college

Simply, the economic disparities between the study region and the nation as a whole are almost wholly attributable to differences in educational attainment of workers.

completion rates in several counties in this study region are less than half the national average, while incomes are only 30 to 50 percent below national average. Simply, the economic disparities between the study region and the nation as a whole are almost wholly attributable to differences in educational attainment of workers. This finding has been replicated with such frequency in economic research that it is not an area that is likely to enjoy much further scientific analysis.

Let us reiterate, imply, the economic disparities between the study region and the nation as a whole are almost wholly attributable to differences in educational attainment of workers. To better understand why educational attainment appears to matter so dramatically in economic growth and income differences it may be useful to look into West Virginia's past and the economic changes that have occurred in the last half century.

Human Capital in the Region

Prior to the early 1980's a dominant part of the State's economy consisted of manufacturing, mining and other more traditional industries. And, while educational attainment differences between parts of West Virginia and the nation as a whole existed, they were not as stark as they are today. Also, they were not accompanied by large per capita income or productivity differences. The reason for this is likely found both in the nature of human capital demands within the labor market and the state of K-12 education.

It is evident to anyone who has been in a steel mill, coal mine or electric-generating facility that high levels of human capital are required in these industries. In these and other sectors, West Virginia workers lead the nation in productivity. For the state as a whole, productivity in these industries is roughly that of the national averages. See the figure below.

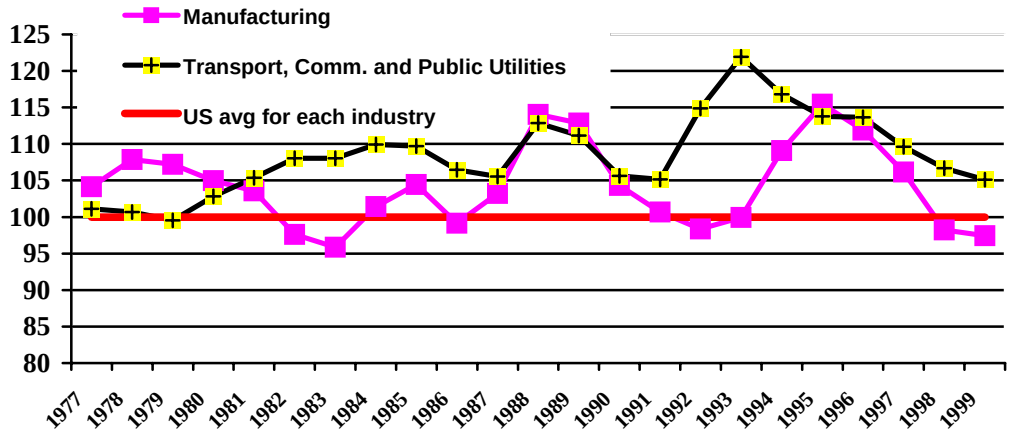


Figure 3, Relative Productivity of Capital Intensive Industries

Unfortunately, this is not true for most other sectors. Manufacturing and transportation and public utilities remain productive, in part, because they can "cherry pick" workers, choosing the best available from the labor force. Before we show what has occurred in other sectors, it is helpful to better understand some historical background.

The challenge to West Virginia is partly explained by a confluence of unhappy events materialized in the 1980's to alter the structure of the State's economy and change the relative importance of human capital for new workers in the State.

In the early 1980's the inability of the OPEC Cartel to maintain high petroleum prices spilled over into domestic energy markets. This led to a 50 percent decline in the real price of coal in a decade. The resulting effort to achieve higher levels of productivity in coal mining led to employment reductions that had a profound effect on the region. At the same time, the nation as a whole continued to lose manufacturing jobs due to efficiency gains worldwide. See the figure below.

Figure 4, Long Run Coal Prices (Inflation-Adjusted)

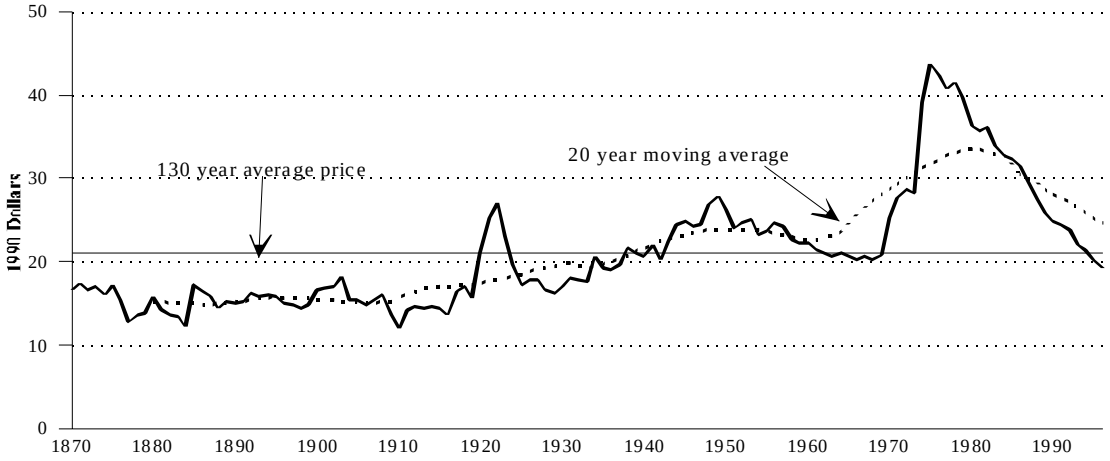
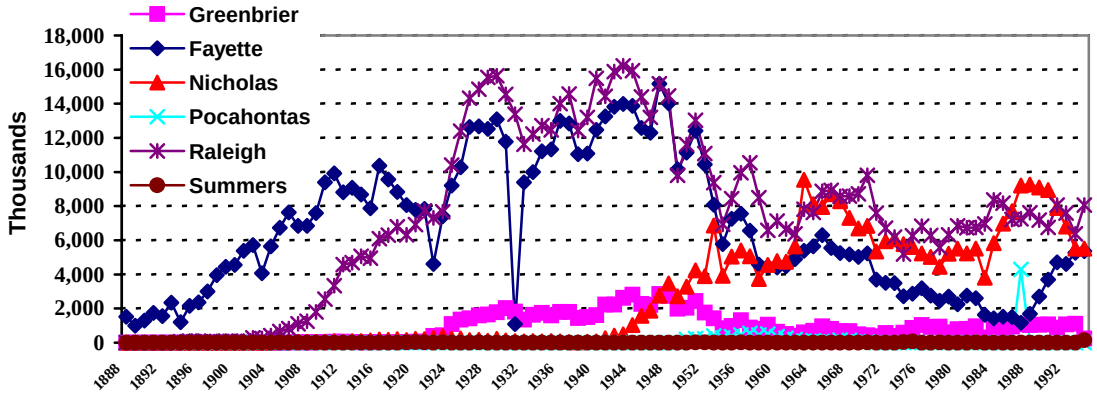


Figure 5, County Coal Production (in Tons)

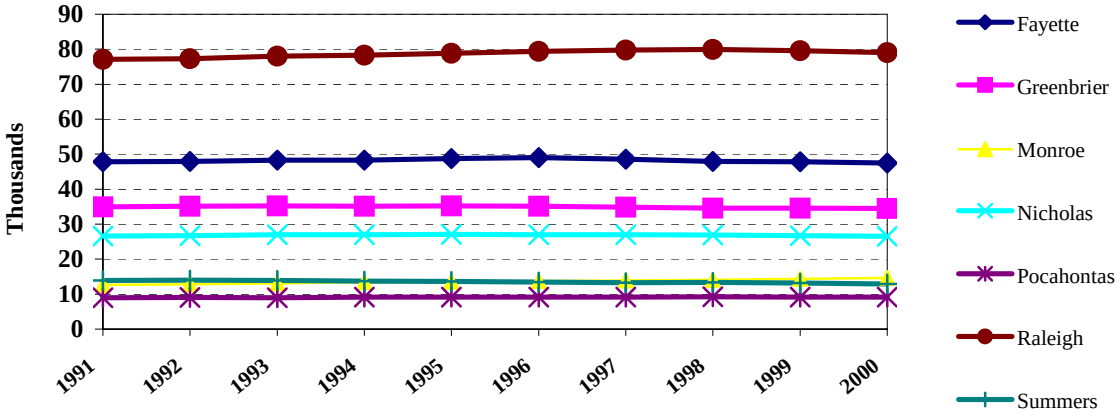


These simultaneous events heavily affected West Virginia so that out migration of job seekers was stimulated by large differences in unemployment rates between the State and nation as a whole. Put simply, West Virginia was whacked in the early and mid-1980's. Unemployment rates for the state edged nearer to the Great Depression totals, even as the country as a whole recovered dramatically by 1984.

A clearer explanation of the impact of migration is that in the short run, workers migrate to jobs, but in the long run, jobs migrate to workers. The State has not really recovered from the early 1980's because at least one factor that, in the past, would have stabilized the population decline and ameliorated a potential income gap is no longer present. This is the labor market's ability to absorb new workers who have skills acquired through secondary education. This continues to affect population growth, which

has been essentially non-existent over the past decade, while the nation as a whole grew at record levels. From 1990 to 2000 the region grew a total of 1.17 percent while the nation as a whole grew by 13.1 percent. See figure below.

Figure 6, Regional Population Levels



Labor Markets, Human Capital and Slow Growth

Throughout much of the last century labor markets were able to absorb large numbers of workers with skills obtained through secondary education. In the past, a higher proportion of firms required only a very basic level of skills for entry level jobs. The skills that were needed were firm specific, making their acquisition more commonly performed on-the-job. This has changed. Today, a much higher proportion of jobs require more advanced skills than those traditionally supplied by secondary education. This is evident in the fact that labor markets are placing relatively lower values on the skills of workers without advanced education. Low levels of human capital result in lower

It is important to understand that the relative wages in a region are market driven outcomes. Demand side efforts to change market equilibrium will inevitably disappoint. Engaging in efforts to attract high paying jobs will not prove fruitful without effective policies designed to improve human capital.

wages, as theory predicts. Indeed, the correlation between human capital and productivity and wages is so strong that wages serve as a de facto measure of human capital.

A further problem is also of concern. Clearly employment changes over the past half-century require a more skilled workforce. Schools operating at the same level as in previous decades (in terms of skills taught) potentially provide workers with insufficient skills to meet the demands of recent changes in labor markets. Essentially, what was taught in 1965 may not be enough to lead a worker to fruitful employment today. It would be a difficult challenge for schools to provide a relatively equivalent education to that of past years given the increase in the demand for skills. However, there is considerable evidence to support an argument that schools are not merely lagging in performance relative to earlier years, but are indeed performing less well in an absolute sense. Certainly, relative to the rest of the developed world, secondary schools in the U.S. perform poorly overall (and perhaps very much worse in West Virginia). As evidence of a potential decline we observe a dramatic increase in remedial education and, perhaps most telling, a recalibration of at least one national college entrance examination in the mid 1990's to prevent a slipping of the average score over time. There is not yet a clear enough set of answers to these issues. For example, it may be that schools are providing more education that benefits society as a whole at the expense of individual work skills. In this case, schools could actually be doing better for society as a whole, but this would not be reflected in labor markets. These are benefits, but they will not directly help the individual in the ways we typically measure economic benefits. Whatever the cause, it is clear that labor markets value high school educations relatively less highly now than in years past.

Some of these skills deficiencies have been addressed with success by the work of programs, such as the Workforce Investment Boards (WIB). For example, Workforce Investment Region 1 is a leader in focusing programs on high demand occupational training. However, the work of these programs should be considered complementary and enhancing to the efforts of the secondary school system's skills curriculum not as replacing basic skills education. Both types of educational training play a vital role in

regional human capital development. One provides a general foundation on which the other builds to meet specific demand requirements of the market.

Some Caveats to Human Capital Concerns

Any discussion of human capital weaknesses inevitably touches a number of sensitive issues. In order to clarify these issues, it is useful to describe what human capital is not, and what economists believe contributes to strengths and weaknesses in human capital. It is also important to understand how some of the data presented above may distort, for better or worse, the condition of human capital in the region.

Despite much popularity in the media, culture appears to play very little or no role in inter-state economic growth or development. While Appalachia has enjoyed considerable scholarly analysis over the past half century, there are strong voices among sociologists who analyze the region that concur with this conclusion.[9] And, while this may be good news for Appalachians long accustomed to negative stereotypes, it may also not offer hopeful news to a region that prides itself on a strong work ethic. Productivity and human capital are simply not related to culture in a distinctive manner.[10]

Engaging in efforts to attract high paying jobs will not prove fruitful without effective policies designed to improve human capital.

Productivity is related to the basic factors that are included in the discussion above. Without the training and tools that permit skilled work, no one can be productive. Simply, there is a shortage of these in the region, which contributes to the lower productivity we observe. Finally, the age distribution of the region has changed markedly over the past two decades. Out-migration has left an older, less well educated population in the region. However, this may not reflect the actual state of human capital since older workers have acquired many skills in the workplace that are not easily observed. Despite these caveats, it is clear that

[9] See collected works of Wilma Dunaway.

[10] The region is much more diverse than most representations suggest, and the ethnic diversity of the region that is often overlooked since Census data collection does not distinguish ethnic groups clearly. For example the Corridor is named for a third generation Lebanese-American, Congressman Rahall. The authors of the study include a first generation Indian-American, born in West Virginia and a Scotch-Irish descendent who can trace his ancestry to the region to colonial times. All three are treated as a single ethnic group in Census reports. This leads to profound misidentification of the region's diversity.

the differential in educational attainment has contributed to considerable income differences in the region.

Understanding the link between human capital, labor productivity and wages is critical to a clear evaluation of economic development policy options. It is important to understand that the relative wages in a region are market driven outcomes. Demand side efforts to change market equilibrium will inevitably disappoint. Engaging in efforts to attract high paying jobs will not prove fruitful without effective policies designed to improve human capital. This in turn increases labor productivity, which is the ultimate determination of wages. This is why an innovative technology led approach to economic growth is so critical for the regions' economic health.

Productivity and Income

Despite many policy interventions, we see the region suffering from continued out-migration and challenges in retaining our most productive workers. This directly translates into lower incomes. Importantly, the link between productivity and income is not well recognized as the dominant source of potential policy intervention. The relationship is easily constructed in a formal model, but should be clear simply through anecdotal observation. For the individual, better skills lead to better paying jobs. For regions this too is true. Though business cycle activity, contract duration, monopoly or monopsony power, gender or ethnic discrimination or other institutional factors may provide short run deviations from market equilibrium, in the long run productivity alone determines wages. In fact, wages to labor are determined by the *value of the marginal product* that labor provides to the firm. More simply, the benefits to firms derived from workers sets their wages.

Though business cycle activity, contract duration, monopoly or monopsony power, gender or ethnic discrimination or other institutional factors may provide short run deviations from market equilibrium, in the long run productivity alone determines wages.

This fact is not typically well absorbed into economic development efforts. For example, policies designed to induce high paying employers to a region face the unhappy prospect of attempting to modify a market outcome. If the underlying human capital were sufficient to induce productivity increases then wages would rise. Efforts to

increase regional wages without addressing the underlying productivity differentials are doomed to fail. Technology potentially holds the key to addressing this challenge.

A further concern regarding migration and the change in human capital arises within the context of West Virginia's economy. Since human capital experiences very high levels of increasing returns, we observe the clustering of economic activity and factors of production that support these clusters. This leads to the resulting out-migration and furtherance of the productivity differential between regions. This, in turn, lowers wages, which potentially reduces an individual's return to human capital investment in the region. This may spark a cycle of out-migration, lower human capital and declining regional economic performance. The result is a clustering of economic activity that occurs in places that already enjoy high levels of human capital. Places without high levels of human capital suffer. Technology holds the hope of reversing this trend.

Trade, Clustering and Increasing Returns

The growth model described above outlines the factors underlying productivity. This is the prime source of income and prosperity in a region, though clearly regional imports and exports matter and are a chief source of productivity improvements if only through regional endowments of natural resources. The dominance of the productivity argument over simple trade should be evident in the fact that the world's output has grown rather markedly (perhaps twenty fold) in the past century. This clearly cannot be attributed to trade flows alone. Trade does matter to economic growth, but less so than simple regional productivity. The relationship between regional trade and productivity is through the creation of regional comparative advantages resulting from productivity differences between regions. In high technology industries, human capital is certainly the dominant source of regional productivity differences hence regional comparative advantages. Without increases in human capital the region will not enjoy increased productivity.

The relationship between regional trade and productivity is through the creation of regional comparative advantages resulting from productivity differences between regions.

At the outset we suggested that regional comparative advantage and agglomeration play an important role in determining regional economic performance. This is true, and within the framework of regional economic growth described above, we can clearly state that the region enjoys some comparative advantages and agglomeration. Indeed, the *Appalachian Regional Commission* reports that the location quotient of technology related employment in the region is roughly 10 percent higher than average. This falls short of a cluster but should be viewed as encouraging.

To achieve for regional comparative advantage in some form of high technology production it is necessary to understand from whence this phenomenon occurs and then apply policies.

The preponderance of evidence suggests that of these three factors, human capital alone enjoys increasing returns to scale. Or, more clearly, a one percent increase in human capital will lead to a greater than one percent increase in output. The remaining factors are widely felt to experience diminishing returns, so that a one percent increase in private or public capital increases productivity by less than one percent.[11] Since human capital compromises the single largest production cost for any industry this phenomenon drives the clustering of economic activity. Human capital's increasing returns may be the dominant element in the concentration of economic activity in regions.

For example, telecommunications networks may offer the possibility for 'virtual cluster.' By this we mean firms may be able to locate less densely by taking advantage of high-speed telecommunications access.

In effect, increasing returns to human capital means that workers will migrate to areas where their education and skills yield higher returns. This almost always occurs where other highly educated workers are located. This is the chief reason cities exist, and the incentives to migrate have apparently become more pronounced in recent years.

The existence of increasing or diminishing returns plays an important role in the development of agglomeration, or clustering, economies. Clustering of economic activity occurs where increasing returns are present. The reason for this is the simple fact that in

[11] In this description, it is helpful to think of the units of each in dollar terms so as to achieve some comparability of the factors.

these regions individuals and firms enjoy their highest return on investments. It is easy to understand why much effort by economic developers is made to induce clustering within regions. Clustering of economic activity expands employment opportunities, wages and regional tax bases. Unfortunately there is no compelling evidence that developers have ever been successful in generating regional clustering (though there is no absence of claims to the contrary).

Factors that affect agglomeration or clustering constantly change. For example, technologies that permit rapid transit facilitate intra-city movement contribute to clustering in cities. So, technology will certainly continue to play a changing role in the spatial distribution of economic activity. For example, telecommunications networks may offer the possibility for 'virtual cluster.' By this we mean firms may be able to locate less densely by taking advantage of high-speed telecommunications access. However, the reverse may also be true. For example, telemedicine may lead to a lower density of medical specialists in a region since their expertise could be tapped through other technologies. When it comes to the impact of technology on the spatial distribution of economic activity one clear conclusion rings true: we cannot predict with accuracy what the impact will be. However, understanding what we do know about the fundamentals of clustering and agglomeration are critical to developing policies that offer the potential for this phenomenon to occur.

Do Regions Really Compete?

Economic developers often refer to regional competition. This analogy may be useful to describe business recruitment efforts, but it also misleads when applied more broadly to policy efforts. If policymakers adopt policies wholly to attract new business there is a lingering danger that this may yield undesired results. For example, ignoring regional amenities through under-investment in important public goods may make some industries happy in the short run (due to lower taxes), but may have an undesired affect in the long run.

In truth, regional trade epitomizes regional co-operation. Regions that trade should better be viewed as cooperating to achieve higher levels of productivity; they are not competing. Perhaps the earliest lesson of modern economics is David Ricardo's

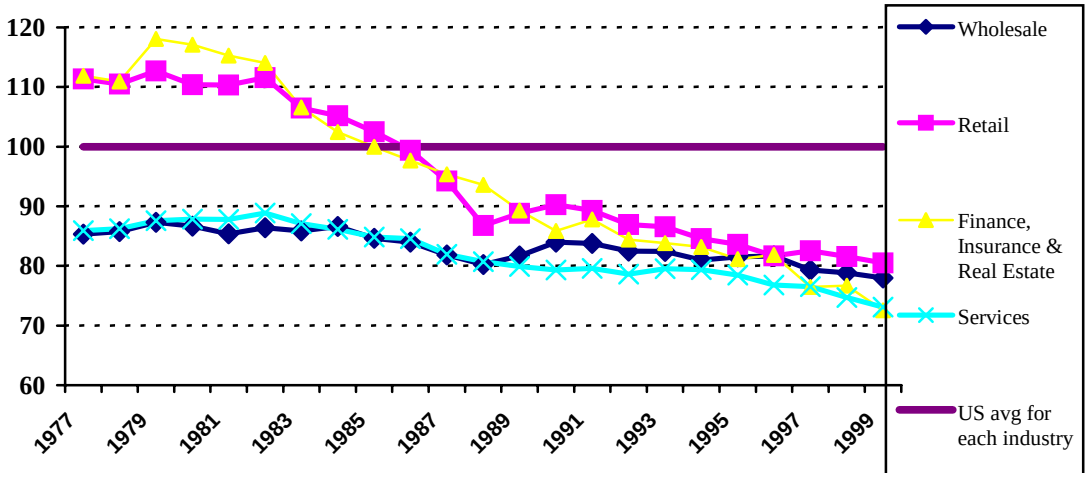
(1815) description of how comparative advantage benefits all participants in an economy where trade occurs. Efforts to improve regional competitiveness should better be aimed at generating local increases in productivity.

A Long-Run Task

The chief concern of this discussion is in the identification of policies that may improve the region's economy. The discussion above has focused on a number of policies that are unlikely to generate higher levels of per capita income or growth. In addition to these policies, any effort designed solely for the short run will also fail to yield results. To observe the period of adjustment, let us simply model the potential changes to human capital that could potentially occur.

Suppose that within a county in the study region we suffer from educational attainment of college graduates of roughly 12 percent, or about half the national average. Suppose that each high school graduate in the region obtains a college degree and remains in the area. Also, assume that the distribution of college graduates among the population is more prevalent among younger adults. Given all these favorable circumstances (no in-migration and no change to the national rate of college attendance) it will be more than 25 years before the college graduation rate in the region reaches the national average. This seemingly long-run convergence is in fact an unrealistically favorable estimate. Indeed, the reverse is true, there is scant evidence that the region is catching up as productivity and wages are declining relative to the nation as a whole. See the following figure for labor productivity in labor intensive industries in West Virginia.

Figure 7, Relative Productivity of WV Labor Intensive Industries



It is a sure prediction that incomes in the region will not converge to the national average in the foreseeable future. However, this alone should not be the goal of an economic development strategy. The identification of individual policies that work must then be grounded in this realization and begin with the basics.

Technology Led Growth

As we mentioned at the outset of this chapter, technology's key role in economic growth is in increasing productivity. The technology that we typically refer to is a form of private capital, though much of it may be provided by regulated industries. The roles that technology plays in enhancing productivity are so varied and changing that a concise description is elusive. A few examples will have to suffice.

Firms and individuals employ technology to reduce costs. For example, computing technology can be employed to reduce the inventory expenses through just-in-time shipments. Similar technologies may be used for screening of potential employee resumes. Firms may be able to reduce labor costs through computer aided design technologies and computerized worker training modules. Even more simple applications such as oil analysis for engine fleets are a technology not readily available a decade or so ago.

The demand for goods can also be affected by technology. Access to markets for goods and services through the Internet is a prime example of newer technology changing

regional growth opportunities. A more precise example of this is the purchase of resort tickets through web sites that make travel to the region more accessible.

Individual firms and consumers require a varied set of technologies, which are typically provided by the private sector. However, private provision of many of these depends upon sufficient regional demand for service providers to find investment profitable. As mentioned in the outset of this chapter, the absence of specific network technologies are likely the result of market outcomes. Simply, firms do not find the investment profitable. Clearly, potential policy options that relate to high technology will focus on reducing costs and increasing demand in the region.

In order to reduce costs and increase demand for technologies, a number of state and local efforts should be undertaken. It is important to realize, that the federal government's role in this is largely as a convener of resources for planning, research and development or perhaps providing seed money. Leadership, such as that provided to the region by federally elected officials is also a deciding factor. But, as with most issues, it is local communities that matter most in ultimately affecting change.

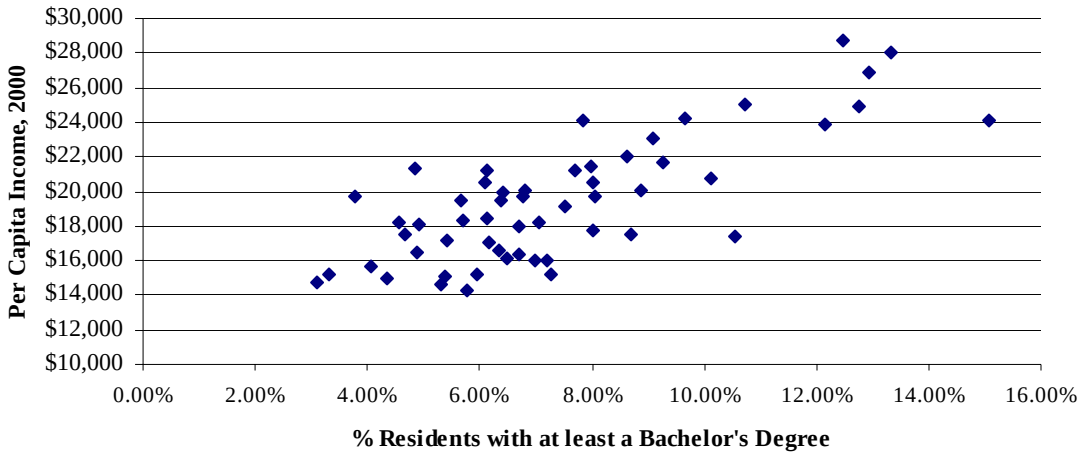
The following chapters describe much of the specific steps that can be taken. However, the general theme to each of these individual recommendations is that they be taken as part of an overall strategic planning process. This strategic planning process should undertake to include a broad spectrum of the local community.

Summary

A number of factors have limited the success of other high technology initiatives around the country. These factors include the recession's impact on high technology investment and state and local revenues. These are short term problems. A longer term reality for many regions is that the sufficient conditions for technology led economic growth are not stressed in strategic planning. This often means that even with cutting edge high technology access, growth will not occur. This is not the outcome the region needs. To emphasize the need for planning with real results that improve human capital we believe it is necessary to illustrate one graph that tells the story about human capital and prosperity. In Figure 8, we illustrate the simple comparison of per capita income and the proportion of residents who have a bachelor's degree in each of West Virginia's

county. The argument outlined above provides what we believe is a compelling argument to support the notion that human capital should be a focus of community technology planning. There may be those who disagree with the approach, but there can be no disagreement about the data provided in the following figure.

Figure 8, Educational Attainment & Per Capita Income in West Virginia in 2000



We focus on outlining a strategic planning process that will lead to the implementation of a suite of policy and program options that will make the region's communities ready for high technology led economic growth. By preparing the region for whatever technologies emerge in the coming years and decades, the region around the *Nick J. Rahall, II, High Technology Corridor* will enjoy the potential for meaningful high technology led economic growth.

CHAPTER 3. OTHER HIGH TECHNOLOGY INITIATIVES

Over the course of this study we reviewed the efforts of our contemporaries in other regions. We did this to glean policy recommendations, provide guidance for the type of research questions that needed to be pursued, and to evaluate how the policies generated by other corridor programs actually affected regional economic performance.

Among the first findings we encountered was that there are relatively few true planning and program organizations designed around technology corridors. This does not mean that there aren't a number of organizations that call themselves technology corridors, just that there are few that have engaged in meaningful planning that is publicly available.

Here we examine two specific regions: The New Century Region in Virginia and the Florida Hi-Tech Corridor along I-4 in Florida. Both of these regions and their economic picture were studied and analyzed by local institutions (e.g. New Century Council and Virginia Polytechnic Institute and the Universities of Southern Florida and Central Florida). The purpose of both efforts was to examine their respective regions and provide ideas to promote economic development.

The approach used by these institutions in pursuit of their efforts has differed in what may be considered a subtle manner to the lay person; however, from an analytical and strategic perspective these approaches are substantially different in their fundamentals. In this section we will review several of the reports that have been issued by these entities. By comparing the two approaches, we hope to establish a strong foundation for our approach that will allow the demonstration and planning process to not only be smooth in its execution but also highly effective.

Virginia's New Century Region

The New Century Region in Virginia is defined as a twelve county and five city region in Southwest Virginia. The organization was created in the early 1990's. We have included a brief review of two of the works of two institutions in this region. The first body of work is a report authored by the *Center for Innovative Leadership* and the second are a few of reports issued by the eCorridors Program associated with Virginia Tech. The eCorridors program is not directly related to the New Century region, however there is

considerable overlap in the regions and the institutions involved in each of the programs. The New Century Region project resulted in the creation of Virginia's High Technology Corridor along I-64, which proceeds east from the West Virginia border. The eCorridors program is part of a Virginia Tech aided project designed, in part, to secure funding from several programs designed to enhance economic development in the southern part of the State.

Studies on the Regional Growth[12]

This three part study focuses its efforts on examining the *New Century Region* in Southwest Virginia. The first part is a preface. The second is an economic overview and analysis, and the third is an analysis of public perceptions of the region. We focus on the second part of this study.

When the report was released in 2000, the authors found the region was the fourth largest concentration of population in Virginia, and it suffered from very slow growth rates relative to the rest of the state. This report assesses that the region continues to cling to old manufacturing industries that are in decline because it has not kept up with the prosperous technology changes that other regions of the country have enjoyed. Because of this, the New Century Region failed to transition out of contracting industries and towards those industries that are expanding. The main factors as stated by this study that contribute to the region's plight include low educational attainment in the area, a lack of new companies that are enticed to come into the area, and a lack of diversity among the companies that are already located in the area.

The study recommendations emphasize the region's need to promote quality of life issues such as the availability of sprawling outdoor activities, low crime rates, low tax rates, and a low cost of living. Additionally, the study argued that if existing companies were to support joint ventures between private firms and university centers the overall level of educational attainment would increase, as would accessibility to research and technology. Despite the participation of a number of individuals and organizations in the

[12] The Center for Innovative Leadership, *Studies on the Regional Economy and Public Attitudes Toward Growth in Western Virginia.* November 19, 2000.

region, the current program has generated little additional planning products since the publication of the study.

eCorridors Program

The eCorridors program associated with Virginia Tech is primarily a broadband initiative program whose goal is to promote the development of the broadband infrastructure in the Southside and Southwest Virginia region. Presently, the program has issued several working papers and a multi-volume series titled *Strategic Technology Infrastructure for Regional Competitiveness in the Network Economy.* We will examine volumes 1 and 5 of the multi volume set.

The first volume, *Rationale, Environment, and Strategic Consideration,* of this series, is meant to provide an overview of the political and economic environment in the region. Central to the text is a justification for public sector involvement in providing resources for broadband access under several state grants focusing on Appalachian and tobacco producing counties in West Virginia. The use of the term broadband referred to a number of technology options that are described in great detail in several of the volumes that we will not review.

As a general comment, the multi-volume study heavily focused analysis on technology and infrastructure design. Beyond recognizing the challenges incumbent with private sector financing of broadband service in rural regions, there was little substantive economic analysis. Economic analysis is a particularly important analytical requirement for the Nick J. Rahall, II High Technology Corridor Region. For this reason, little of the eCommerce studies were useful for our purposes. However, a few findings of the brief economic analysis collected in the eCommerce study are useful. Among these are the observation that:

> *The dilemma is that the telecommunications industry is having great difficulty in justifying a business case for the deployment of advanced communications network and information technology infrastructure.* (Volume 1, page 5)

One useful element of this study is an encyclopedic collection of federal and Commonwealth of Virginia programs designed to aid in telecommunications access.

The purpose of Volume 5: Financial Feasibility and Investment Rationale is to provide estimates for the financial feasibility of implementing a network infrastructure and some implementation guidance. The report suggests that locally based initiatives in network infrastructure may be a desirable approach. It also presents several total network construction scenarios and options for cost recovery. It also recommends the formation of a technology support organization.

Observed together the study produced by the New Century Region and the eCommerce study should be viewed as a very helpful set of data and program ideas for anyone involved in the Nick J. Rahall, II High Technology Corridor planning process. In particular, a number of the recommendations should be considered as part of the second phase of the Nick J. Rahall, II High Technology Corridor planning process.

Florida Hi-Technology Corridor

The Florida Hi-Tech Corridor Council was created in 1996 as a partnership between the Universities of South Florida and Central Florida and industry and economic development institutions. Their research efforts have focused on six industry clusters that have been identified along I-4. Following are reviews of a few of their analytical studies.

The Report on Florida's Laser and Optics Cluster examined 106 Central Florida optics companies. The study employed overlapping research using in-person interviews, mail questionnaires, and database and network analysis. The limits to economic growth within specific industry sectors are delineated in each study. Recommendations for the region's economic developers and other policymakers are also outlined.

The optics firms identified marketing as the largest obstacle due to the fact that the firms need assistance in diversification of their new and existing products. The quality of the region's workforce was identified as the second largest obstacle for the optics clusters. The firms recognized that they all needed access to new workers, to retrain old employees, and utilize continuous improvement of skills of all employees. The third obstacle that was recognized was an absence of regional research support. Due to the fact that the optics industry relies heavily on continued research, the firms wanted technology transfer policies to be updated to encourage better research commercialization, technology licensing, and faculty start-up companies.

The report identified the Florida Laser and Optics Clusters as needing strategic planning recommendations to aid in their high-technology development. First, educational institutions should gear themselves toward high technology based curriculum needed by the industry. Second, economic development organizations are encouraged to include Florida's high-tech optics cluster in their marketing, trade shows, advertising, etc. Third, the Optics Industry Association should market the cluster within trade journals, trade shows, and academic events. Finally, local legislators are encouraged to initiate state programs that can attract the relocation and expansion of technology.

The University of South Florida executed a study of microelectronic companies located in the I-4 Corridor region for purposes of planning and economic development. This study was published as the *Report on the Microelectronics Industry in Florida's I-4 Corridor Region* The study focused on 641 microelectronic companies in Florida, 530 of which reside in the I-4 Corridor.

The study found several interesting features of this industry. First, they found there was a high turnover rate (17%) and a high growth rate (30%) in regional employment.[13] Second, they found a critical high technology workforce shortage. Third, costly investment that companies must make in high tech equipment creates a tax burden for the companies. Finally, they found that there is a critical marketing and exposure problem.

These groups of studies recognize that human capital is a key factor in economic growth whether it is identified as having low educational attainment or a pure shortage of workers. Both sets of regional institutions recommend strategies that will hopefully result in a better qualified pool of human capital. Interestingly, the county suffering the lowest percentage of college graduates within the I-4 region had a higher proportion of college graduates than the best of the counties within the I-64 region we studied.

However, the subtle difference is the degree of emphasis that is suggested by the priority that marketing the region is given in relation to addressing human capital needs. As is emphasized throughout this study, regions do not compete, businesses in regions

[13] Newer data available from the Census and Bureau of Labor Statistics suggests this rate is not inconsistent with either other regions or other industries. However, it is striking, and a feature of economies that few outside the research community are familiar with.

do. These businesses compete based on the productivity of their overall operations. In the high technology sector, the human capital is the key in productivity. As implied, by the work of the Florida Hi-Technology Corridor Council's study on micro-electronics even if a region has the benefits of an already established nationally competitive industry cluster, expansion of this cluster is limited by the availability and capability of its human capital pool as well as costs of an inappropriate tax structure.

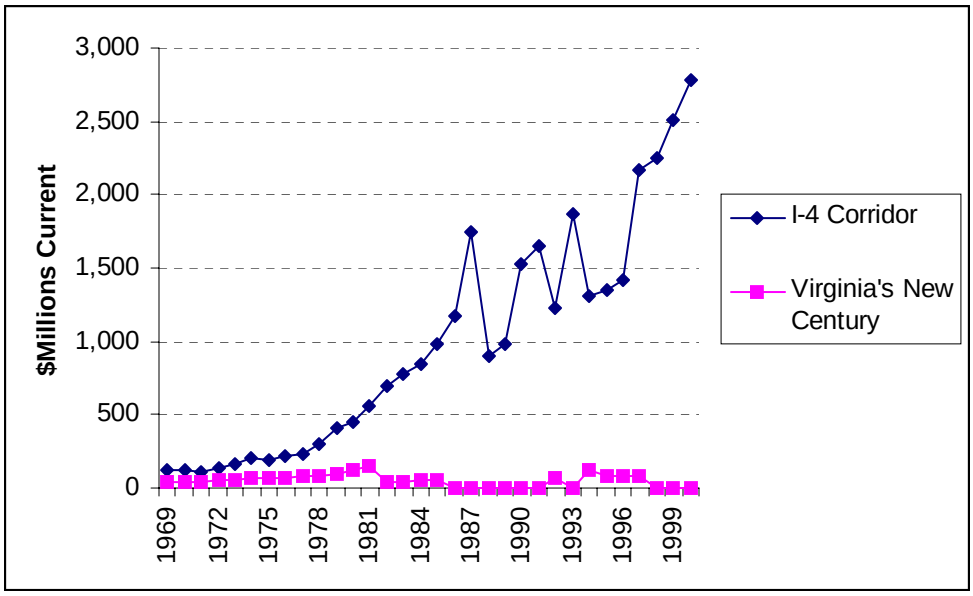
Florida's I-4 Region and Virginia's New Century Region Compared

To understand why we favored I-4's study, even beyond its recommendations, it is useful to compare what has actually occurred in high technology manufacturing in both regions. In Florida, the 1996 creation of the I-4 Corridor correlated strongly with a stabilization, and subsequent growth in Electronics manufacturing wages. They do not claim credit (an uncharacteristically modest approach), but these data suggest at least they identified a trend in regional growth.

In contrast, the urban areas targeted by the Virginia New Century Corridor initiative have lost all their electronics manufacturing (we did not look at their rural counties). Interestingly, this initiative began five years prior to Florida's efforts.

We do not believe either regional organization can realistically take credit or assume blame for these outcomes. This is simply a comparison.

Figure 9, A Comparison of Corridors (Employment in Electronic Production)



West Virginia's High Technology Initiatives

West Virginia has also dedicated considerable efforts to examine high technology and support its growth. Studies include analysis sponsored by the West Virginia Development Office performed by Hammer, Siler, George, Inc. and Mac Holladay's "Vision Shared." Programs include the I-79 High Technology Corridor and the Advantage Valley efforts that range from Charleston to Ashland, Kentucky. The Governor's Office of Technology has also provided several position papers on issues regarding the State's technology plans.

The Vision Shared planning document resulted in several studies and an implementation plan. The implementation plan provided considerable focus on incentives, planning and human capital development. The specifics of this study are available at http://www.wvcouncil.org/. There are several technology related issues in this report and implementation plan.

The I-79 Corridor stretching from Clarksburg to the Pennsylvania state line has seen considerable economic and population growth in the past decade. The area around Fairmont and Morgantown has benefited considerably from the presence of West Virginia University and Federal agencies engaged in high technology research (e.g. NASA). In a 2002 forecast of the region's economy, our colleague at West Virginia

University, Dr. George Hammond, summarized the region's strengths: "The concentration of highly-educated residents in the region sets the stage for gains in higher-paying service-producing sector jobs."[14]

Policy papers produced by the Governor's Office of Technology relevant to the High Technology Corridor include the *West Virginia Enterprise Information Technology Blueprint* and *A Proposed Blueprint for the Use and Growth of Technology in West Virginia*. Both of these papers provide strong recommendations for improving workforce preparedness. We wholeheartedly concur with this recommendation. Our reservations regarding educational efforts in other regions are that despite the demand for particular skills in high technology firms, we believe it is in the area of general preparedness for advanced schooling where the biggest gains to our region can be made.

The report suggests that West Virginia's economy may be greatly enhanced if the state can strengthen its technology-based development by focusing on technology sectors with the strongest potential for the state. The following are key actions required for West Virginia to adopt a high technology profile and grow its technology workforce. First, the state must deploy a full-time IT/Telecom business representative and aggressively market to Northern Virginian companies. Second, put in place new technology-oriented business incentives and policies. Third, develop improved sites and buildings and complete appropriate highway and telecom infrastructure. Fourth, move forward on a technology commercialized agenda. Fifth, promote entrepreneurial development and angle financing networks. And finally, continue to make investments in improving the quality of the State's workforce.

Each of West Virginia's high technology initiatives has focused on different issues in High Technology. The I-79 Corridor has sought to leverage a relatively highly educated workforce into high paying service sector jobs. The WVDO studies have sought ways to strengthen business recruitment efforts. The GOT policy papers have sought to engage in state policies and procedures to strengthen the states' economy through a variety of high technology related initiatives. With perhaps the exception of the I-79 Corridor, success from these efforts remains to be measured.

[14] George Hammond, I-*79 High-Tech Corridor Region Outlook*. Forecast: 2001-2006, July 2002.

We believe the approach that best meets the needs of the Nick J. Rahall, II High Technology Corridor is a comprehensive planning effort that focuses on the fundamentals of technology led growth. This process is more comprehensive than most studies that focus specifically on narrow technology solutions. But, if performed effectively we believe this process will yield much more acceptable results in the long run.

The following chapter provides some basic guidance on planning, along with a menu of recommendations specific to the Nick J. Rahall, II High Technology Corridor region.

CHAPTER 4. RECOMMENDATIONS

This chapter provides direct recommendations for policies and programs to stimulate high technology led economic growth in the region. We begin with basic considerations and guidance on planning to support high technology. We discuss steps that will be undertaken in the *Integration Plan* of this overall project. We then focus on specific functional areas: general strategies, education, business support, community development and lifestyle and environment.

General Planning Considerations

Strategic planning will be necessary for the region to influence the market driven path of economic growth. Clearly, there is considerable effort involved in developing demand for high technology, but the presence of a regional strategic plan in support of high technology may facilitate investment in public and private capital. This focus is in large part what the High Technology Corridor provides the region. A few simple considerations for planning are reviewed below. Later sections provide a menu of options to "flesh out" the strategic plan.

First, institutions matter. Local involvement and the convening of organizations that focus resources is a critical step. This is important because firm decisions to locate and provide services may be influenced by the degree of involvement and interest in high technology. The High Technology Corridor provides this central convening organization for the region.

Second, real policy change must be addressed. While a wide range of policy options are available, without change to West Virginia's tax structure and significant improvement in school performance in basic skills education the benefits of all other policy options will be muted. While initiatives directly associated with the High Technology Corridor cannot directly affect these issues, adding a strong voice on education and taxation at the State level should be an early priority of the organization.

Third, a bottom-up infrastructure strategy based on demand should guide investment. In any strategic planning process the concerns of a few individuals and firms will play a dominant role. It is important that the process clearly evaluate and inventory technology needs. What are currently perceived needs may be wholly inappropriate

when matched against realistic resource constraints. Also, technology should be broadly interpreted so that "eliteness" in targeting an industry is avoided. This does not mean that recruitment efforts should not be narrow, but rather that, when assessing technology demand a broad view is taken. In all these considerations effective institutions matter.

Finally, a focus on long term policy is necessary. Simple fixes will not change the underlying structure of the region's economy. This does not mean that short term efforts are unwarranted. On the contrary, they are vital, but are only part of the mix of success in technology led development.

Steps Following Strategic Planning

Later sections outline a menu of recommendations that should be part of a strategic planning process. It is equally important to outline steps that are potentially envisioned, but are as yet unready for deeper analysis.

First, private sector demand is not yet at the level to secure many of the investments that may be desired by individuals and firms in the region. This may lead to public sector involvement in directly inducing firms to engage in this type of investment. These projects are necessarily individually evaluated, and tools to aid this process developed subsequent to this analysis. Strategic planning must pre-date this process otherwise costly errors may occur.

Suppose sufficient demand for fiber-optic access will not be available for a decade (as determined in the strategic plan). Under this scenario, waiting for this technology may be in error. Instead, the region may elect to support a pilot project for wireless broadband connected to a local area network in the community that currently enjoys the most high technology related employment (in absolute, not relative terms). Here, the federal government may provide important assistance. This outcome is a dramatically different resource allocation than pursuing regional fiber-optic broadband access. Also, the strategic planning process is necessary in defining a scope of analysis that would estimate both regional and national economic development benefits to a region.

Of particular importance is the need for successful pilot projects that integrate many of the recommendations and regions we describe below. An example of a pilot

project would be the creation of an integrated high-technology park which serves as a center for high technology related activities. Ultimately, what is to be done must be determined by citizens of the region.

A Menu of Recommendations

The most important of all of our recommendations is to form a Corridor Organization to oversee and coordinate hi-tech development activities. The organization should have state, regional, and local support. It is our recommendation that the organization have a steering committee, an advisory board, and four sub-committees. The steering committee will include the 'chairs' of the sub-committees, a member of the advisory board, and a technical advisor with no voting privileges (preferably an economist, regional development specialist, or a high technology business development expert). The four sub-committees would be Education, Business Support, Community Development, and Lifestyle and Environment.

The mission of this organization is to: *Serve as a regional resource that promotes business development in the high technology sector and creates opportunities for living the good life by supplementing (not duplicating) the activities of partner economic development organizations, emphasizing lifestyle improvement, and creating opportunities to improve the regional quality of life in the pursuit of the American Dream.*

Once the Corridor Organization is created its role and scope of influence should include the following general strategies:

- Serving as a liaison between entrepreneurs and the community
- Providing guidance to entrepreneurs as to where to seek business development assistance
- Creating a regional, national and international level to attract entrepreneurs, businesses, and potential employees
- Becoming a central resource center by maintaining a presence on the World Wide Web that will provide regional information, links to business

development assistance, and a directory of businesses and supporting organizations

- Locating, creating and developing opportunities for Research and Development Partnerships between entrepreneurs and educational institutions or research organizations

In order to accomplish these tasks the Corridor Organization will have four sub-committees that will focus on specific goals. Initial suggested projects for these subcommittees are briefly described as follows.

Education

1. Develop business-centered specialized training programs to complement not replace the efforts of other institutions. These programs would investigate the labor needs of regional high technology businesses and develop curricula to meet these needs. Courses could be taught in public or private settings and in a regular school year timetable or in short-course form as necessary.
2. Research and investigate existing educational models in other regions that have a significant high technology sector in order to develop and modify educational models for the region.
3. Support and encourage extracurricular math and science activities for school-age students such as summer science camps. Types of support include providing facilities, monetary compensation for teachers, mentorship opportunities with local organizations, and most importantly encouraging students to attend- especially those who would not normally identified as wanting to participate. These programs should not be exclusive, but tailored to meet the needs of the participants.
4. Develop a biannual Technology Conference to introduce entrepreneurs, institutions, and the community to one another. This would also be a good opportunity to introduce primary and secondary students to the high technology sector and possible career opportunities.

Business Support

1. Review and market existing Research and Development tax incentives to make entrepreneurs aware of the benefits of locating in the region.
2. Create a support network for entrepreneurs that consist of private and public organizations that can assist in business development. These organizations may be able to offer expert advice, services, and volunteer labor for start-up etc.
3. Create an online database of entrepreneurs that can be accessed by the public. This database would allow customers to search for businesses and allow businesses to find each other.
4. Attend networking functions on a local, regional, national, and international level in order to create a presence, promote the region, and to develop ties with entrepreneur who may want to relocate or expand into a new location.

Community Development

1. Integrate high technology development efforts with community development efforts such as Mainstreet in order to reinforce the community-business sector identity.
2. Form community partnerships with higher education through Research and Development group funding and creating technical outreach programs
3. Forge school/community/business links through mentorship and 'shadowing' programs.
4. Identify and target 'high visibility' events and avenues such as Bridge Day to recruit firms and potential employees by sending business and community representatives from the region.

Lifestyle and Environment

1. Market the environmental amenities of the region including the state parks, and recreational venues as both lifestyle and educational opportunities.
2. Provide sponsorship at outdoor events such as an exposition at Bridge Day to create a 'identity link' between high-technology and the environment.

3. Establish inter-generational programs to integrate the arts and high technology such as virtual art exhibits, online art and cultural history courses from local colleges, teleconferenced art sessions, etc.
4. Use urban renewal ventures to create opportunities where high technology and community restoration work together to improve local working environments.

These recommendations are meant to provide the Corridor Organization with a starting-point. These initial steps are necessary to strengthen and build the region's economic development potential.

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